Hawaii Scientific Drilling Proj.

UNIVERSITY OF HAWAI'I

SENIOR VICE PRESIDENT FOR ADMINISTRATION

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

February 7, 1997

Mr. Gary Gill
Office of Environmental Quality Control
220 S. King Streeet, 4th Floor
Honolulu, HI 96813

Dear Mr. Gill:

Enclosed are four copies of a final environmental assessment for the Hawaii Scientific Drilling Project along with a summary of the project for publication in the OEQC Bulletin. The University of Hawaii (School of Ocean and Earth Science and Technology) is the lead agency for the proposed project and, as such, is the initiating agency for this action. The approving agency will also be the University of Hawaii. The contact person is Dr. C. B. Raleigh, Dean, School of Ocean and Earth Science and Technology, 1000 Pope Road, #205, Honolulu, HI 96822.

The draft environmental assessment for this project was submitted to your office on November 27, 1996 and a summary was published in the December 8, 1996 OEQC Bulletin. At that time, copies of the draft environmental assessment were also distributed to twenty six County, State, and Federal agencies and interested individuals. Comments were received from ten recipients of the draft environmental assessment; these comments have been responded to directly and copies of the letters received and our letter responses are included in Appendix C of the enclosed final environmental assessment. Summaries of the comments and our responses have also been included in Section **10.2 Draft Environmental Assessment**, and in **PART XI : RESPONSE TO AGENCY COMMENTS**. Upon evaluation of the projected impacts, the public and agency comments, available mitigating actions, and the significance criteria listed in Subchapter 6, Section 11-200-12, we have made a determination that the proposed project will have no significant impact on the environment surrounding the proposed project site.

Thank you for your assistance with this matter. Should you have any immediate questions regarding this submission, please contact Dr. Raleigh at 956-6182.

Sincerely yours,

Eugene S. Imai
Senior Vice President for Administration

Enclosure

c: Dean Raleigh

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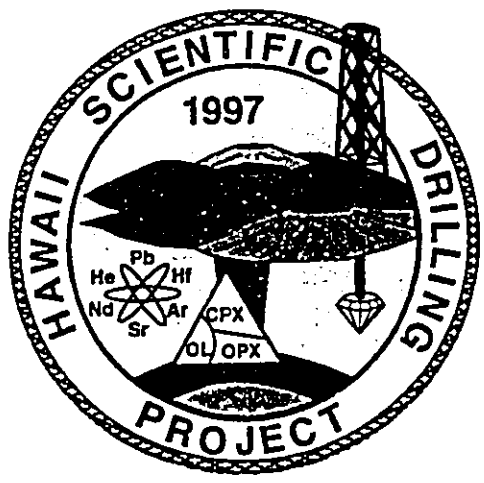
1997-02-23-HI-FEA-Hawaii Scientific Drilling Project

THE HAWAII SCIENTIFIC DRILLING PROJECT

Final Environmental Assessment
And
Finding Of No Significant Impact



LOCATION
SOUTH HILO DISTRICT
ISLAND OF HAWAII
STATE OF HAWAII

PROPOSING AGENCY
THE UNIVERSITY OF HAWAII
SCHOOL OF OCEAN AND EARTH SCIENCES AND TECHNOLOGY
100 POPE ROAD
HONOLULU, HI 96822

ACCEPTING AUTHORITY
THE UNIVERSITY OF HAWAII

February 1997

FINAL ENVIRONMENTAL ASSESSMENT

PROJECT
HAWAII SCIENTIFIC DRILLING PROJECT

LOCATION
South Hilo District
Island of Hawaii
State of Hawaii

PROPOSING AGENCY
The University of Hawaii
School of Ocean and Earth
Science and Technology
100 Pope Rd.
Honolulu, HI 96822

ACCEPTING AUTHORITY
The University of Hawaii
Sr. Vice-President for Administration
2444 Dole Street
Honolulu, HI 96822

CONTACT
Dr. C. Barry Raleigh
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa
100 Pope Rd.
Honolulu, HI 96822

TABLE OF CONTENTS

Executive Summary

This environmental assessment has been prepared to comply with Section 11-200-5 (b), Environmental Impact Statement Rules, which states that "..when an agency proposes to implement an action to use state or county lands or funds, it shall be subject to the provisions of Chapter 343, Hawaii Revised Statutes, and this chapter"; and, Section 11-200-10 which states that "The proposing agency .. shall prepare any draft or final environmental assessment of each proposed action and determine whether the anticipated effects constitute a significant effect in the context of Chapter 343, Hawaii Revised Statutes, and Section 11-200-12."

Description of the Action

The University of Hawaii School of Ocean and Earth Science and Technology, in collaboration with University of California at Berkeley and California Institute of Technology, propose to conduct a research drilling project. The objectives of the research are to sample an extended sequence of lava flows from a "hot spot" volcano and analyze these samples to better understand the geologic history of Hawaii and of the processes by which Hawaiian volcanoes form.

Two prospective locations are under consideration for the proposed research program; selection of the single site to be used will be guided by the results of the environmental review process. The first, Site A, is a portion of the parcel TMK 2-1-13:151, located adjacent to the Mana Quarry in the Waikea section of the South Hilo District on the Island of Hawaii. It is located south of the General Lyman Field access road, east of, and immediately adjacent to, the stone crushing and quarry operations of the James W. Glover Company, and west of the County of Hawaii Solid Waste Transfer station. This parcel is within the Urban Land Use Classification and is zoned General Industrial under the Hawaii County Zoning code. The second prospective site, Site B, is located approximately 400 m north of Site A and occupies a portion of TMK 2-1-12-9.

The project will level a portion of the selected parcel and establish a drill site of approximate dimensions of 60 m by 120 m and construct a drill pad of dimensions of 4 m by 6 m. From this pad a 4500 m research well will be drilled using diamond core drilling technology. The diameter of the finished hole will be ~ 12 cm at the surface and reduce to about 7.5 cm at depth. Drilling will be done in three six-month intervals spaced over a period of approximately six years. The planned configuration of the hole will be to have a 101 mm (4") diameter from the surface to a depth of 3300 m, and a 76 mm (3") diameter from 3300 m to 4500 m. Throughout the duration of the drilling and coring operation, the core samples recovered from the hole will be subjected to scientific study by a team of researchers from universities and research organizations from around the world. At the conclusion of the drilling program, the deep hole will be used for fluid sampling and observations of seismic and other geophysical phenomena within the deep interior of the island's volcanoes.

Summary of Potential Impacts and Mitigating Measures

Geologic Hazards

The lava flow hazard within this area is considered to be low and would allow sufficient time to remove the drilling rig prior to inundation of the site. The proposed location is outside of the tsunami hazard zone and is not within a likely flooding zone.

Air Quality

The drill rig and support equipment emit diesel exhaust at rates that are equivalent to those from similar sized truck engines. Emissions are believed unlikely to contribute significantly to the existing load of vehicular, utility power plant, and jet exhaust discharges that occur in this area. Mitigating action will be to utilize the smallest rig that will accomplish the required drilling and, to the extent possible, maintain the rig at a constant speed to minimize emissions.

Water Quality

The materials used in the drilling process that are likely to be discharged into the shallow aquifers consist of bentonite clay and organic polymer additives that are routinely used in water well drilling. The groundwater beneath the drilling site is believed to contain low concentrations of dissolved solids but may contain contaminants derived from the County Solid Waste facility located up-gradient of the proposed drilling site. There are no known drinking water sources down-gradient of the proposed drill site. The proposed action is not expected to have any impact on drinking water or surface water resources. Mitigating actions will be to install shallow casing at appropriate depths to minimize loss of drilling fluids into shallow formation.

Noise

The drilling rig will be equipped with standard mufflers used for diesel engines. The proximity of the site to General Lyman Field, two operating quarry and stone crushing operations, a large electric utility plant, and a solid waste transfer facility makes it unlikely that the drilling operation will detectably contribute to the ambient noise levels. Both sites are located in operating (Site A) or abandoned (Site B) quarry pits and are surrounded on three sides by rock walls having heights of ~10 m to ~15 m which will tend to suppress horizontal propagation of noise from the rig operations. Both sites are located at distances of more than 1 km from the nearest residential communities and it is considered unlikely that noise impacts from the drilling activities on residential areas will be detectable. Mitigating action is the choice of location to be as far as possible from residential areas while still meeting scientific objectives; orientation of rig within the quarry area will also be chosen to minimize noise propagation. If noise impacts on adjacent communities are greater than anticipated additional mitigation measures can be taken such as installation of high efficiency engine mufflers or the construction of suspended noise screens around the rig that will further reduce noise propagation off site.. In the highly unlikely event that these measures prove unable to reduce noise to acceptable levels, modification of rig operations can be considered to further reduce noise generation.

Flora and Fauna

The proposed drilling sites are located in areas that are currently in use, or were formerly used, as quarries and, as such, have heavily impacted ecosystems. Surveys of both sites have found few native species of flora or fauna present and none that are endangered or are considered threatened. Mitigating action is the choice of a location that has already experienced substantial

disturbance and where few native species were likely to be present.

Archaeology

The original land surfaces within both parcels have been thoroughly disturbed, or entirely obliterated, by overburden removal and stockpiling by earlier quarrying operations. State Historic Preservation Division did not identify any features of historical significance. Mitigating action is choice of disturbed location

Socio-Economic Impact

No adverse socio-economic impacts are anticipated from the proposed project. The project is expected to several million dollars into the economy of the island of Hawaii in the form of salaries for skills ranging from laborers to college graduates. The project will recruit all skill levels on the island of Hawaii first, and only if there are inadequate numbers of qualified applicants to fill the positions, will it recruit from the state-wide or national labor pool.

Access and Traffic

Access to Site A will be via a ramp that will extend from the edge of the Leilani Avenue Extension (Hilo dump road) which currently carries a significant traffic load of both heavy trucks as well as passenger vehicles and light trucks. The addition of an average of fewer than ten vehicle-trips per day to accommodate crew changes and staff visits, and an average of one truck-load of materials per day to the site will not add measurably to the existing traffic load on this street. Site B will be accessed by way of the General Lyman Field access road and will not significantly add to the existing passenger and cargo traffic to and from the Hilo airport. Mitigating action will be to encourage car-pooling among project participants and, to the extent possible, restrict movement of heavy equipment to times when access roads are less heavily used.

Infrastructure, Utilities, and Services

The anticipated demand of the project on electrical utilities will amount to the equivalent of about two households' electrical demand during the drilling phases of the project. In order to minimize the project's impacts on the existing potable water supply for Hilo, we propose to install our own shallow water well for on-site water that will be used in cleaning core and for drilling make-up water. Solid waste volumes are expected to average less than one truck-load per week and will be disposed of at the Hilo landfill or as otherwise directed by the County of Hawaii or the Department of Land and Natural Resources.

Visual Impacts

The rig will not present a significant contrast to the existing industrial land uses in the area. Further, both proposed drilling sites will be located in pits that lie 10 m to 15 m below grade; the only portion of the rig that will be visible above the walls of the pit will be the rig mast which will be shielded by surrounding vegetation and other industrial facilities and equipment in the area. Mitigating action is choice of location that confines most of the activity below grade and out of common view-planes.

Lighting

The drilling contractor will be informed of the Hawaii Outdoor Lighting Regulations and compliance will be a condition of the contract.

ENVIRONMENTAL ASSESSMENT CHECKLIST
(§ 11-200-10)

Draft Env. Assess. __ **Negative Declaration** X **EIS Preparation Notice** __ **NEPA** ____

Document Title Environmental Assessment, The Hawaii Scientific Drilling Project

Y 1. Identify the Applicant or Agency proposing the action. **Page 4**

Y 2. Identify the Approving Agency. **Page 4**

Y 3. Identify the Agencies consulted. **Page 4 -5**
- Y Was applicable county planning office notified of project?
- Y Were any appropriate community groups notified?
- N Is the project in the Conservation District, Special Management Area, Shoreline Setback?
- NA Has appropriate agency been contacted (concerning dual purpose EA)
- Y For Final EAs, were comment letters and responses included?
- Y For Final EAs, were comments adequately addressed?

Y 4. General description of the proposed action:

- Y Technical **Page 6-13**
- Y Economic (Proposed timing or phasing of Project? **Page 6-13**
  Project costs? (State and County Projects)) **Page 6**
- Y Social (How does the project affect the community?) **Page 25-28**
- Y Environmental characteristics § 11-200-12(b)(11) **Page 19-23**
  Is the project located in an environmentally sensitive zone (floodplain, tsunami zone, erosion prone area, geologically hazardous land, estuary, fresh water, coastal waters, archaeologically/historic/cultural sites, natural resources)? **No**

Y 5. Summary description of the affected environment including: **Page 12 - 15**
- Y Site location map (U.S.G.S. Topographic map preferred) **Page 25 IX. Figures and Tables**

Y 6. Summary of the major impacts: § 11-200-12(b)(11) **Page 19-28**
- Y Short Term:
  Construction impacts?
- Y Long Term:
  Significant effect on water or air resources? (Contact DOH, CWB, CAB?)
  Does project discuss noise, traffic, and visual impacts? **Page 23-28**
  Was DLNR?SHPD contacted concerning archaeologic and historic district/sites concerns Y
  Was a flora and fauna survey done to determine the presence of any rare, threatened, or Endangered species or their habitat at the site? § 11-200-12(b)(11). **Appendix A**

Y 7. Alternatives considered (if any). **Page 28**

Y 8. Mitigation measures proposed (if any). **Page 19-28**

Y 9. Agency letter of submittal (Draft EAs) or determination (Negative Declarations & EISPNs).

Y 10. Findings and reasons to support the determination.

NA 11. Agencies to be consulted if an EIS is prepared.

NA If this EA concerns only a portion of the overall project, has a previous EA/EIS been filed?
N Does project have a significant effect on environment? Re: Significance Criteria § 11-200-12(b)(11)

Revised: July 1, 1992

1.2 Citation of Requirements

This environmental assessment has been prepared to comply with Section 11-200-5 (b), Environmental Impact Statement Rules, which states that "..when an agency proposes to implement an action to use state or county lands or funds, it shall be subject to the provisions of Chapter 343, Hawaii Revised Statutes, and this chapter"; and, Section 11-200-10 which states that "agencies .. shall prepare an environmental assessment of each proposed action and determine whether the anticipated effects constitute a significant effect in the context of Chapter 343, Hawaii Revised Statutes, and Section 11-200-12."

1.3 Guiding Document Citation

This assessment was prepared following "A Guidebook for the Hawaii State Environmental Review Process", Appendix F "Environmental Assessments", dated August 1992, *provided by the State of Hawaii Office of Environmental Quality Control.*

1.4 Planned Agency Submittals

1) University of Hawaii at Manoa (as E.A. approving agency)
2) State of Hawaii Department of Land and Natural Resources
    a. Land Division
        i. Right of Entry/Revocable Permit/Lease (Site A)
        ii. Drilling permit for deep hole
        iii. Drilling permit for on-site water well
    b. Water Resources Management Division
        i. Drilling permit for on-site water well
3) State of Hawaii Department of Transportation
    a. Airports Division
        i. Right of Entry (Site B)
4) State of Hawaii Department of Health
    a. Clean Air Branch
        i. Initial Non-covered Source Application (may be required for drilling rig)
    b. Clean Water Branch
        i. NPDES Permit may be required depending on surface water discharges
    c. Noise and Radiation Branch
        i. Community Noise Permit Application
        ii. Community Noise Variance Application (if directed by DOH)
5) County of Hawaii
    a. Building Department
        i. Electrical permit
        ii. Temporary building permit for on-site trailers
    b. Planning Department
        i. Plan approval

6) U.S. Department of Transportation
    a. Federal Aviation Administration
        i. FAA Form 7460-1, Notice of Proposed Construction or Alteration
        (for erection of drilling mast)

II. APPLICANT PROPOSING ACTION

University of Hawaii at Manoa
School of Ocean and Earth Science and Technology
Hawaii Institute of Geophysics and Planetology
Hawaii Scientific Drilling Project

Project Contacts:

Oahu:
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Dean
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Hawaii Scientific Drilling Project
University of Hawaii at Manoa
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Project Fax. 808 956-3188

Hawaii:
Dr. Donald M. Thomas
Director, CSAV
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Hilo, HI 96720-4091
Ph. 808 933-3631
Fax. 808 933-3677

III. IDENTIFICATION OF APPROVING AGENCY

University of Hawaii at Manoa
Note: Because this action will occur on State land under the jurisdiction of DLNR, that agency will be consulted on all aspects of the environmental review process

IV. AGENCIES CONSULTED

The following agencies have been consulted prior to the submittal of this Environmental Assessment to the State of Hawaii Office of Environmental Quality Control:

County Agencies
Hawaii County Planning Department
Hawaii County Water Supply Department
Hawaii County Department of Research and Development
Hawaii County Public Works - Division of Solid Waste Management

State Agencies
Department of Land and Natural Resources: Division of Land Management
Department of Land and Natural Resources: Water Resources Management

Department of Land and Natural Resources: Historic Preservation Division
Department of Transportation: Airports Division
Department of Health: Office of Environmental Quality Control
Department of Health: Hawaii District Office
Department of Health: Environmental Management Division
Department of Hawaiian Home Lands
University of Hawaii: Environmental Center

Federal Agencies

U.S. Department of Transportation: Federal Aviation Administration
Department of the Interior: U.S. Geological Survey, Hawaiian Volcano Observatory
Department of the Interior: U.S. Geological Survey, Water Resources Division
Department of Defense: U.S. Army Corps of Engineers, Permits Division

Organizations that will receive copies of the Draft Environmental Assessment will include all the above agencies as well as the following:

State of Hawaii DHHL Office, Hilo
Panaewa-Keaukaha Community Association
Panaewa Farm Lots Association
The Upper Waiakea Houselots Association
The Lower Waiakea Houselots Association

V. DESCRIPTION OF THE ACTION

5.1 Summary of the Hawaii Pilot Hole Project

The University of Hawaii School of Ocean and Earth Science and Technology, in collaboration with the University of California at Berkeley and Cal Tech University, proposes to undertake a deep research drilling project in the Waiakea area of the South Hilo district of the Island of Hawaii. The project is intended to advance a number of research programs that are studying both the processes by which Hawaiian volcanoes form as well as the ongoing geologic and hydrologic conditions that occur deep within ocean island volcanoes. The project will be funded by the National Science Foundation and the International Scientific Drilling Program over a period of six years; approximately $11 million will be provided by these agencies to conduct the drilling, complete the scientific analysis of the core materials, and perform studies in the deep hole.

The drilling program will drill a single hole to a depth of approximately 4,500 m (14,500 ft.) over a period of approximately six years and will attempt to recover continuous samples of core throughout the interval drilled. The drilling will be accomplished during three six-month intervals that will be interspersed with twelve to eighteen month periods during which rock samples will be analyzed and downhole measurements will be made in the drillhole. Measurements of downhole rock morphology and chemistry, water chemistry and temperature, and seismic and other geophysical phenomena will continue for a period of several years after completion of drilling.

5.2 Background

The unusual conditions that have led to the formation of the Hawaiian Archipelago are widely recognized as providing unique opportunities to study a number of fundamental earth science questions. Included among these are not only the study of volcanic hazards but also the very basic questions of why volcanoes such as those that form Hawaii occur at all and the role that this type of volcanism plays in the planetary evolution process.

The Hawaiian archipelago makes up one of a very few volcanic chains that exist in the world that result from a mantle "hot spot" located tens to hundreds of kilometers below the earth's crust. Current geologic models indicate that the mantle "hot spot", or "plume", that is responsible for the Hawaiian Archipelago has existed for tens of millions of years beneath the ocean floor that forms the Pacific Plate of the earth's crust. During this time, the Pacific Plate has moved slowly northward while the mantle plume has pumped molten magma onto the ocean floor to form the sea mounts and islands that we know as the Hawaiian chain. Until very recently, we have known very little more about this plume, or "hot spot" than that it exists and appears to be nearly stationary relative to the rest of the planet below its surface crust.

An earlier drilling project, funded by the National Science Foundation and conducted in Hilo in 1993, has added substantial new knowledge to our understanding of the processes that occur within the mantle plume that has formed the Hawaiian island chain. Although this earlier project was intended primarily as a proof of feasibility for a deeper drilling effort, detailed analyses of the core samples taken from that hole, and downhole measurements of fluid chemistry, showed that many of our scientific models of Hawaiian volcano growth and evolution, and of groundwater flow, were incomplete. The results of that drilling project showed us that: the lava flow recurrence interval (time between successive flows at a given location) and duration of volcanism of a Hawaiian volcano is nearly twice as long as had been thought; the compositions of the lavas show clearly detectable and systematic changes with time that reflect the passage of the volcano over the mantle plume; Mauna Loa is nearing the end of its shield-building activity and is sinking into the ocean faster than it is able to replenish new surface flows; freshwater is channeled to substantial depths beneath younger lava flows by now-buried soil and ash layers of the older volcanoes; and that seawater circulation deep within an island volcano can carry heat away from the volcanic edifice at a substantial rate and thus maintains very low rock temperatures (~6°C, 45°F) at substantial distances from the centers of magmatic intrusion.

The technical success of the earlier drilling project, and the new scientific insights provided by the studies of the core and the borehole, resulted in the present research project that proposes to drill and core a substantially deeper hole into the flank of Mauna Kea volcano. This program will be a joint effort of the University of Hawaii School of Ocean and Earth Science and Technology, the University of California at Berkeley, and California Institute of Technology. The objective of the research is to obtain a continuous sequence of samples of lava flows that have formed a single volcano and that span a substantial portion of its eruptive life. This effort will require drilling to a depth of nearly 4.5 km (14,500 ft.) using wireline coring technology.

5.3 General Characteristics of the Project

The research program will consist of: construction of a drill site of less than 2 acres in size; the installation of a concrete wellhead pad having dimensions of ~4 m by ~6 m; the mobilization of a drilling rig onto the site; the continuous (24 hr per day) operation of the drill rig for three six-month periods interspersed with twelve to eighteen month periods of analysis of the cores and down-hole measurements; at the conclusion of the drilling program, geophysical measurements will be made in the hole for a period of several years. Access to the prospective sites for the rig and transport of materials and personnel will differ for each location: at Site A, an existing earthen ramp that extends from the edge of Leilani Ave. toward the quarry will be modified to allow access to the floor of the quarry and an access path across the quarry to the site will be leveled; at Site B, an existing, partially paved road currently extends from the General Lyman Field access road to the floor of the abandoned quarry and can serve as our access to this site.

5.4 Site Location

Two locations are under consideration as prospective drilling sites: Site A, located within a State-owned parcel of land at TMK 2-1-13:151 (Fig. 1a-d; Fig. 2) that is currently under lease to James Glover Company as part of the Mana quarry complex; and Site B, located on a small portion of State-owned land at TMK 2-1-12:9 (Fig. 1a-d; Fig. 3) that is under the jurisdiction of the Department of Transportation - Airports Division. The land parcel encompassing Site A is currently in use by Glover for stockpiling of quarry materials but will be returned to the State by mid-1997 or soon thereafter. The preferred location of the drill-pad within this property is at the south-west corner of this parcel (Fig. 1d). Access to the site currently is across other Glover-leased parcels of State land that are being used for a stone-crushing operation and equipment and inventory stockpiling. After return of TMK 2-1-13:151 to the State, an independent access to the site will be developed from Leilani Ave. via a currently-disused ramp. This parcel is zoned Urban/General Industrial under the Hawaii County Zoning Code.

Site B is located on the southern edge of the Airports Division property within a now-abandoned quarry that was last worked in about 1968. The site is currently overgrown with weeds and weedy tree species and is used as a disposal site for green waste from airport operations. The site is currently accessed by a partially paved secondary road that intersects the Airport access road that may require only minor improvements to be used by the project. This parcel is zoned Urban/Limited Industrial under the Hawaii County Zoning Code.

Both prospective sites are able to meet the scientific objectives of the proposed project and are considered to be equally suitable for our use from both scientific and logistical considerations. Both sites are considered to be far superior, in terms of environmental and socio-economic impacts, to other sites in the Hilo vicinity that were considered; however, we will defer a final decision on which of these sites may be most suitable until after the environmental review process is complete in order to allow us to incorporate any public or agency input into the final determination of the best location for our proposed project.

5.5 Site Preparation

Site A: Access to the parcel will be through the existing earthen ramp on the northern boundary of the property that is currently separated from Leilani Ave. by an earthen berm; a portion of the berm will be removed to allow access to the existing ramp. In it's current configuration, the ramp discharges onto the floor of a portion of the quarry that will remain under lease to Glover Co.; in order to maintain all operations and access within the State-controlled parcel, the lower third of the ramp will have to be modified to enable vehicle access to discharge onto the floor of the quarry as shown in Figure 1e. A cinder covered roadway will also have to be constructed across the floor of the quarry from the ramp discharge to the drilling site. The exact location of this roadway will be determined in consultation with DLNR in order to best accommodate other potential users of the remainder of the parcel not being used by the drilling project. Access to the parcel will be restricted by a gate located at the Leilani Ave. entrance to the ramp.

A drill site having dimensions of approximately 60 m by 120 m will be leveled and fenced at the south east corner of the parcel for location of the rig, drilling fluid tanks, drill-pipe laydown area, management trailer, core processing facilities, sanitary facilities, and for access by supply vehicles. The location and configuration of the site within the parcel will be determined in consultation with DLNR to best facilitate other possible activities that may occur on the parcel. The drill rig pad will be prepared by digging a 2 m by 2 m (6 ft. by 6 ft.) cellar to a depth of approximately 1.5 m (4 ft.). A steel reinforced concrete pad, having dimensions of 4 m by 6 m (12 ft. by 20 ft.), will be poured to form a stable base for the rig; at this time a concrete pad will also be prepared as a cover for the wellhead cellar.

Utilities (power and telephone) will be supplied by the installation of two utility poles that will enable us to connect to existing power and telephone lines that cross the Hilo Dump road 80 m south of the property boundary. Pole installation would be located adjacent to the Dump road on County-controlled property. The preferred source for water at the site will be to construct a shallow (~15 m) water well that will allow us to withdraw groundwater for use in formulating drilling fluids and for use in processing the recovered core. We anticipate using an auger to drill a ~50 cm diameter hole that will be lined with a steel casing. This hole will also be used as an access point to the shallow water table for an airgun seismic source(see below), similar to that used in the Pilot Hole, with which to conduct seismic surveys of the deep hole.

Site B: Access to this site will be via a secondary road that currently intersects the Airport access road. Improvements to the secondary road may include further grading of the unpaved portions and coverage with compacted cinder. Additional modification to the road (e.g. reflectors, lighting, etc.) will be at the discretion and direction of the Airports Division staff. Access to the site proper will be restricted by a gate at the entrance to the quarry.

Preparation of a drill pad within the abandoned quarry will require leveling of the land surface and coverage with compacted cinder. The most appropriate location of the site appears to be at the eastern end of the quarry where access to utilities will require the installation of the fewest utility poles. The site preparation will be identical to that described above for Site A.

Electrical power will be supplied from an existing utility line that runs parallel to Leilani Ave. and adjacent to southern edge of the quarry. We believe that only a single pole will have to be installed on the site to allow us to make this connection. Telephone service to the site will be via the installation of a new line that will have to be strung from its current terminus, near the National Guard facility, to our site. This new line will use existing poles that carry the electrical power lines. Water supply to this site would again be provided by the installation of our own water supply well as described above.

5.6 Drilling Operations

The drilling rig that is anticipated for use during this project will be similar to the Universal 5000 rig that has been widely used for scientific and mineral exploration drilling (Fig. 4). The rig has

a self-contained power train and uses a 230 hp diesel engine to generate its own hydraulic and electrical power; the total mast height for this rig is ~23 m. It should be noted, however, that the actual rig used will be determined by the required bidding process for the program. The maximum sized rig that is likely to be used would be one with a capacity of 400 hp and a mast height of 35 m.

The well pad and drilling site will be set up as shown in Figure 5. Ancillary equipment that will be installed on the drilling pad include: drilling fluid tanks and pumps, mud mixing tanks, a shallow water well and water supply tank; a supplies trailer, a cuttings sump, a management office/trailer, and a core processing area. All structures will be of single-story height and will consist of containers, portable office-trailers, or fabric shelters.

The drilling program will consist of three six-month phases of drilling interspersed with twelve to eighteen month intervals during which the rig will be demobilized from the site and scientific studies will be conducted on the core and in the borehole (Fig. 6). The first phase of drilling and coring will consist of the following:

A 16" diameter hole will be augered and a 13-3/8" conductor casing will be cemented into place down to a depth of ~10 m;

Coring will begin at 10 m depth with CHD-101 drillrod (~4" dia.) and will penetrate to a depth of ~120 m where downhole logging will be performed using geophysical tools (temperature, resistivity, acoustic televiewer, etc.);

The hole will be reamed to a diameter of 12-1/4" to allow a 9-5/8" surface casing (K-55, 36#) to be cemented in place;

Coring will resume to a depth of ~ 600 m where the open section of the hole will be logged;

The hole will be reamed to 8-3/4", and a 7" casing (K-55, 23#) will be installed from the surface to 600 m;

Coring will then resume and continue to a depth of 1700 m where logging will again be conducted;

A 5" liner (K-55, 15.5#) will be installed from 560 m to 1700 m;

At the conclusion of the casing installation, the rig will be released and de-mobilized from the site;

Throughout the duration of the drilling program, the core recovered from the hole will be processed at the site in preparation for its being analyzed and documented by the scientific team. This process will involve washing the core, re-assembling any fragments into the same configuration that they had in the formation, drying the core using a gas dryer, marking it, and splitting the core sections using a rock saw. After this process is complete, the core will be secured in boxes for transport to an analysis facility located in the Hilo vicinity.

The downhole logging program will consist of lowering a series of instruments into the hole on a wireline cable from a truck or skid mounted winch. As the instruments are lowered into the hole, measurements of temperature, pressure, fluid electrical resistivity, acoustic velocity, and natural gamma emission from the formation rock will be made. We will also perform a

borehole televiewer survey that will provide an acoustic image of fractures in the formation.

After the first phase of drilling and casing the hole is completed, the borehole will be allowed to reach thermal equilibrium with the formation and downhole temperature measurements will be made in order to identify subsurface fluid flows (in the earlier drillhole, water temperatures ranged from 23°C, the temperature of Hilo Bay water, to 6°C, the temperature of deep ocean water, and indicated water from several different sources were present in the formation penetrated by the drillhole) (Fig 7). After an equilibrium temperature profile has been obtained and appropriate sampling intervals have been identified, the 5" and 7" casings will be perforated to allow us to conduct fluid sampling and hydrologic measurements in the borehole. This process will involve purging fluids from the well and monitoring water levels, water temperatures, and water flow rates in the open borehole.

During the post drilling interval, there will also be a series of geophysical experiments (vertical seismic profiles) performed in the hole that are intended to probe the geologic structure below the bottom of the wellbore. During these experiments, an array of seismometers will be lowered into the hole and an airgun will be deployed in the shallow water well where it will repeatedly discharged a burst of high pressure air into the ground to generate a seismic signal that will be detected by the downhole string of seismometers. Although the airgun generates a audible "thump", its use in the prior drilling project did not generate a significant audible signal off-site (~100 m away). The use of an airgun is considered to be safer and less intrusive than using explosive charges which have typically been used for the same application in other active seismic experiments. At the conclusion of this, and other geophysical work in the borehole, the wellhead will be secured until the next drilling phase.

The second phase of coring will require re-mobilization of the rig onto the site where it will re-enter the borehole drilled during the first phase. The process for the second phase of drilling will be as follows:
The perforations in the 5" and 7" diameter casings will be sealed with cement;
A second string of 5" casing (K-55, 15.5#) will be installed from 560 m to the surface;
Coring will resume using CHD-101 (~4") driilrod to a total depth of 3400 m;
The hole will be logged;
The CHD-101 drillrod will be cemented in place from the surface to 3400 m;
The rig will be demobilized from the site.

As during the initial coring operation, core will be recovered from the hole and will be processed on site and prepared for later analysis. Following completion of the drilling and casing operation, the hole will be allowed to come to thermal equilibrium and perforations will be installed in the 1700 m to 3400 m section of casing to allow fluid sampling and hydrologic measurements to be made in that interval of the hole. Vertical seismic profiling and other geophysical measurements will also be made in the hole at this time.

The final phase of coring will:
Seal the casing perforations with cement;
Core from 3400 m to 4500 m using CHD-76 (~3") drillrod;
The open section of hole will be logged;
A final string of CHD-76 rod will be installed as a hole liner from 3300 m to total depth.

During the drilling process, fluids will be pumped down the hole to cool and lubricate the drill string and bit. We will use a bentonite based drilling fluid to which organic polymers (guar gum) have been added to increase lubricity and viscosity. The drilling fluids will be circulated down center of the string and those that return will be cycled through a "mud tank", to allow rock particles to be removed, and then will be recycled down the hole. During the prior drilling effort, the return of drilling mud to the surface was minimal and we expect the same to occur during the present drilling. However, if drilling mud and cuttings are returned to the surface, at the conclusion of each phase of drilling, the waste materials will be de-watered and disposed of in the County land-fill or as otherwise directed by the County or DLNR.

5.7 Access

As described above, access to the drilling site will differ depending on whether Site A or Site B is used. In the former case, a portion of the existing berm along Leilani Avenue Extension (Hilo dump road) will be cleared to allow entry onto an earthen ramp. The existing ramp will be modified near its terminus to allow vehicles to exit the ramp directly onto the State-controlled parcel and a compacted cinder roadway will be constructed across the quarry floor to the drill site. Access to the site will be controlled with a locked gate located at the Leilani Ave. entrance to the ramp. Access to Site B will be via an existing secondary cinder/paved roadway that intersects the Airport access road. Access to the site will be controlled by a gate at the entrance to the quarry floor.

The total number of staff occupying the site will average eight to ten persons during the daytime and four during the evening shift. Four of these persons will be the rig crew, who will stand twelve hour shifts; daytime staff will include the drilling engineer, and two to three core processors. The site will also be visited daily by the scientific staff to review the progress of the drilling and to provide information to the drilling engineer on the characteristics of the rock samples recovered.

5.8 Infrastructure

Electrical power will be supplied to Site A from an existing utility line that runs along a corridor located approximately 75 m (250') south of the proposed site. We anticipate having to install one additional pole adjacent to the Dump road, a second at the upper edge of the quarry pit, and a third on the floor of the quarry to bring electricity into the site. The expected usage of electrical power will be for rig and area lighting, power for hand tools at the site, and power for air conditioning and office lighting in the management trailer. Telephone service will also be

brought into the site via a subsidiary line from a trunk that parallels the electrical lines.

During drilling water is used to make drilling mud that is circulated down the drill string to cool the bit and to flush cuttings from the borehole. Water will also be required at the site for washing and processing the core samples recovered from the borehole. It is estimated that the maximum water usage will occur during the hole-opening (reaming) work done in the borehole and will require up to 35,000 gallons of water per day; most of this water will be lost to the rock formation until we can set and cement casing into the hole. We propose to obtain this water from a shallow well located within the area of the drill pad. The floor of the quarry is located about 3 m above the local water table and a shallow (15 m depth) well will be able to provide water of sufficient quality and quantity for our needs. Although an alternative to this plan would be to install a subsidiary line on a County water main that runs along the eastern edge of this parcel of land, this course of action would inhibit access to other parts of the property and unnecessarily burden the County drinking water supplies for water that need not be of drinking water quality. Other circumstances that support the proposed action include: there are no other nearby wells or surface water supplies that the proposed shallow water well would adversely impact; the proposed well will enable us to perform the vertical seismic profiling experiments without the use of explosives; the well could, if desired, also serve the needs of the County and the Department of Health in the capacity of a monitoring well for the dump operations that are located southeast (up-gradient) of the proposed drilling site.

Liquid and solid waste will be disposed of as appropriate for the material concerned. Chemical toilets will be installed at the site and sanitary wastes will be handled by a local contractor for the project. Solid wastes will typically be composed of mixed paper and plastic bags for drilling mud, plastic buckets for drilling polymer, and wooden pallets used to transport supplies; we anticipate no more than one truck-load per week of this waste. Drilling waste will consist of rock cuttings and cement cuttings. These will be disposed of either in the County landfill or will be used as site restoration material as directed by DLNR and the County of Hawaii.

5.9 Schedule

Drilling operations are expected to begin during the third quarter of 1997 or as soon thereafter as permitting allows. Drilling will occur on a 24 hour per day schedule and the duration of the drilling operations will occur during three six-month intervals that will be spaced over a period of six years.

5.10 Follow-on Work

After completion of the drilling work, it is anticipated that the borehole will continue to be used for studies of the deep interior of the volcano for a period of several years. That work is likely to involve the installation of seismometers or other geophysical instruments into the borehole with a small instrument shed over the wellhead being the only surface impact of this work.

Part VI : DESCRIPTION OF THE EXISTING ENVIRONMENT

6.1 The Physical Environment

Climate

Long-term climatological information exists for the Hilo Airport located immediately adjacent to the proposed drilling site. A compilation of this data indicates (Table 1) that the mean annual temperature has a daytime average of 81°F and a nighttime average of 66°F. Annual rainfall is approximately 128 in. per year with maxima of about 13.5 in. and 14.9 in. during, respectively, March and November and minima of about 9.4 in. and 6.5 in. during January and July respectively. Wind speed and direction vary diurnally with maximum wind speeds of about 4.5 mph occurring during the middle of the day and minimum wind speeds during the evening hours. Wind direction is from the Northeast during the daylight hours and shifts to Mauna Loa drainage winds from the Northwest and West during the nighttime hours (Fig. 8).

Geology

The geology of the area proposed for drilling is composed of relatively young basaltic rocks derived from lava flows of Mauna Loa volcano. Neither of the prospective sites has significant soil cover and the surface consists of broken rock and cinder. The subsurface geology is not known in detail, but, on the basis of the drilling results from the earlier drillhole, probably consists of an extended interval of basalt from the Panaewa flow series that is underlain by a few to as many as thirty meters of calcareous sediments that formed the pre-Panaewa Hilo Bay bottom. Below this interval is a sequence of older basalt flows, and possibly black sand deposits, from Mauna Loa that is expected to extend to a depth of 300 m or more where the now-buried surface of Mauna Kea lies. That surface will be marked by a ~3 m thick soil interval and will be underlain by a series of subaerial Mauna Kea flows that is expected to extend down to a depth of 1 to 1.5 km. At this depth we expect to encounter shoreline and submarine flows of Mauna Kea; the latter are expected to extend down to the bottom of the hole at 4.5 km depth.

One of the major criteria in the choice of this area for a drilling target is the avoidance of alteration of the subsurface lava flows by hydrothermal activity. Hence, the site is located as far away from the rift zones of either Mauna Kea or (to the extent known) Mauna Loa. We do not anticipate encountering thermal activity of any kind in this hole and hope to avoid any evidence of past active thermal alteration of the lava flows sampled. The results of the earlier drilling project suggest that the area chosen for this project is unlikely to have significantly elevated temperatures down to depths of at least two to three kilometers: the pilot hole (KP-1) showed a negative temperature gradient with deeper temperatures falling to as low as ~6°C (~45°F) (Fig. 7). Nonetheless, temperature profile measurements will be made during our planned drilling operations to ensure that any significant temperature increases are detected well before they present any threat to our operations. As a further means of protection against unanticipated temperatures or pressures in the hole, we will install pressure control equipment on the wellhead when a depth of 600 m is reached. This is well above the bottom of the pilot research hole

drilled in Keaukaha where temperatures were approximately 6°C.

The original topography of the area around the proposed sites was gently rolling but has now been heavily modified by the ongoing or prior quarry operations. At Site A, the drillsite will lie at the bottom of a sheer rock face that rises ~12 m to the original surface elevation that is now covered with a ~5 m berm of overburden material that was removed from the quarried area. The northern boundary of the parcel is also a sheer rock face that, at its western end is modified with an earthen ramp leading up to the elevation of Leilani Ave. The floor of the quarry is at an elevation of about 6 m; the elevation of the original land surface is about 21 m. At Site B, the elevation of the floor of the abandoned quarry is at approximately 8 m. The southern wall of the quarry is a ~10 m rock face that rises to the elevation of Leilani Ave.

Geologic Hazards

The proposed drilling sites are within Lava Flow Hazard Zone 3 as identified by Helicker in the USGS publication "Volcanic and Seismic Hazards on the Island of Hawaii (U.S.G.P.O. # 1990-259-799). This zone encompasses virtually all of Hilo and much of the lower flanks of Mauna Loa volcano. If a lava flow were to threaten Hilo, there would be more than adequate time to secure the hole and remove the drilling rig to a safe location.

The proposed sites are located approximately 2 km from the shoreline and are not within the tsunami evacuation hazard zone at Hilo. Similarly, there do not appear to be any major drainages that pass through or near the site and flood hazard appears to be low.

Hydrology

The hydrology beneath the earlier drillhole was found to be quite complex near the coastal zone with a series of alternately fresh and brackish water bodies down to a depth of more than 300 m (Figure 7). Because this site is farther inland, we anticipate a somewhat simpler hydrology with fresh to brackish water immediately below the site that will grade to more saline water with depth into the Mauna Loa formation. The freshwater zone represents outflow of meteoric recharge to Mauna Loa that is being discharged at coastal springs and seeps that are present along the shoreline in the Hilo area. The volume of this discharge is estimated by the U.S. Geological Survey Water Resources Division staff to be on the order of several billions of gallons per day. The earlier hole also showed that freshwater from Mauna Kea recharge is trapped beneath the soil layer that marks the transition from Mauna Loa to Mauna Kea lavas and it is highly probable that we will again encounter a deep zone of freshwater when we cross the transition from Mauna Loa to Mauna Kea lavas. Below this interval, we expect to return to deep saline waters derived from seawater and to continue to be in saltwater saturated rocks for the balance of the borehole.

As noted above, this site was chosen to be as far away as possible from the rift zones of Mauna Loa or Mauna Kea to avoid the possibility of alteration of the lava chemistry by hydrothermal processes. Temperatures within the earlier drillhole confirmed that we are well removed from any shallow thermal activity. Hence we do not expect to encounter thermal fluids in the present

drilling program. Nonetheless, the casings and wellhead equipment used will be engineered to withstand temperatures and pressures well above ambient.

Noise

Ambient noise levels are controlled by the industrial nature of the surroundings of the proposed site. The Hilo airport runway ends less that one kilometer from Site A; the Glover and Yamada rock crushing operations abut the site on the west and south borders; and the Hilo dump road runs along the eastern boundary of the site. A survey of noise levels at Site A along Leilani Ave. that were conducted during a typical workday found levels that ranged from a low of 46 dbA to a high of 81 dbA. Predominant noise sources included heavy trucks (81 dbA) hauling refuse and stone, helicopters (65 dbA), jet noise from the airport (60 - 65 dbA), and light trucks and passenger cars 55-60 dbA. The breakdown of traffic at the site was approximately 20 light trucks and passenger vehicles and about 5 heavy trucks during a 10 minute interval. Short-duration episodes of aircraft noise associated with jet take-off and landing events number nearly 100 events per 14-hour day (06:00 - 20:00), with an additional one to two dozen helicopter landings per day, and an unknown number of National Guard and Civil Air Patrol flights during daylight hours. In addition to this would be about four cargo aircraft events during the late night hours (22:00 to 05:00). Although noise levels were not monitored at the Site B boundaries, traffic patterns into and out of the airport suggest that surface vehicle noise would be somewhat lower due to the smaller number of large trucks that use the Airport access road but aircraft noise levels are expected to be much higher due to the closer proximity to the airport runway.

Nighttime noise levels around the site are expected to be considerably lower than those occurring during the day, although, as noted above, there are nighttime cargo flights into General Lyman Field during the late evening and early morning hours. Beyond the intermittent, loud aircraft noise, the predominant noise source is traffic along State Highway Route 11, the main thoroughfare through Hilo toward Keaau and Volcano. Experience from the earlier drilling project indicated that nighttime traffic noise dominated the ambient noise levels until well into the early morning hours (01:00 to 02:00) with only a few hours of quiet noise levels until the early morning commuter traffic began.

6.2 The Biological Environment

A biological assessment of the proposed sites has been conducted by Dr. Grant Garrish, a botanist with the UH-Hilo Natural Sciences Dept. The findings of this work are attached as Appendix A and can be summarized as follows: The site has been heavily impacted by prior anthropogenic activity and the vegetation is dominated primarily by alien species. Although there are limited numbers of native plant species present on the site, none are listed as threatened or endangered species. Recommendations from this report are summarized as follows: 1) Because of the absence of endangered species on the proposed sites, no precautions need be taken to protect the plants and animals observed on either site or described as being likely users of the sites; 2) In the unlikely event that construction crews encounter an 'I'o defending a nest with noisy calls, construction activity should be halted and the U.S. Fish and Wildlife Service contacted. If a nest is found within the project site, it should be left

undisturbed until any 'I'o chicks have left the nest and the nest site has been abandoned; and 3) The proposed action includes 24-hour-a-day operation of the drilling rig. All lighting on or near the site should be shielded to conform to County of Hawaii standards to prevent harm to night-flying seabirds including the Endangered 'Ua'U (Dark-Rumped Petrel) and the Threatened 'A'o (Newell's Shearwater). These legally protected birds have been reported flying through the Hilo area from the ocean to mountain nesting sites (Conant, 1980).

6.3 Archaeology

An assessment of these parcels was requested of the staff of the State Historic Preservation Division in September, 1996. A written response from them indicates that, because the land surface has been extensively altered by quarrying operations as well as overburden stockpiling and other bulldozing work, it is unlikely that significant historic sites remain in the project area (Appendix B).

6.4 The Socio-Economic Environment

The proposed sites are located in an Urban Land Use district; Site A is designated "General Industrial" within the County of Hawaii zoning code whereas the parcel on which Site B is located is zoned for Limited Industrial use. The surrounding area is devoted largely to industrial activity (quarrying, electrical power production, refuse dump), airport property, and warehouses.

The population of Hilo is approximately 50,000 persons and its industrial area encompasses several large tracts of land adjacent to the main airport and State Highway 11. Site A is bounded by a quarry and rock crushing facility operated by J.W. Glover Co. on the west and north, a rock crushing facility operated by Yamada and Sons on the south, and the Hilo rubbish dump road on the east; Site B is bounded by the Hilo rubbish dump road on the south and the airport access road and runways on the north. Toward the east and west are auto storage yards for vehicle rental companies and the Water Department storage yard respectively.

The nearest residential area is the Waiakea District of Hilo, which is located about 1200 m west of the site beyond the quarry and industrial area. The overall character of the Waiakea District nearest the proposed sites is one of older single-family dwelling residential use mixed with more recent use for commercial and business use within single story detached office buildings. The housing density is moderate, by Hilo standards, with lot sizes being in the range of ~10,000 to 20,000 square feet. Toward the south are located both an industrial area, with warehouses, equipment yards, and power generation facilities, and larger farm lots of five to ten acres in size; the latter area is sparsely populated. Toward the north, the main airport for the eastern side of the island abuts Site B and, beyond the airport runway, at a distance of about 2 km from Site B, lies the Keaukaha district of Hilo that consists of a low density (0.5 to 1.0 acre per lot), well established subdivision.

The nearest park facilities are located along the coastline to the north along Banyan Drive ("Ice Pond" area) and on Kalanianaole Ave. where Keaukaha and Onekahakaha Beach Parks are located. These parks are located at distances of 2 to 3 km from the site and are unlikely to be impacted by the proposed project.

Infrastructure and Utilities

The main roadway through the industrial district is Railroad Ave. that begins at Leilani Ave. and trends in a southwesterly direction through an area of warehouses, workshops, and storage yards. At the Site A location, the "Dump Road" extension of Leilani Ave. runs parallel to Railroad Ave. Power line corridors run in a generally east-west direction both to the south and north of the parcel on which the drill pad will be located; the closest power and telephone lines are located on the parcel immediately south of this prospective site. A County water main runs along the western edge of the parcel but, as noted above, we do not anticipate using this as a source of water for the project. Although a county sewer main also passes near the site, we expect to use chemical toilets at the site.

At Site B, the primary roadway near the site is the Airport Access road; a spur/secondary road from this thoroughfare will provide entry to the site. Electrical power lines run parallel to Leilani Ave., immediately south of the site, and can be used to provide power. Telephone lines do not currently run near the site and would have to be strung along the existing power poles to our site. County water and sewer lines are located at a distance of about 300 m from the site and could be accessed if such a requirement were imposed on the project.

All other infrastructure expected for a city having a population of 50,000 (fire protection, hospital, industrial and fuel supply houses, etc.) are easily accessible from either site.

Part VII : POTENTIAL IMPACTS AND MITIGATING MEASURES

7.1 Introduction

The proposed project is for purposes of scientific research. Samples of rock and water will be recovered from the proposed drill hole and measurements of rock properties and subsurface conditions will be made in the hole after its completion. In a general sense, the overall impacts from the present project can be gauged from those of the earlier scientific drilling program conducted at Kaukaha in 1993. Although drilling was of shorter duration and used a smaller rig, nearly all the activities at the proposed site also occurred during the earlier effort. The impacts from that project were, to the extent they could be detected at all, minimal: noise impacts on the community, located about 200 m away from the site, were undetectable by the residents; losses of drilling mud did not detectably impact water quality in the Hilo Bay, located about 100 m away, or on a shallow observation hole drilled less than 50 m away from the deeper drillhole; site clearing removed about one-half acre of weedy tree species that have since been replaced by by a mix of ironwood trees as well as the weedy species already there; site clearing also resulted in the removal and proper disposal of significant amounts of trash and debris from the area immediately around the site; socioeconomic impacts included increased employment for twoBig Island residents as rig hands, increased business activity by heavy construction companies, electrical contractors, and residential hotels in the Hilo area; no adverse impacts on night-flying birds from the site or rig lights were detected; and no significant impacts on air quality were detected. At the present time, most of the site has been allowed to revegetate naturally and is presently covered with small ironwood and albezia saplings; some of the site has been maintained clear to allow ongoing research to be conducted in the hole.

As was the case with the earlier drilling effort, the primary environmental impacts from the proposed action are transitory in nature: the drilling rig will be on site for three six-month periods spaced over a ~six year interval. Subsequent measurements in the hole will require that a logging truck be sporadically parked at the site for a few hours to a few days during periods of downhole measurement; for long-term studies, we anticipate the construction of a small shed (~3 m X 3 m) to provide utility power and protection for surface instruments.

As noted earlier, the land parcels being considered for the project are either currently used, or were formerly used, as stone quarrying operations. The impacts of the earlier uses of these sites has been extensive. As described in the biotic assessment in Appendix A, native vegetation has been all but completely removed from the site: only a small proportion (7 out of 70) of the tree and plant species identified were indigenous to Hawaii, none of which were rare or endangered, and large areas of the prospective Site A have been completely cleared of vegetation. It is our intent to restrict our activities to the areas in which ground disturbance has already occurred during prior use of the site. Hence, our impacts will be either negligable or, in the case of our removal of noxious weed species or existing trash and debris, improve upon the existing conditions at these sites.

The area around the site is classified as Urban: Site A falls in the General Industrial zone, and is devoted to industrial and warehouse activities; Site B falls in the Limited Industrial zone. The work proposed here is not expected to significantly impact any current uses immediately adjacent to the sites nor to have an impact on the more distant surrounding lands.

7.2 Geology and Soils

The parcels on which the proposed drilling will be conducted have been used as stone quarries. Site A has been mined down to a depth of ~12 m which is only about 3 m above the local water table. The current surface consists of mixed crushed stone and, a'a cobbles, and cinder; because the overburden material was removed from the surface there is no naturally occurring soil currently exposed on the site. Site B has also been mined for rock but has had only about 9 m of rock removed. The surface of the site consists of crushed stone, boulders, and rubbish that has been dumped there during the ~30 years the site has been unused. It is unlikely that any naturally occurring soils are present in this heavily disturbed area.

The geologic hazards for the site are indicated to be minimal. The lava flow recurrence interval for the area was shown by our prior drilling project to be one flow per 3,000 years. The site is outside the tsunami inundation zone and is unlikely to be impacted by tsunamis of a magnitude that is consistent with those recorded in recent history. The site is not located within any known drainage channel of Mauna Loa and is not expected to have a high likelihood of flooding.

Mitigating actions for soils and geologic impacts consist of the choice of location in an area in which valuable soils are absent and where geologic hazards are minimal.

7.3 Air Quality

The air quality impacts arising from this project will include minor dust mobilization during site grading activities and diesel exhaust emissions associated with the grading equipment and the drilling rig. Given the high rainfall at the site, dust mobilization is likely to be transitory and minimal. However, if dust becomes a problem, water can be sprayed over the exposed portions of the site to minimize the dust generation. The emission rate of diesel exhaust will be less than or equivalent to that produced by a standard 40' trailer truck. The diesel engines on the rig will be operated at constant speed and, hence, the engine will burn more cleanly than an equivalent motor that accelerates and decelerates in its normal mode of operation. The rate of these emissions within the industrial district will not contribute detectably to the existing load of exhaust generated by discharges from jet and helicopter engines using the nearby airport, the electrical utility plant that burns both diesel and bunker fuels, and the routine traffic using Leilani Ave. to access the County dump and the Airport Access road.

Although some concern has been expressed regarding the possibility that the depth of the core-hole would penetrate a geothermal system, with attendant hydrogen sulfide emissions, we do not believe that there is a significant probability for this occurring. As noted elsewhere in this

document, the choice of the Hilo area as the location for this project was, to a great extent, based on the desire to avoid the effects of current (or past) subsurface thermal activity. Present surface geology indicates that this site is as far as possible from the current locations of the Mauna Loa and Mauna Kea rift zones and other geologic data indicate that older, now-buried rift zones, are not present in the Hilo area. Because rift zones (and calderas) are the only geologic structures known to contain significant quantities of geothermal heat in Hawaii, we believe that the likelihood of the drilling program encountering significantly elevated temperatures is remote. Further, the results of our earlier drilling program showed that temperatures declined with depth in this region (Figure 7) and at ~ 1 km depth, subsurface temperatures were as low as about 6°C. None-the-less, pressure control equipment will be installed on the well to ensure that elevated formation pressures, whether resulting from elevated temperatures or from other causes, will be controlled at the wellhead and will not be allowed to discharge from the well during our drilling activities.

Mitigating actions for air quality impacts will be to restrict the rig to the smallest size that can reasonably accomplish the required work. The rig will also, to the extent possible, be operated in a mode of constant output which will minimize diesel exhaust emissions. Mitigating actions with respect to potential geothermal emissions include: choice of location away from known geologic structures having geothermal activity; installation of wellhead pressure control equipment (blow-out preventors) well before any possible thermal zones could be encountered; and periodic downhole measurements and analysis of temperature logs with respect to any indications of elevated subsurface temperatures.

7.4 Water Quality

The water underlying the site consists of generally fresh to brackish water derived from tidal mixing of seawater with natural freshwater coastal discharge. The surface water quality appears to be good (< 200 ppm total dissolved solids) but the thickness of the freshwater lens in this area is unknown. Because we are located in the near-shore environment, the surface water layer is believed to be underlain by saline seawater that has infiltrated into the deeper basalts by tidal action. The prospective project sites are located below (downgradient) the Department of Health Underground Injection Control Line (shown on Figure 1b.) which defines the mauka (up-gradient) limit for the installation of wastewater injection wells. A single municipal water well (number 4202-02 on Figure 1b.) is located in proximity to the proposed project sites but is not currently in use and, according to discussions with Department of Water Supply staff, has not been used for a number of years.

The drilling operation does have the potential to release drilling mud into the rock formation around the drill hole. The mud to be used in the project will be composed of a mixture of bentonite clay particles and organic additives derived from plant material (guar gum). The bentonite used will be of high quality and will contain minimal amounts of potentially toxic substances; because this type of mud is used in the drilling of water wells for potable supplies, it is not considered to pose a significant health or environmental hazard. The design of the well

has also been developed to minimize losses of drilling mud into the shallow environment: successive strings of casing will be installed (cemented) in the hole (Figure 6) that will limit loss of drilling fluids to the formation and will also restrict any fluid circulation between saline and fresh aquifers.

Although drilling a well in close proximity to the shoreline could conceivable result in the loss of drilling fluids into the coastal waters, it is considered highly unlikely that this will occur. Even if substantial amounts of drilling mud were lost to the formation during the shallow drilling, water velocities outside the immediate vicinity of the borehole are low enough that any particulates would almost certainly settle out in the formation. Our earlier drilling project, conducted within 100 m of the shoreline, supports this contention: no evidence of drilling mud leakages were found either in the waters being discharged to the Bay or in a shallow hole drilled within about 20 meters of the deeper hole. Similarly, the proposed drilling project is not anticipated to detectably impact the water quality at the municipal water well 4202-02 since it is located several hundred meters from the proposed drilling sites. Hence, we do not anticipate any impact on nearshore waters or on nearby wells from our drilling effort. Finally, it should be recognized that the hole will be cased down to ~10 m and ~120 m within a few days of the start of drilling; this action will substantially limit the loss of drilling fluids in the shallow formation through the remainder of the project.

We also will drill a shallow (<10 m) well on our site in order to provide non-potable water for our drilling and core processing operations. We will need to pump a maximum of about 35,000 gallons per day of water from this well. The rocks within the Panaewa flow series are known to be highly permeable; further, the high rates of freshwater recharge to the upper slopes of Mauna Loa are believed to supply on the order of billions of gallons per day of freshwater to shoreline springs in the Hilo vicinity. The volume of water withdrawn will be substantially less than three one-hundredths of one percent of the total available and, hence, withdrawal of groundwater for use in our drilling program is not anticipated to detectably impact (draw down) the local water table. We also note that the majority of the water will be immediately returned to the ground in the form of drilling fluids and, hence, shouldn't detectably affect the basal water table. A further positive aspect of the shallow hole is that it can serve as a monitoring well for possible impacts from the solid waste transfer station and refuse dump that are currently being operated up-gradient of our drilling site. Analysis of samples from this site will enable the County and State regulatory agencies to determine whether these activities are having a significant impact on groundwater quality or have the potential to impact shallow discharges to the Hilo Bay. If the shallow waters are contaminated by up-gradient solid waste activities, we do not expect our use of this water to have a significant impact on the local water quality since, at worst, we will be pumping water from the shallow contaminated aquifer and re-injecting it as drilling fluids back into the local groundwater only a few meters away; as the drilling operations proceed, we will have the shallow aquifer cased and be injecting the (potentially) contaminated water into deeper aquifers that are unlikely to be used as a drinking water source due to their increased salinity.

Liquid waste water generated at the site will include core washing water as well as sanitary wastes. Sanitary wastes will be disposed of into chemical toilets and will be removed from the site by a contractor. Core wash water will be collected in a sump and pumped into the mud tanks for use in preparation of drilling fluids which will be used in the hole. Residual drilling fluids left after each drilling phase is completed will be de-watered and disposed of as directed by the County or DLNR.

Mitigation actions will include the use of high-quality (and, therefore, non-toxic) drilling fluids and the installation of shallow casing strings in the borehole that will minimize the loss of drilling fluids into the shallow groundwater system. The installation of our own water supply well will also minimize the impacts of our water use on the higher quality, municipal water supply system for Hilo. Wash water will be re-used for the preparation of drilling water and sanitary wastes will be handled by an independent contractor.

7.5 Noise

Noise will be generated both by the use of heavy equipment during the site preparation process and by the drilling rig during the drilling operation. The former activities will be conducted during daylight hours only using a single bulldozer with intermittent truck deliveries of cinders and concrete for leveling and grading the drill pad. The impact of this noise source will be trivial relative to the existing truck and jet traffic that frequents this area.

Noise associated with drilling will be continuous since drilling operations will be on a twenty four hour a day schedule. At Site A the drilling rig will be shielded on three sides (north, south, and east) by ~12 m rock faces; the western edge of the drill site will open onto the Glover rock crushing operation and the far western wall of the quarry at a distance of about 300 m. At Site B, walls of about 9 m height will shield the site on its east, west, and south sides; toward the north, the site will open out onto the airport runway.

The nearest residential area is located slightly more than 1 km toward the west, across State Highway 11 from the industrial area. This area is mixed residential and business use and experiences high levels of ambient noise from vehicular traffic as well as noise associated with the operation of the airport. Shielding of this residential area from rig noise by existing topography (the topography falls away west of the industrial area and the closest residential area is lower than the western wall of the quarry), as well as the existing high levels of background noise, are likely to make operation of the rig unnoticeable to the nearest residents. As noted above, moderately high levels of noise are expected from traffic using Hwy. 11 even during the late evening and early morning hours and, hence, should mask the noise of the drill rig during these periods. A further mitigating factor for this community is that, during the quietest periods of the day (nighttime hours) wind directions are typically from upslope (west) (fig. 8, Table 1) and will help to further suppress noise propagation toward the residential area. It is also important to recognize that noise from the rig will be predominantly engine noise that will occur as a constant "drone" and will be much less intrusive than periodic noise from passing vehicles

or aircraft. This is substantiated by our experience from the earlier drilling project which, although it used a smaller rig, was located less than 200 m from a residential area: throughout that drilling operation, no noise complaints were received and, when some of the nearest residents were questioned about rig noise after the project started, their response was that it was undetectable even during nighttime hours.

The only other potentially noisy operation at the site is the execution of a downhole vertical seismic profile. We propose here to use an "airgun" which discharges a burst of high-pressure air to generate a low-frequency "thump". When this operation is conducted under several feet of water, as is proposed here, the majority of the acoustic energy is directed downward into the stratigraphic section and very little is released into the air. During this exercise at the Pilot Hole site, the air discharge events were not audible at a distance of more than 100 m.

The primary mitigating action is the choice of drilling location: the placement of the rig in a 9 to 12 m deep pit will minimize the propagation of noise in a horizontal direction away from the drilling site; location of the site at a substantial distance from residential areas further minimizes noise impacts; and finally, the location of the site in a down-wind direction from the closest communities will further reduce possible impacts. However, after the project begins operations, we will be contacting members of the communities nearest the project site to determine whether the noise from our activities is causing any difficulties for the residents. If the residents indicate that nuisance levels of noise are occurring, we will be able to take a number of steps to further reduce the impacts including: the installation of high performance mufflers on the drill rig engines; installation of noise baffles around the primary noise generators at the site; and reconfiguration of the equipment on the site to re-direct the noise propagation away from the community. If these measures prove to be inadequate, then a noise consultant will be hired to assist us in the design of other methods of noise reduction such as active noise suppression through the use of distructively interfering noise generation. Although we are certain that these measures will prove to be sufficient to eliminate nuisance levels of noise in the community, if some unique circumstance should occur that we do not currently anticipate, as a last resort, the hours of operation of the noisiest equipment could be curtailed to eliminate the noise source during the hours of greatest impact.

7.6 Flora And Fauna

The attached botanical report did not identify any significant negative impacts resulting from the proposed action on the botanical resources on this site. Recommendations made by the survey, to avoid any operations around occupied 'I'o nests and to shield rig and area lighting, will be followed.

Mitigating action is the choice of location in a heavily industrialized and impacted area where few native plants or animals are expected, or were found, to exist.

7.7 Archaeology

In light of the finding by the Historic Preservation Division that significant historic sites are unlikely to be present within the parcels proposed for this project, that division has indicated that the proposed work in these parcels will have "no effect" on significant sites.

Mitigating action is the choice of location in an area where ground disturbance has been intensive during past uses and where no historic or cultural values are found.

7.8 Socio-Economic

There will be eight or more workers engaged in the drilling operation: two shifts of four workers each with a foreman, one driller, and two to three helpers. The contractor will be strongly encouraged to recruit as many staff from the island of Hawaii as possible although it is likely that the driller and foreman will initially be from existing contractor staff. As the program progresses, we will encourage the contractor to hire and train local laborers to replace his existing staff. This will reduce the cost to the driller (by reducing his subsistence costs) and will enable more of the salary costs to remain in the community. An additional, longer term impact, will be to provide access to off-shore drilling projects to the Hawaii trained labor force. In past drilling operations, Hawaii-trained drilling staff have been offered permanent jobs with the drilling contractor after the local project was completed.

Any workers that are brought in from off-island or out of state will reside in local apartment or rental housing. Ancillary work (e.g. core processing and preliminary geologic description) will, to the extent possible, also hire local staff. The earlier drilling project employed six to eight students and former students from the University of Hawaii Geology Department who had more than adequate training for the work done; we anticipate that we will again hire from the Big Island labor pool for these tasks.

Local contractors and suppliers will be used for all general utility supplies as we do not believe that the completion of this well will be so specialized as to require importation of non-standard materials from off island.

The total cost of the drilling portion of the project is estimated at about $5 million; of this amount, several hundred thousand to several million dollars will be spent locally over the life of the project. Although these funds will not be disbursed in a continuous fashion, spending will occur over an extended period of time and is not so large as to require the importation of significant labor from outside sources. Consequently the activity will enable a substantial portion of the expenditures to remain in the community and will help, in a small way, improve economic conditions on an island that has been hit hard by the current economic downturn.

The only other socio-economic impacts that arise from the drilling project are considered to be those associated with the added scientific activity occurring on the Big Island and the

information derived from the analysis of the cores and water samples derived from the hole. It is likely that there will be visits by a number of scientists to the project site and to the interim core storage facility (currently planned to be at a warehouse in the Hilo area). Aside from a slight increase in economic activity at the local hotels, these visits will afford increased opportunities for interaction of the staff of the Geology Department and the Center for Study of Active Volcanoes at U.H. Hilo with scientists conducting state-of-the-art research in the earth sciences. These interactions may be both directly beneficial, in terms of information exchange, and indirectly important by generating interest in geoscience problems of local interest such as those associated with volcanic hazards, coastal subsidence, or long-term sea level changes.

Consideration has been given to potential impacts on cultural values associated with the land parcels currently under consideration for use. As noted earlier, both sites are located on "ceded" or former Crown lands owned by the Hawaiian Kingdom and athough they are located near land that is under the jurisdiction of the Department of Hawaiian Home Lands, neither of these parcels currently falls, or were formerly, under the DHHL. Discussions with community leaders in the Hilo area have indicated that there are no known (to them) cultural values associated with either parcel and that, at prospective Site B, the only use of the property by native Hawaiians was for the collection of leaves from the few hala trees that are present at the site. The mitigation action to be taken to protect this use will be to orient our site so as not to impact these trees.

The direct products of the investigations associated with this research hole include:

1) Studies of the recurrence interval of lava flows reaching the coast line in the vicinity of Hilo. The earlier research drilling showed that this hazard in the coastal area was much lower than had previously been assumed; the present drilling project will allow us to extend our analysis further inland.

2) Analysis of water compositions beneath the coastal area. Analysis of fluid compositions and water ages in the earlier hole has allowed us to substantially revise our models of groundwater flow in an island environment. Fluid compositions in the present hole will provide further insight into water transport processes further from the shoreline and deeper in the interior of the volcanic edifice. We expect that the results will have substantial implications for these issues both in Hawaii as well as on a global scale.

3) Seismic analyses that can be performed in the hole may be able to yield information on the structure of Mauna Loa and Mauna Kea volcanoes and possibly allow us to better understand the potential for seismic damage on the lower flanks of Mauna Loa.

7.9 Access and Traffic

The increased usage of Leilani Ave., or the Airport Access road, as a result of this project is estimated to amount to an average of approximately six to eight auto round trips, for crew changes and drilling management, and one to two truck round trips, for supplies, per day. Both roadways currently carry substantial numbers of private vehicles as well as heavy trucks and the addition of our traffic load will contribute an insignificant burden to that already existing.

Mitigating action will be to encourage car-pooling wherever practical and, to the extent possible, restrict heavy equipment movement onto or off the site to non-peak traffic hours on the access roadways.

7.10 Infrastructure and Utilities

The project is expected to have minimal impact on utilities or other infrastructure. Electrical power requirements are estimated to amount to the equivalent of that of two households, on average. The project is expected to use up to 35,000 gallons per day of water for drilling fluids; installation of a shallow water well on site for this water will eliminate any significant burden on drinking water supplies for the Hilo area. The impact of water use and discharge of drilling fluids back to shallow water aquifers are not considered likely to significantly affect water resources on the island and, because there are no groundwater wells down gradient of the proposed site, it is unlikely that our activities will affect other independent water producers.

Sanitary wastes will be dealt with using contractor-supplied chemical toilets and, hence, no impacts are anticipated from these services. Solid wastes will be generated by importation of supplies for the drilling (drilling mud, cement, polymer additives, etc.) and as a result of drilling solids being brought to the surface. The refuse (mud bags, pallets, plastic buckets) will amount to no more than one truck-load per week; drilling solids will be de-watered and used on site for surfacing material or otherwise disposed of as directed by the State and County regulatory agencies by a commercial contractor; the relatively small volume of solid wastes generated should not materially affect hauling or dump capacities on the island.

Mitigating actions will be to install our own water well to minimize demand on the municipal water supplies for Hilo. To the extent possible, solid wastes will be recycled, reused, or minimized.

7.11 Public Facilities and Services

The limited duration and scope of the proposed activity, and our efforts to recruit project staff locally will minimize the project's impact on schools, hospitals, fire protection, police protection, or other public services of this nature.

The location of the drilling rig in the vicinity of the airport, and it's likely impact on air traffic into and out of the airport has been considered. The location of the rig in a quarry pit is intended, in part, to minimize the impact of the rig mast on aircraft using the General Lyman Field. Estimates of the current height of the existing foliage and power poles on the surrounding landscape indicates that the rig mast height will not exceed its surroundings. The mast will also be marked with a flashing red light in compliance with any requirements of FAA.

7.12 Aesthetics

The visual impact of the project will be associated with the presence of the drill rig and lighting for nighttime operations. Because the rig will be located at the bottom of a quarry, it will be shielded from any residential areas by the rock faces that form the walls of the quarry as well as the vegetation growing on the original surfaces above the walls. Although more distant view-planes may be able to see the top of the rig mast, its location in an industrial area, surrounded by buildings, truck ramps, and gravel conveyors, is likely to make its presence insignificant.

Mitigating action is the choice of location for the project in an industrial area, and placement of the rig in already occurring depressions in the ground that will lower the profile of the majority of the facility below the view-planes of most of the residents of Hilo.

7.13 Light Impacts

Lighting on the rig will be shielded according to the Hawaii County Lighting Code to minimize its impact on adjoining properties and the island's astronomical facilities. All the area lights and rig floor lights will be shielded by the quarry faces and only the light(s) at the top of the rig mast (which will be required for safety of the rig crew) are likely to be visible from offsite.

7.14 Alternatives Considered

A number of alternatives have been considered for several aspects of the present project. Alternative methods of collecting the scientific samples required for this study (e.g. surface sampling, ship dredge sampling, submersible sampling) have been discussed in the scientific community but none can provide the sampling density and control that core drilling affords; neither will they provide us with the ranges of sample ages required to conduct our study. We have been unable to identify other methods of core drilling that are technically proven to meet the needs of this project. Alternative locations have been considered but, within the restrictions placed on the project by scientific considerations, relocation of the project site would either place the project: 1) closer to an identified volcanic rift zone (increasing the likelihood of encountering subsurface heat); 2) closer to residential areas; 3) within an agricultural community; 4) or farther from the exposed flank of Mauna Kea volcano and thus require substantially more drilling to achieve the scientific objectives of the project.

The no-action alternative has also been considered. The impact of such a decision would deprive the scientific community of substantial new information on the planetary processes that drive hot spot volcanism and would deprive the residents of the Big Island of additional information on groundwater resources on the island, the volcanic hazards that exist within the Hilo area, and possibly important data on other natural hazards that exist on the island of Hawaii. Further, it would deprive the island of the economic benefits that are to be derived from a project of the magnitude proposed.

Part IIX : DETERMINATION

An assessment of the significance of the proposed project must consider at least the 13 significance criteria listed in Subchapter 6, Section 11-200-12 as follows:

1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource: neither natural, historical, nor cultural resources of any significance are known to be associated with either prospective drilling site and, hence, none will be impacted by the proposed project.

2) Curtails the range of beneficial use of the environment: the potentially adverse impacts of the proposed project will be both limited and transitory in nature and will not significantly impact any natural resources in the area surrounding the proposed project sites.

3) Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders: the transitory nature and minimal cumulative or follow-on impacts of the proposed project are not anticipated to have any impact on the state's long-term environmental policies and goals.

4) Substantially affects the economic or social welfare of the community or State: the project is expected to have a small positive impact on the economic and social welfare of the Island of Hawaii by providing employment opportunities for a range of labor skills over the six-year life of the project;

5) Substantially affects public health: the minimal air quality, noise, and water quality impacts thatcan be identified for this project are not likely to have significant impacts on public health;

6) Involves substantial secondary impacts, such as population changes or effects on public facilities: the identifiable secondary impacts of the proposed project include an increase in the understanding of the geology, hydrology, and volcanic hazards of the Island of Hawaii. Whether this increased understanding will have long-term impacts cannot be predicted accurately, however it is believed that they will be generally positive by allowing future land-use decisions to be made on the basis of a better understanding of the geology of Hawaii;

7) Involves a substantial degradation of environmental quality: the impacts of the proposed project are expected to be small and transitory and, hence will not result in a substantial degradation of environmental quality;

8) Is individually limited but cumulatively has considerable effect on the environment or involves a commitment for larger actions: no additional drilling projects of this nature are presently anticipated for this area nor will the results of the current project require additional drilling or any other form of action, hence, there are no cumulative impacts nor is there a commitment for larger action;

9) Substantially affects a rare, threatened, or endangered species, or its habitat: no rare, threatened, or endangered species have been found at either prospective drilling site nor has either site been identified to be a significant element in the habitat for any rare, threatened, or endangered species. Furthermore, mitigation measures have been noted that can minimize the project's impacts on such species should they be identified during the course of the project;

10) Detrimentally affects air, or water quality, or ambient noise levels: the activities outlined in the proposed project are not expected to have significant impacts on these qualities at the proposed locations that are under consideration;

11) Affects or is likely to suffer any damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters: neither of the prospective project sites falls within any of the above listed areas;
12) Substantially affects scenic vistas and viewplanes identified in county or state plans or studies: the prospective project sites are located at elevations that are below the local grade-level and are surrounded by either vegetation or by existing industrial infrastructure and will be visible from only a very few nearby locations or only at a substantial distance;
13) Requires substantial energy consumption: drilling activities will require the use of diesel fuel which will be equivalent in amount to that used by two to three heavy tractor trucks and is not expected to detectably impact fuel supplies currently available on the island.

In consideration of the foregoing environmental assessment, the discussion of the likely impacts and available mitigation measures, and the absence of significant impacts as judged by the significance criteria of Subchapter 6, Section 11-200-12, we therefore make a Finding of No Significant Impact that will arise from the proposed project.

Part IX : FIGURES AND TABLES

Figure 1a. Maps of the Island of Hawaii showing location of the Pilot Hole (KP-1) drill site and the proposed site (Quarry Site) for the proposed drilling program.

Figure 1b. Prospective drill sites A and B shown on USGS Topographic map.

Figure 1c. Arial Orthophotoquad of Hilo vicinity showing prospective drill Sites A and B.

Figure 1d. Prospective drill Sites A and B shown on TMK reference map.

Figure 1e. Current and proposed configuration of the access ramp at Site A.

Figure 2. Photographs of prospective drill Site A showing rock walls and surface contour.

Figure 3. Photographs of propsective drill Site B showing surface contour and vegetation.

Figure 4. Photograph of Universal 5000 drilling rig as it would be assembled at drill site. Mast height is approximately 80' (26 m).

Figure 5. Generalized layout of drill site showing rig location and ancillary equipment and storage at site.

Figure 6. Generalized diagram of the design of the completed borehole. PQ size core hole is equivalent to 122.6 mm diameter hole; HQ size core hole is equivalent to 96 mm diameter hole; and NQ size core hole is equivalent to 75.8 mm diameter hole.

Figure 7. Downhole temperature profile taken from the KP-1 Pilot Hole. Temperatue profile marked Thermocline corresponds to an open ocean water temperature at an equivalent depth in the water column. Temperature profiles marked 12/18/93, 7/22/94, and 3/9/95 reflect rock formation temperatures in the hole at various times after completion. The sharp temperature changes above the Mauna Loa/Mauna Kea interface (heavy black line across the plot) reflect fresh and saline aquifers in the stratigraphic section; the 19°C zone at the top of the Mauna Kea Section reflects a large freshwater discharge zone; and the low temperatures at depth indicate ocean water circulation in the deep stratigraphic section.

Figure 8. Plots of average diurnal meteorological data for the Hilo area.

Table 1. Monthly average temperature and precipitation for the Hilo area.

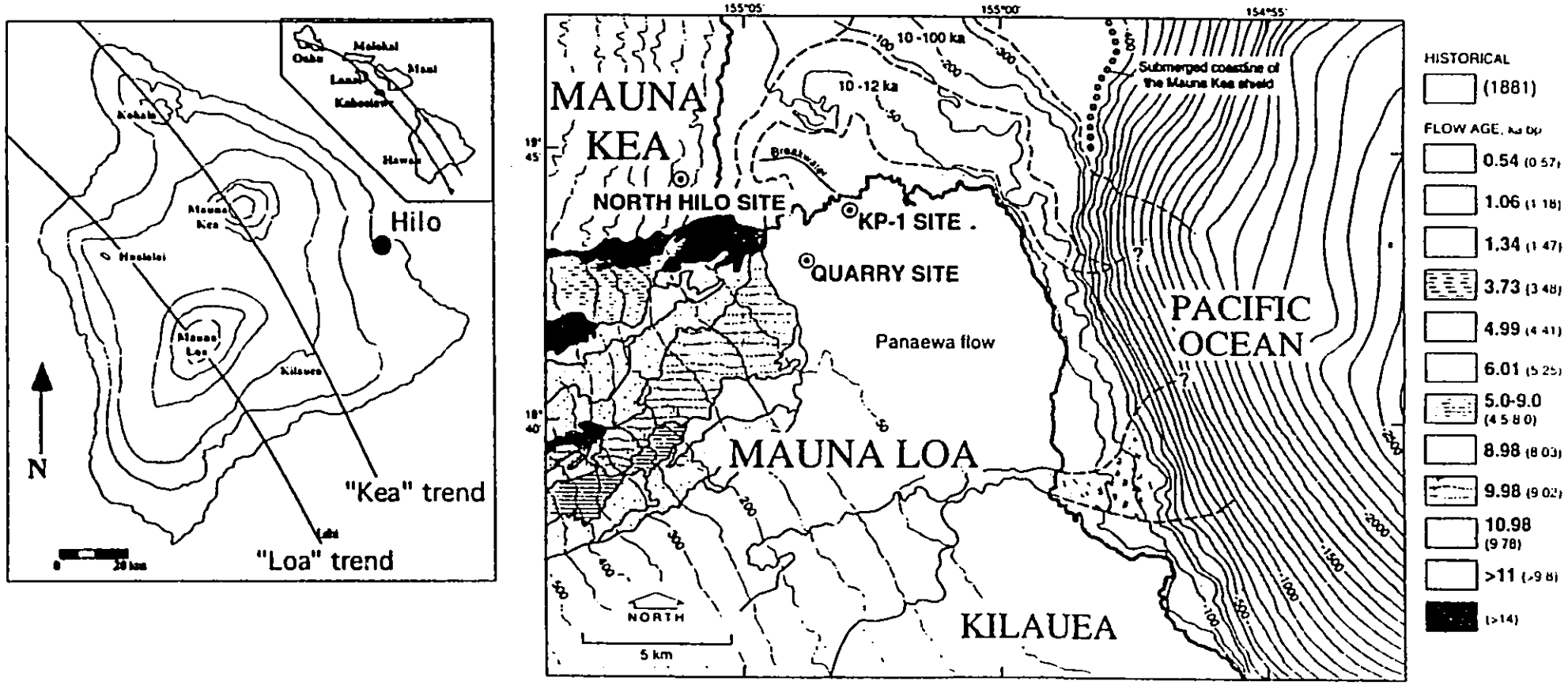


Figure 1a. Island Map showing general location of prospective drill sites. KP-1 denotes location of Pilot Hole; the "Quarry Site" denotes location of proposed drill hole.

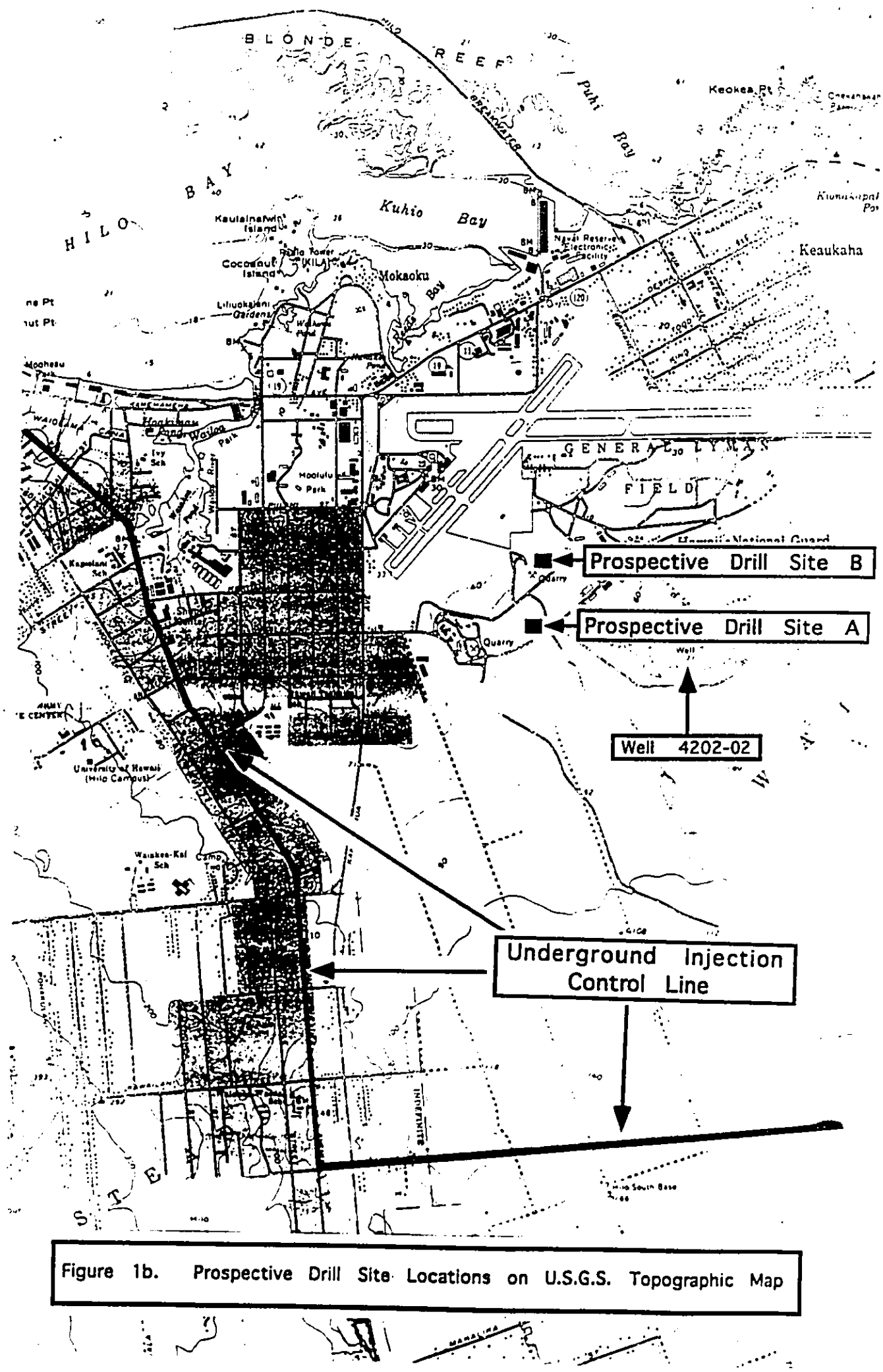


Figure 1b. Prospective Drill Site Locations on U.S.G.S. Topographic Map

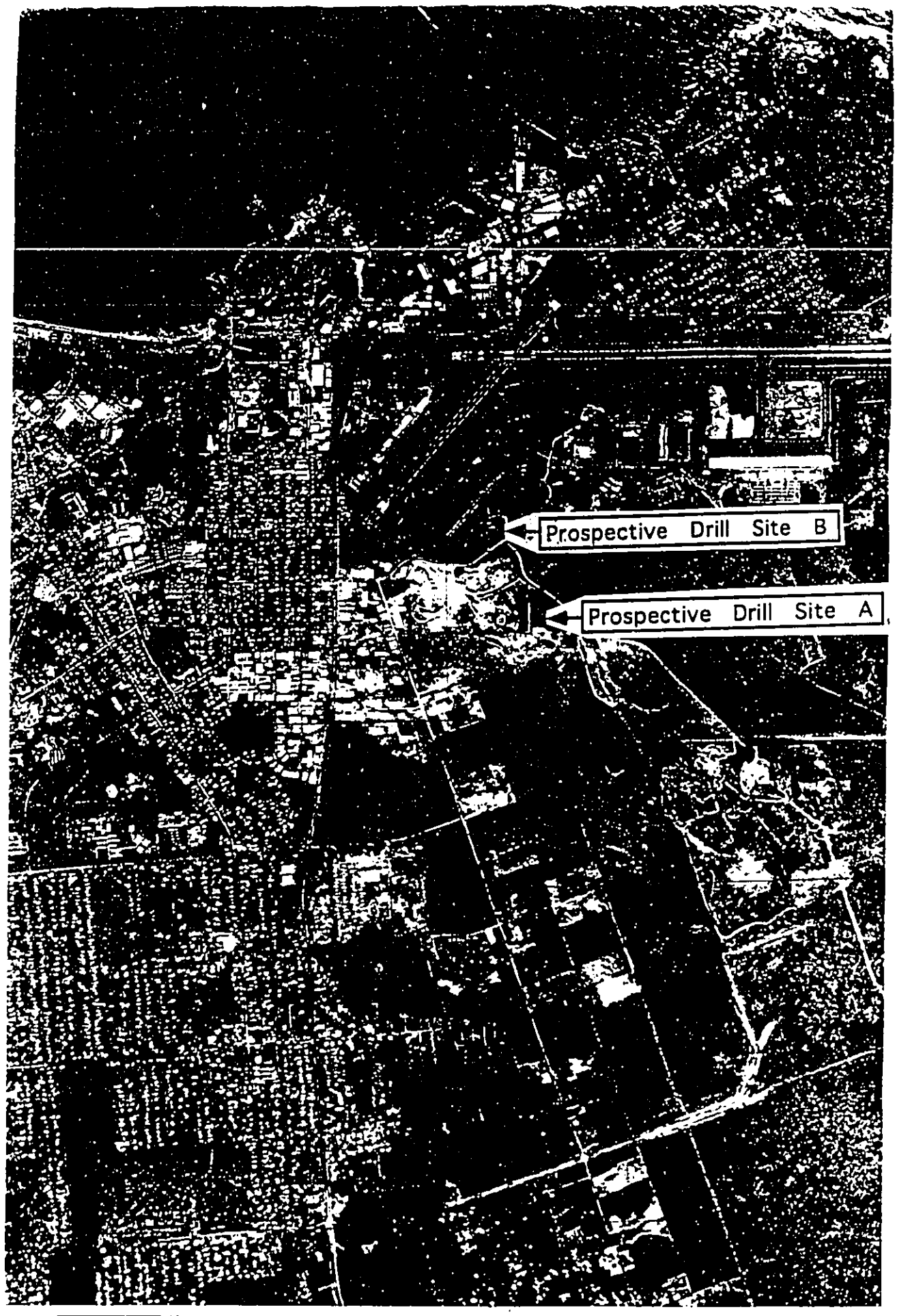


Figure 1c. Prospective Drill Site Locations on Arial Orthophotoquad

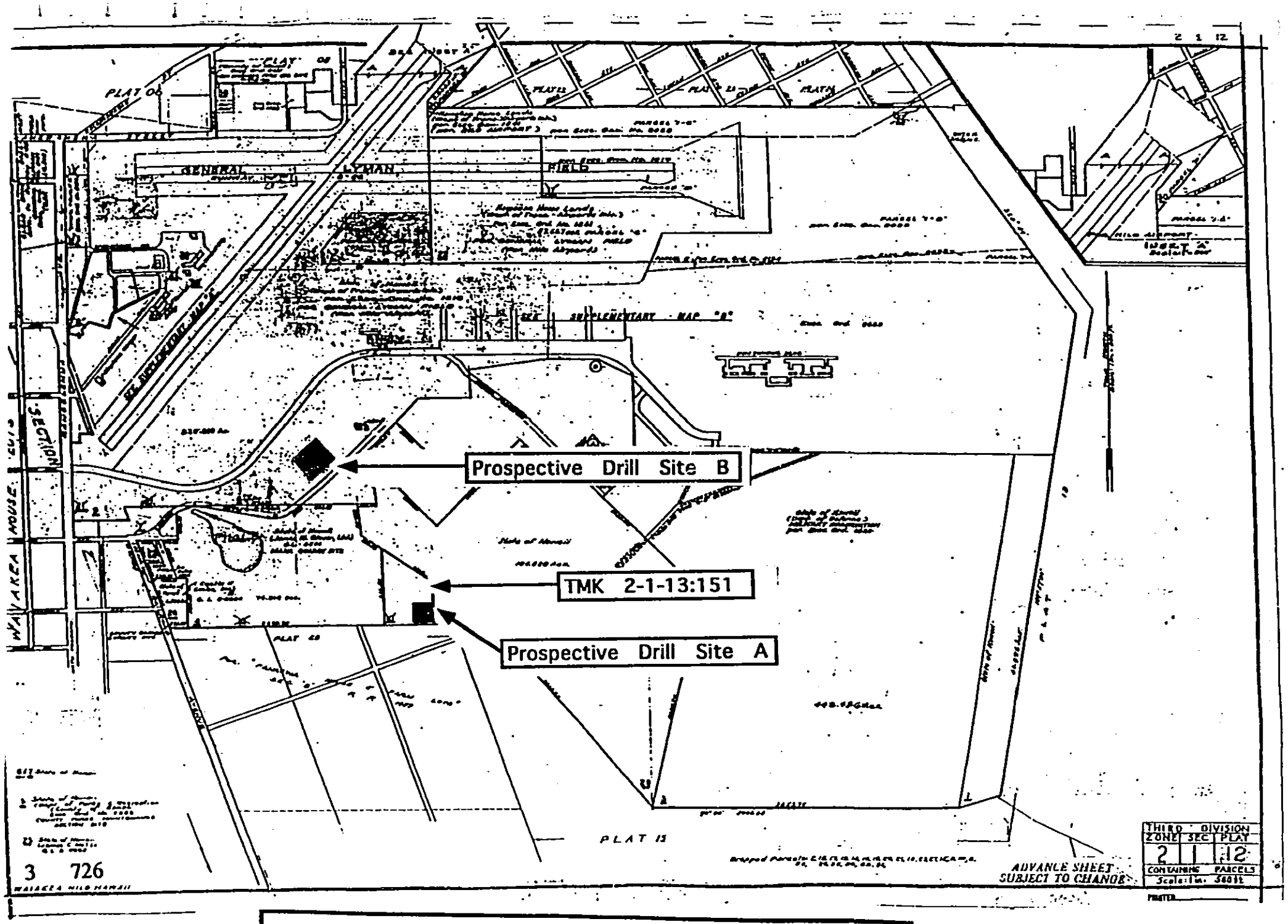


Figure 1d. Prospective Drill Site Locations on State of Hawaii Tax Map

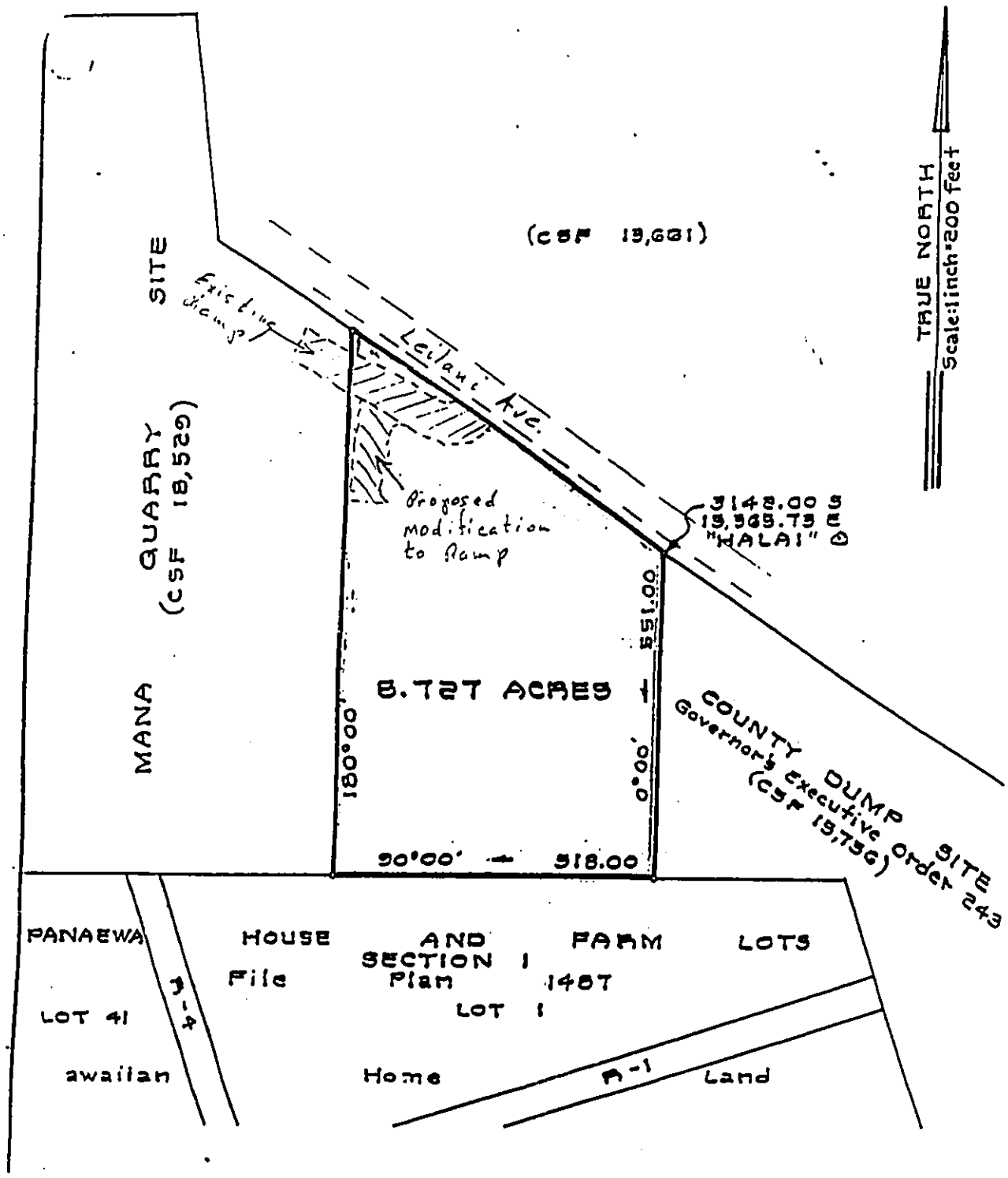


Figure 1e. Current and proposed configuration of access ramp to prospective drilling Site A.

JOB H-20T(88)
C. BK

TAX MAP: 2-1-13:181

SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES

EXHIBIT "B"

C. S. F. No. 20,798

STATE OF HAWAII

R.S.N. July 8, 198

DOCUMENT CAPTURED AS RECEIVED

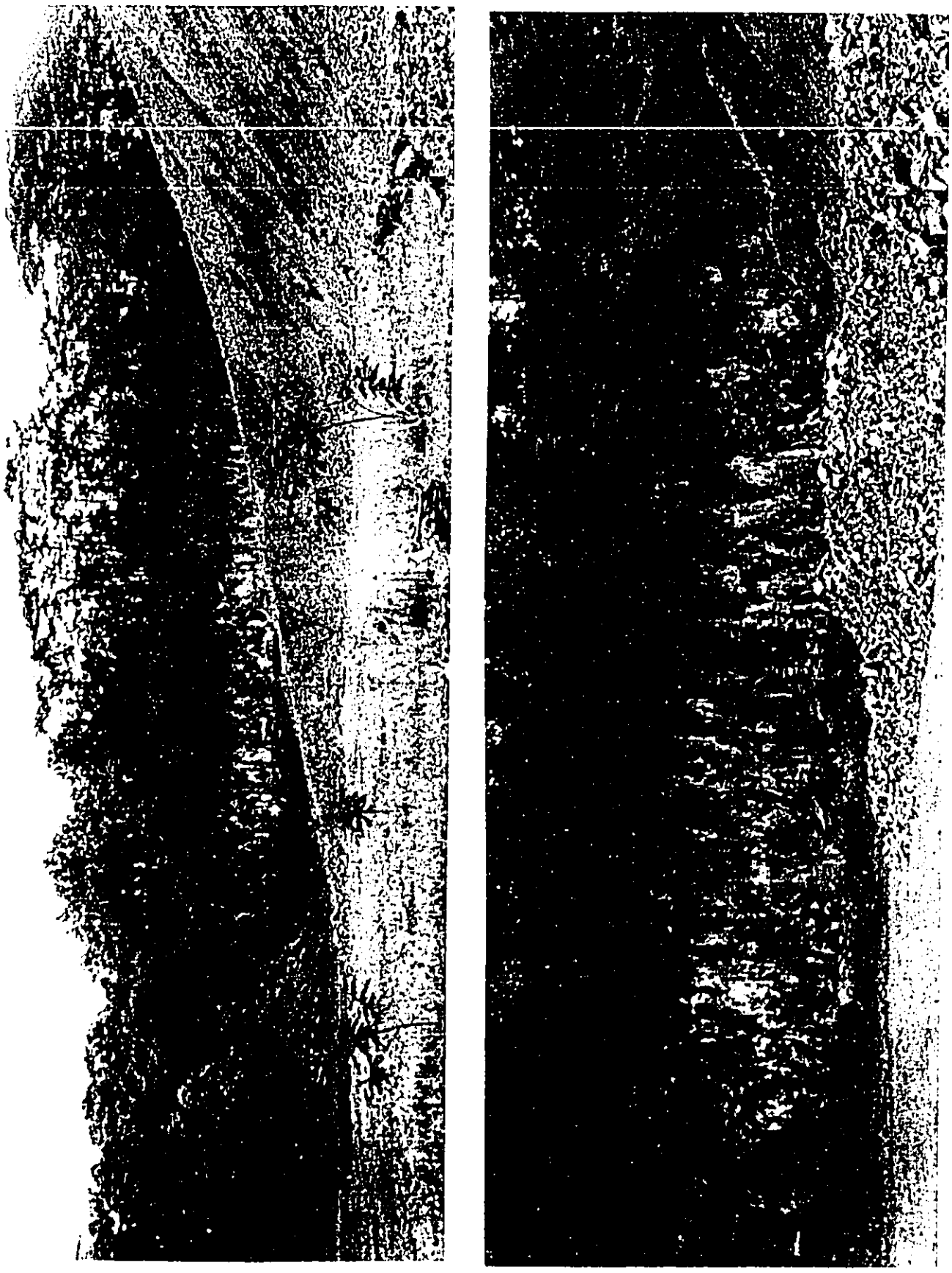


Figure 2 Photographs of prospective Site A

Figure 3 Photographs of prospective Site B

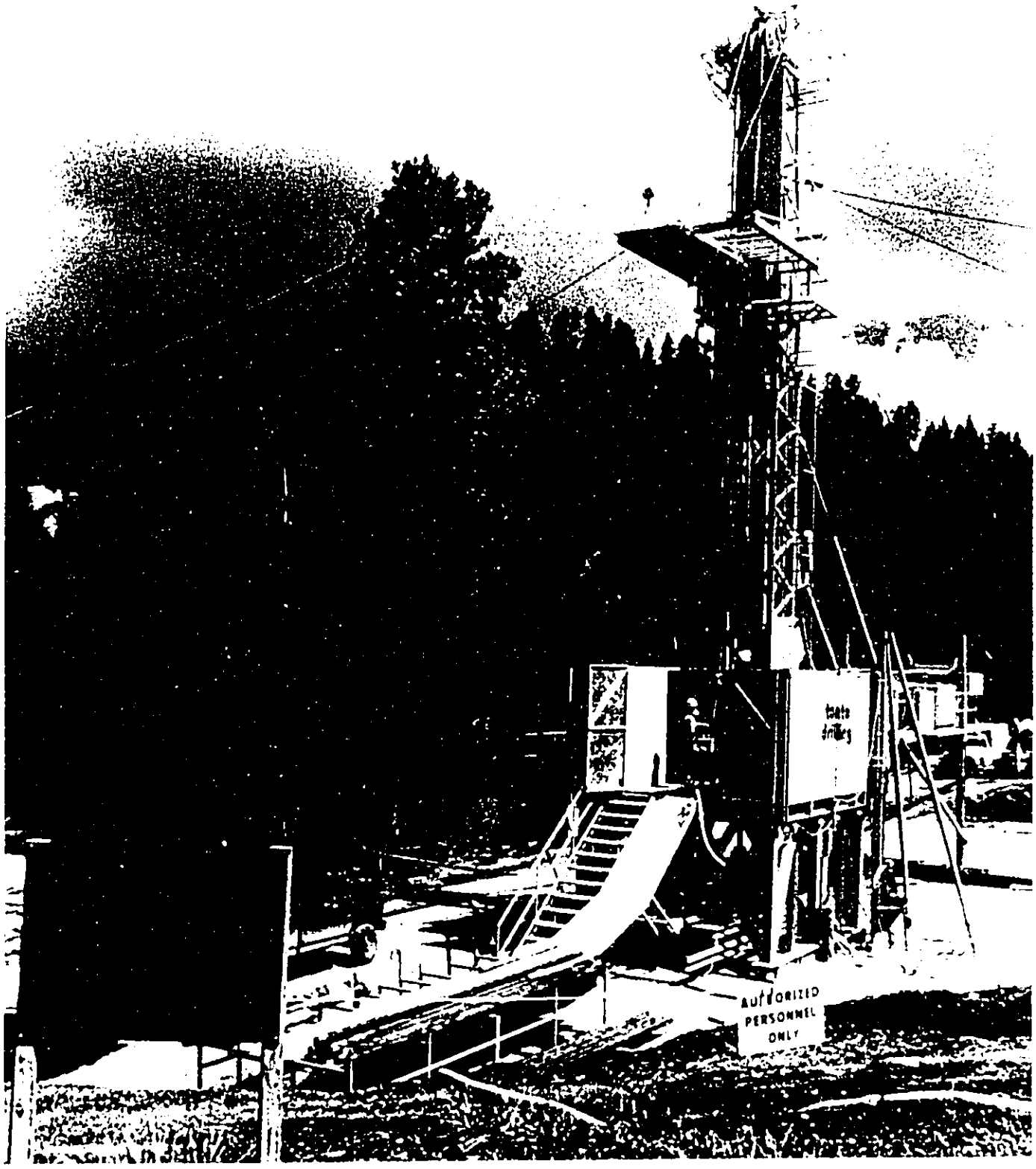


Figure 4 Photograph of Universal 5000 drilling rig as it will be assembled at site. Mast Height is ~80' (26 m).

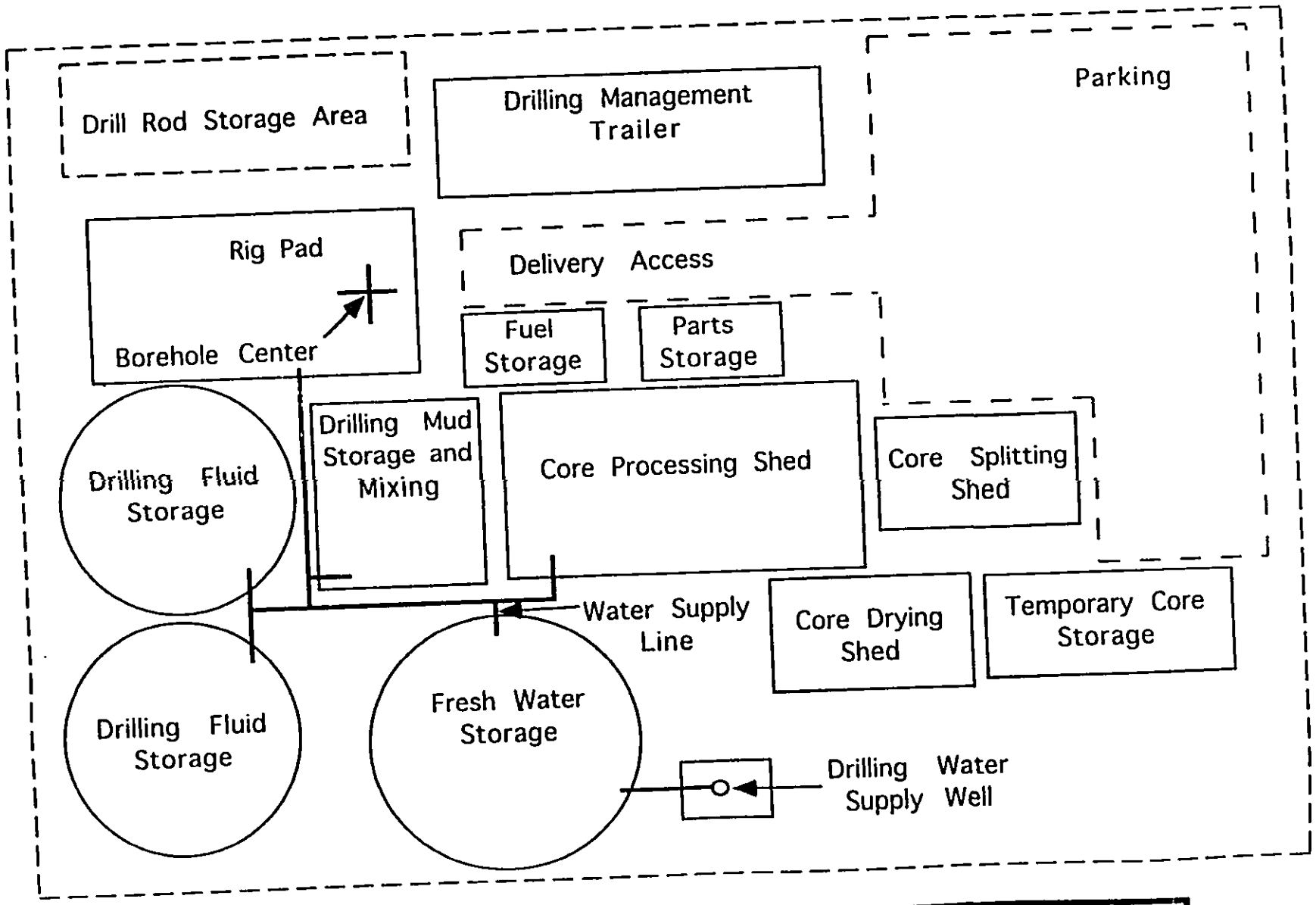


Figure 5 Generalized layout of drilling site and ancillary equipment

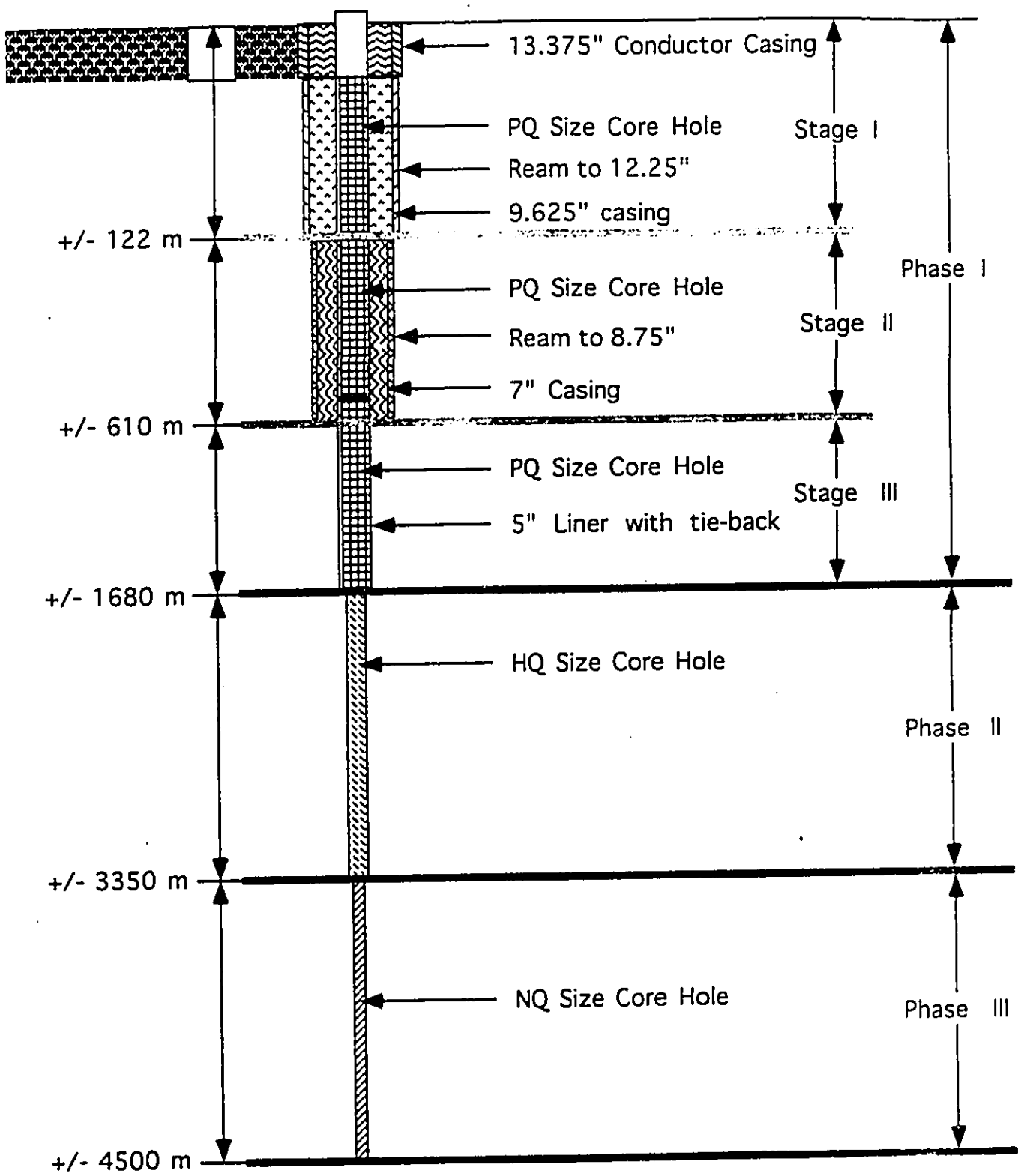


Figure 6 Diagram showing hole casing program and proposed phasing of the drilling effort

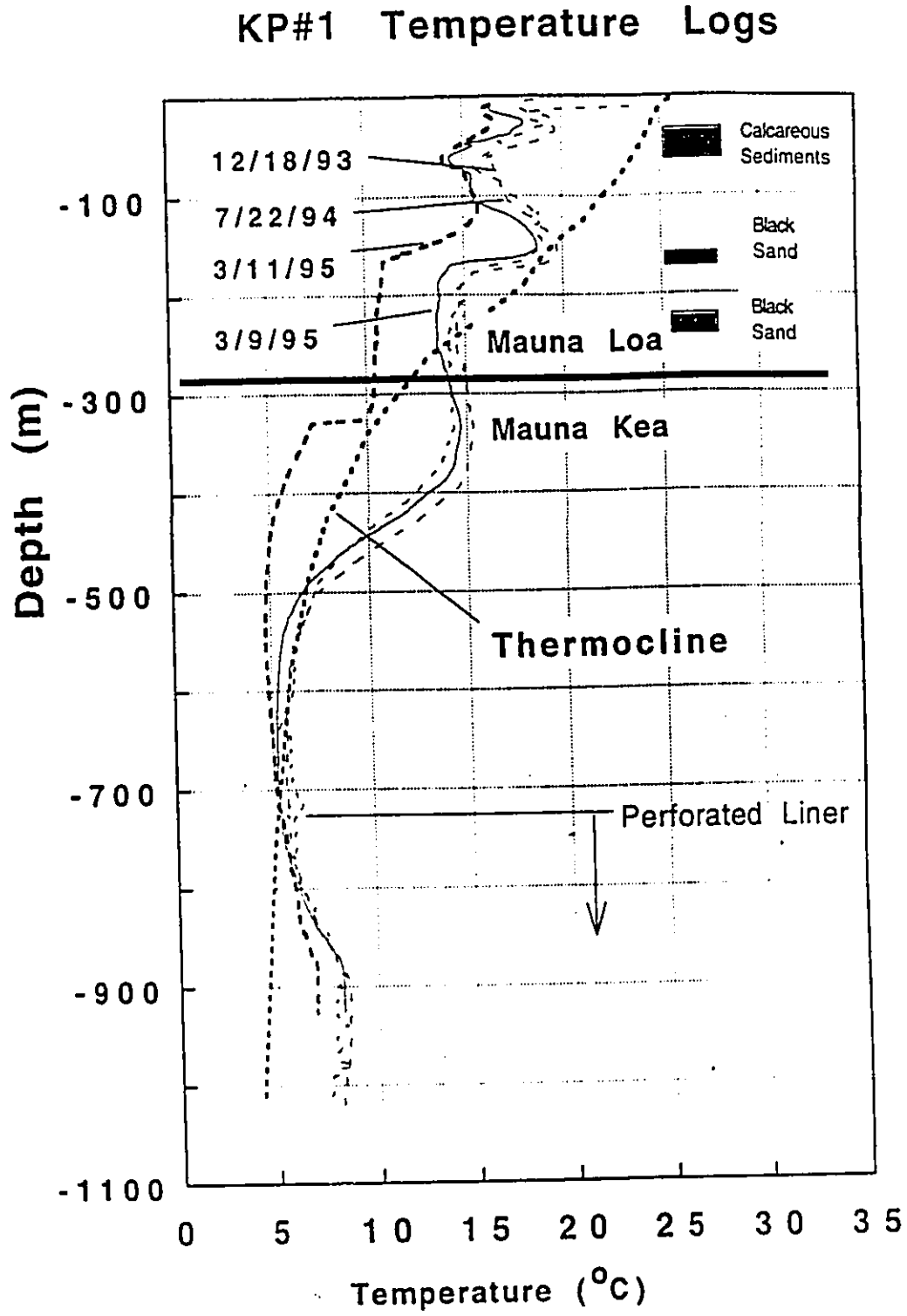
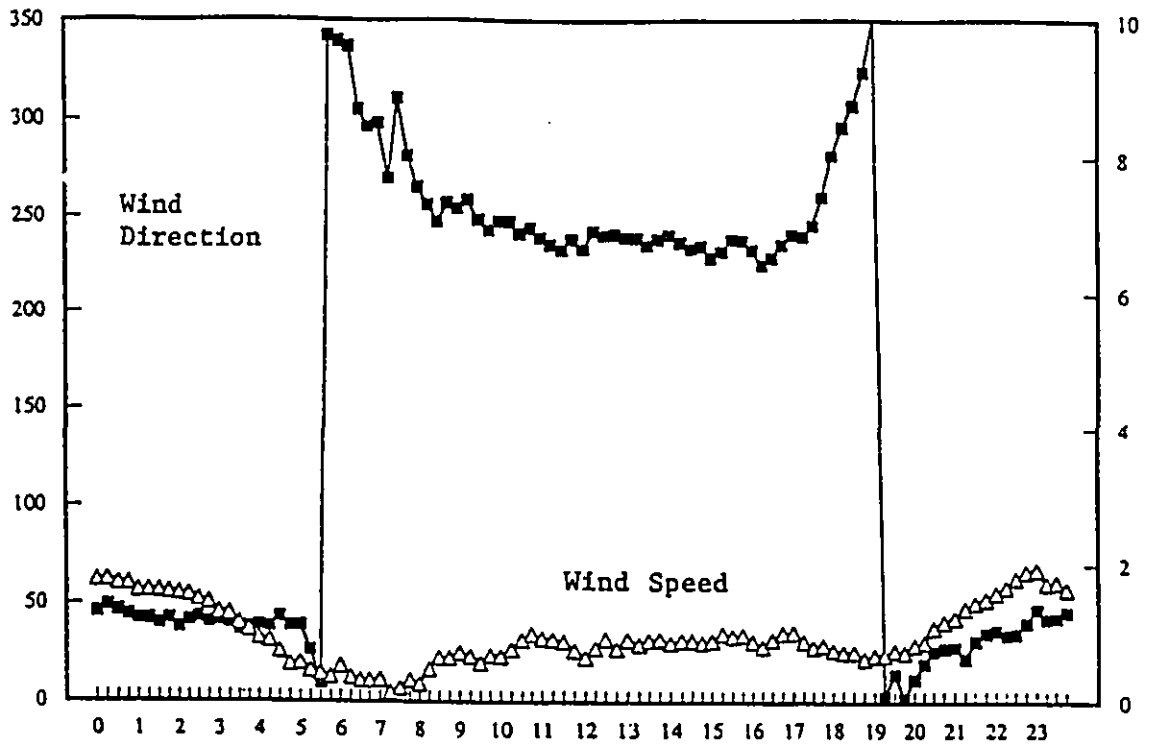


Figure 7 Temperature profile found in the KP-1 drillhole



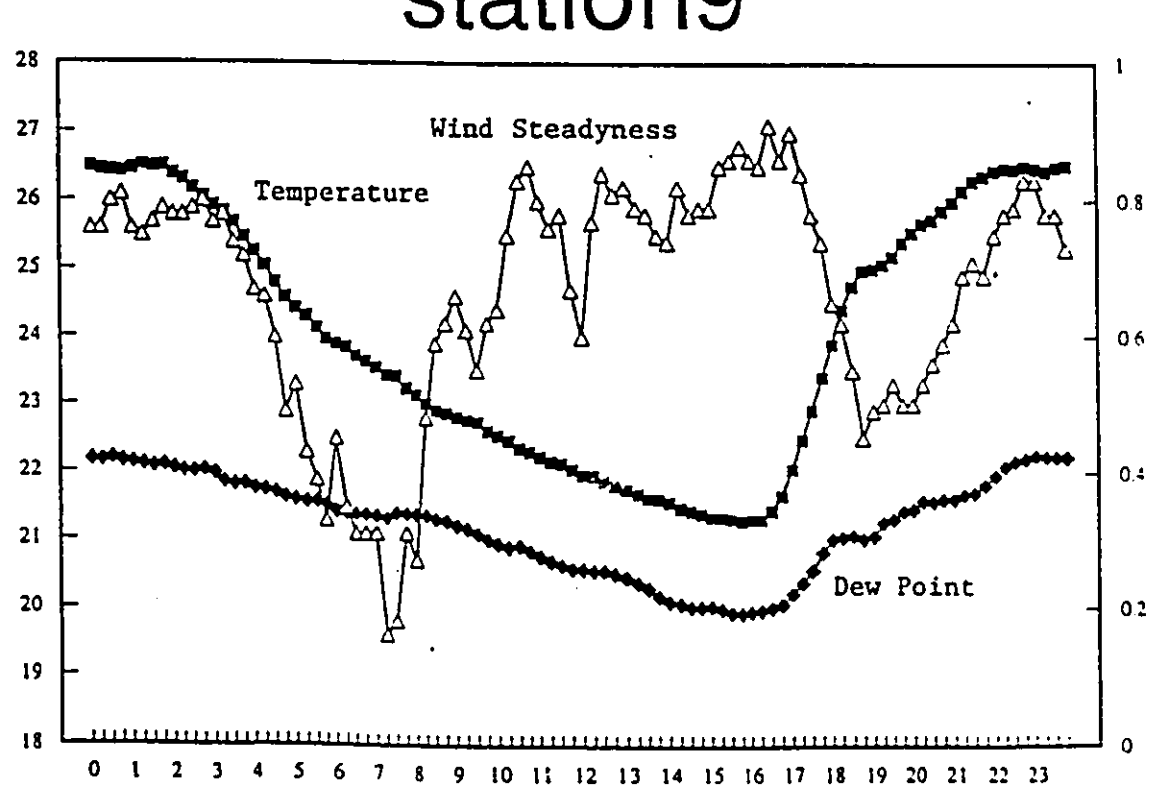


Figure 8 Plot of wind speed and direction for Hilo

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
Temperature °F													
Normals													
-Daily Maximum	79.5	79.0	79.0	79.7	81.0	82.5	82.8	83.3	83.6	83.0	80.9	79.5	81.2
-Daily Minimum	63.2	63.2	63.9	64.9	66.1	67.1	68.0	68.4	68.0	67.5	66.3	64.3	65.9
Precipitation (inches):													
Water Equivalent													
-Normal	9.42	13.47	13.55	13.10	9.40	6.13	8.68	10.02	6.63	10.01	14.88	12.86	128.15
-Maximum Monthly	32.24	45.55	49.93	43.24	25.01	15.50	28.59	26.42	14.36	26.10	35.72	50.82	50.82
-Minimum Monthly	0.36	0.58	0.88	2.93	1.18	1.80	3.83	2.66	1.59	2.40	2.33	0.28	0.28
Wind:													
Mean Speed (mph)	7.5	7.7	7.6	7.4	7.3	7.1	6.9	6.8	6.7	6.7	6.8	7.2	7.2

Table 1 Meteorological Data for Hilo Hawaii

PART X : RESULTS OF PROJECT ENVIRONMENTAL REVIEW PROCESS

10.1 Preliminary Draft Environmental Assessment

The above Environmental Assessment was distributed for agency review in early November, 1996. Comments received from the Department of Health recommended consultation with U.S. Army Corps of Engineers to determine whether permits were needed for the proposed project; this was done with a preliminary determination that no permits will be required. The Department also indicated that an air emissions permit may be required and suggested more detail be added to the assessment regarding the potential for air emissions from a possible geothermal system and mitigating actions to prevent these emissions; the text was modified to reflect these suggestions.

The County of Hawaii agencies' review did not identify any significant changes required for the Preliminary Draft.

The review conducted by the University of Hawaii Environmental Center suggested several changes in wording to clarify the intent of the text and suggested inclusion of a discussion of site access control (fencing/gates) and improvements to the discussion on water quality impacts and mitigation.

10.2 Draft Environmental Assessment

Nine letters were received from individuals or agencies after submittal of the Draft Environmental Assessment to OEQC for publication of the project summary and solicitation of public comment. In addition, comments were solicited by telephone from three other agencies and one individual to whom a Draft EA had been sent but from whom no written response was received. The comments received from individuals are summarized below with our responses to those comments; summaries of agency comments and our responses are presented in **PART XI : RESPONSE TO AGENCY COMMENTS** below; and copies of letters received and those sent in response are attached as Appendix C.

Mr. Byron Fujimoto, James Glover Ltd.:
Your comments related to the project are as follows:
Comment 1: The Jas. Glover Co. has no objections to the drilling project and supports the concept of the research program.
Response: Thank you for your expression of support. We believe that the drilling data recovered may prove to have significant value to the Hilo community and may provide useful data to your company and other lessees in the immediate area.

Comment 2: In order to provide a measure of security for the project site, Glover suggests that a 6' chain link fence and gate be installed along the common boundary between TMK:2-1-13:151 and TMK: 2-1-12:4.
Response: If the drilling project ultimately uses the site (Site A) on TMK: 2-1-13:151, we will definitely be installing some form of security fence around the site. In that event, we plan to meet with you or your operations manager to discuss the form of fencing that would be used and its final configuration.

Mr. Arthur Isemoto, President of the Lower Waiakea Houselots Association:
Comment 1: Negative impacts generated by the earlier 1993 drilling project in Keaukaha were not noted.
Response: Thank you for pointing this out. We definitely should have included a statement in the Draft EA regarding the level of impact from the earlier project (Please see Sections **7.1 Introduction**, page 19 and **7.5 Noise**, page 23). In fact, that project caused few adverse impacts during or after the drilling effort. Noise emissions were controlled at a level that did not generate any disturbance to the surrounding community; drilling activities did not detectably impact the water quality in Hilo Bay nor did it impact the groundwater quality in a shallow observation hole that was drilled within 30 m of the deeper well. As in the present case, the site chosen for the earlier project had been heavily impacted by prior activities and our site preparation work resulted in the removal and clean-up of a substantial amount of debris and "junk" that had been dumped at the site as well as the removal of a number of weedy tree species that had grown over the site. Socioeconomic impacts were transitory: we provided direct employment to two Hilo residents as well as about $50,000 in contract work to local companies during the project; we also provided freshwater to the residents of the homeless village that was located along the "Breakwater Road" during the project as well. Other positive impacts that came from the earlier work was a better understanding of the geology and the lava flow hazards in the Hilo area as well as new discoveries about the groundwater hydrology beneath this part of the island.

Comment 2: The negative impacts of quarrying work up to 1968 were not noted.
Response: You are again correct. Although we do not have any records of the condition of this part of Hilo prior to the quarrying activities, it is likely that the land surface would have been part of the coastal rainforest as exists further out beyond the Keaukaha area and the airport property. This type of forest would have been dominated by ohia and other native lowland plants and shrubs. As indicated in our Botanical Survey, the current condition of the abandoned quarry (Site B) is that it is heavily infested with non-native trees, grasses, and vines that have invaded the area since the quarrying operation was terminated. The botanical assessment of the abandoned quarry identified only a few (substantially less than 1% of the total number of plants) native species present in the area (Please see Section **7.1 Introduction**, page 19). In the Glover quarry, which is currently in use (Site A), most of the surface is barren, having been cleared when the rock was mined out of the formation.

Comment 3: You have summarized the plans for the Hawaii Scientific Drilling Project, the organizations involved, and the projected time table for the program.
Response: Your summary is generally correct although there appears to be one minor misunderstanding of the intended plan. We have evaluated two possible sites that are considered to be equally acceptable to us for the drilling program. However, we expect to drill the observation hole at only one of these sites (Please see Section **5.1 Summary of the Hawaii Pilot Hole Project**, page 6). Our intent is to proceed with the environmental review for both sites and, at the conclusion of that process, we will choose whichever site appears to be most environmentally acceptable. If the review process indicates that both are equally acceptable, then we will choose the site for which our site preparation costs are expected to be smallest.

Mr. Isami Segawa, President of the Upper Waiakea Houselots Association, telephone conversation: After review of the Preliminary Draft Environmental Assessment, he indicated that, with the activities occurring in the Airport Quarry (Site B) or in the Mana Quarry (Site A), he did not believe that the project would have any significant impact on the residents of the Upper Waiakea area.

10.3 Final Environmental Assessment (future use)

PART XI : RESPONSE TO AGENCY COMMENTS

Two agencies to whom Draft EA were sent, the **County of Hawaii Planning Department** and the **State Department of Land and Natural Resources**, responded that they had no comments to make or objections to the project as described in the Draft EA.

The **Hawaii County Department of Water Supply**:
Comment 1: Well No. 4202-02 is located within Tax Map Key No. 2-1-12:9 at latitude 194240 and longitude 1550252 is owned by the Department of Water Supply and is presently not in use.
Response: Thank you for providing the number and location of this well; this information will be included in the Final Environmental Assessment.

The **Department of Hawaiian Home Lands**:
Comment 1: In Description of the Action, you suggested that we should include the estimated cost of the project and source of funds for the work.
Response: We appreciate the suggestion and will include that information in the Final EA (see Section **5.1 Summary of the Hawaii Pilot Hole Project,** page 6). The total cost of the program is about $11 million with about $4 million to be used for the drilling and $7 million to be devoted to scientific analyses of the cores and experiments that will be conducted in the hole. The source of funds for the work will be the National Science Foundation, which has given approval for about $9.5 million and, and the International Scientific Drilling Program which has indicated that they will provide the balance.

Comment 2: Further mitigative steps should be taken if complaints of excessive nighttime noise are received.
Response: You are correct. One of the primary (and most effective) mitigation actions we have taken for noise control is the choice of the prospective drilling sites in locations as far as possible from the residential areas of Hilo and their location in quarries where the noise source will be surrounded by higher ground; a further advantage is that the residential areas are located upwind of the site during the quietest night-time hours (when drainage winds from Mauna Loa and Mauna Kea will blow from the west north-west toward the south east) which will further reduce noise propagation into the community from the project site. We believe that noise from our operations at either of the prospective locations will be undetectable in the surrounding communities. Nonetheless, we will be meeting with residents from the nearby communities prior to and after the start-up of the project to determine whether any disturbance is being generated; if so, then we will require the contractor to install additional high-performance mufflers on the rig and other power equipment and to install noise muffling screens around the primary noise generators on the site. Should these efforts be inadequate to alleviate the disturbance, then a noise consultant will be hired who will be asked to make more sophisticated modifications to the site or equipment that will eliminate the disturbance (Please see section **7.5 Noise**, page 24).

We note, too, that the prior drilling project was located within about 200 m (600 ft.) of the Keaukaha community with a nearly direct line of sight between the rig and the community. We operated at that site for approximately seven weeks without generating a single noise complaint. During the course of that project we inquired directly of the closest members of the community whether our noise caused them any problems; none of the individuals we spoke with indicated that they could detect a noticeable noise from the project at their homes (Please see Section **7.5 Noise**, page 23). The current project will be located more than 1000 m away from the nearest residence and will be surrounded by rock walls; we are certain that we will be able to minimize the noise emissions from our activities to a level that will not be noticeable by the community even during nighttime hours.

Comment 3: You have endorsed our intent to provide jobs to the Hawaii community.
Response: As in the prior project, we intend to hire as many staff for the drilling and scientific work from the local labor pool as possible. We hope that this project will enable the younger staff and entry level workers to obtain experience that will ultimately lead to permanent employment.

Comment 4: You ask that we confirm that the duration of the project will be at least 10 years and that recycling of the well as a source for domestic or agricultural water is not likely.
Response: At the present time, we are expecting to conduct drilling and testing activities in the well for a period of about six years at which time we will install scientific equipment in the well (e.g. seismometers or dilatometers) that will enable us to monitor the volcano more effectively; the duration of data collection from those instruments is likely to be for a period of at least several (5 to 10) more years. We would also point out that, by the time the well is completed, the surface diameter of the casing will be about 5" and the upper part of the hole, where fresh water would likely be located, will be cased with three strings of casing. As a result, an expensive plugging job (to isolate the bottom 14,000 ft. of hole), and an expensive perforation job (to gain access to the shallow water resource) would have to be conducted before it would be possible to extract even a minor amount of water from the small diameter of the well casing. In summary, the hole that will remain at the end of the drilling program would have a minimal (if not a net negative) value as a water well when compared with other water sources in the Hilo area.

State of Hawaii, Department of Health (comments received on Preliminary Draft EA after submission of Draft EA to OEQC):
Comment 1: Depending on the size and emissions, the drilling rig's diesel engine may require an air permit.
Response: We are aware of the possibility that we will need to obtain an air permit for the diesel engines that will be used for the project. We will submit a formal request for a determination on that issue in several months after we have selected a specific drilling contractor and have firm data on the size of the power train supplying the drilling rig, mud pumps, and other ancillary equipment at the site. This possible requirement has been

included in Section **1.4 Planned Agency Submittals** on Page 2 of the Final Environmental Assessment.

Comment 2: The EA should address the potential for air emissions and mitigative measures that will be taken should a geothermal resource be encountered during drilling operations.
Response: As indicated in the Final EA (Section **7.3 Air Quality**, pg. 20 and 21), we believe that the likelihood of encountering a geothermal system during drilling is extremely small for a number of reasons. In summary these include: 1) geothermal systems in Hawaii are found in areas of rift zones and calderas where magma has been intruded underground where is slowly cools; the prospective locations are located as far as possible away from any known evidence of rift zone (or caldera) intrusive activity on the island and, hence, should be free of any significant intruded magma. 2) The recent drilling project at Keaukaha, which penetrated to a depth of 3,464 ft., encountered a negative temperature gradient (the temperature decreased with depth over most of the hole) with a minimum temperature of about 46°F; this further substantiates our belief that an active hydrothermal system is not present below the present site. It should also be understood that the deeper portion of the hole (below about 1500 ft.) will be drilling into lava flows from Mauna Kea volcano. These flow units were shown by the earlier drilling to be at least 100,000 years to more than 400,000 years old; we believe that the much greater age of these lavas further reduces the likelihood of encountering any significant residual heat in the project area. Nonetheless, we will be conducting temperature surveys in the hole during the drilling exercise that will allow us to measure the maximum downhole temperatures as we progress to depths greater than 3,500 ft; we will also be periodically performing detailed temperature surveys in the hole over the entire depth drilled. This will allow us to continually project temperatures downward and to anticipate any unexpected temperature increases and prepare for elevated temperatures if they are encountered. The drilling program will also be recovering a continuous sequence of core from the hole which will be analyzed as the hole is being drilled; this will provide us with additional information with which to assess the likelihood of encountering current or fossil hydrothermal systems. Further, well control equipment will be installed at the wellhead that will be able to prevent the release of any fluids during drilling if a high temperature or high pressure zone is encountered. We have also designed the well to be able to withstand any reasonably expected pressures that could be encountered in the formation during the drilling process; hence, in the unlikely event that we do encounter unexpectedly high temperatures, we believe that we will be able to prevent the emissions of any fluids or gases from the well. Finally, we will have a drilling engineer on site or on call in Hilo during the entire drilling process; if conditions develop that suggest that a threat of elevated temperatures or pressures exists in the well, he will be able to advise us of any changes we need to make to ensure that discharges from the well can be precluded.

Comment 3: The applicant should contact the Army Corps of Engineers to determine whether a federal permit is required for the project.

Response: The Army Corps of Engineers has been contacted and has reviewed the Draft Environmental Assessment for the project. They have indicated that there are no issues related to the proposed work that falls within their jurisdiction.

Comment 4: A National Pollutant Discharge Elimination System (NPDES) permit is required for certain types of discharges to waters of the State and, if required, an NPDES permit should be obtained.
Response: We have discussed this issue with staff of the Department of Health and it is our understanding that an NPDES permit would be required if these types of discharge are expected to flow into any surface water body or into a storm drain that would lead to a surface water body. Both prospective drilling sites are in closed topographic depressions (quarries) that lie 5 m to >10 m below the local grade level and there are no surface water bodies that flow into or through either area. Further, we do not expect to generate any of the types of water discharge listed (storm water related to construction activities, storm discharge from industrial activities, construction dewatering, cooling water discharges, groundwater remediation activities, and hydrotesting water) that could be released from the site into any surface water body near the
prospective sites. Nonetheless, we will meet with the Clean Water Branch staff to further brief them on the project and confirm the absence of any significant impact from the proposed project.

State of Hawaii, Department of Health:
Comment 1: Drilling activities must comply with provisions of the Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control."
Response: As indicated in the Draft EA, the specific sites under consideration for the project were chosen to minimize its potential impacts on the surrounding communities. Included in our consideration of both sites was the advantage of having the drilling activities occur in a topographic depression (an excavated quarry) that will greatly reduce the radiation of noise off the site and into the community. Nonetheless, we are aware of the new regulations governing noise emissions from drilling and construction activities and have requested copies of Chapter 11-46 and copies of the application documents required for a noise permit. We expect to meet with DOH staff to discuss the requirements for the proposed project and to submit all necessary permit applications or variance applications (Please see Section **1.4 Planned Agency Submittals**, page 2 and Section **7.5 Noise**, pages 23 and 24).

Comment 2: The applicant should contact the Army Corps of Engineers to determine whether a federal permit is required for the project.
Response: The Army Corps of Engineers has been contacted and has reviewed the Draft Environmental Assessment for the project. They have indicated that there are no issues related to the proposed work that falls within their jurisdiction.

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State of Hawaii, Office of Environmental Quality Control:
Comment 1: Deep drilling into Hawaiian volcanoes may have issues relating to native Hawaiian culture; you suggest that we consult with the Office of Hawaiian Affairs to identify any concerns and mitigate any impacts.
Response: We are aware of the potential for conflicts that might arise from the drilling program. We have, however, taken a somewhat different approach than that suggested and have directly consulted with members of the Hawaiian community on the Big Island. Specifically, we have discussed the project extensively with Mr. Patrick Kahawaiolaa, a very active member of the Keaukaha community who is quite concerned with issues related to the use of Hawaiian lands. We have also briefed Ms. Pualani Kanahele, a widely respected expert on issues related to Hawaiian history and culture, and specifically asked if there might be any reason for concern in the Hawaiian community over the proposed drilling project. Neither individual indicated any overriding concern about the proposed activity and only requested that we take care not to adversely impact individuals in the Hawaiian community that may use either of the prospective locations for purposes of gathering of natural materials. We have also provided a copy of the Draft Environmental Assessment to the Office of Hawaiian Affairs for their review and the only issue that they have raised in our discussions of the project has been that we acknowledge that the parcels under consideration for the project are former Crown (ceded) lands (Please see Section **7.8 Socio-Economic**, page 24).

Comment 2: Lighting on the rig may impact flying animals; you suggest that we consult with U.S. Fish and Wildlife Service regarding this matter.
Response: We are aware of this issue. As indicated in the Draft Environmental Assessment, a biotic survey was conducted at the site and no evidence of native bird nesting was observed; it was also indicated that this area was not in a flight corridor that is known to be frequented by night-flying birds. It is further noted that the contractor supplying the drilling services will be required to shield all rig (working) lights to avoid

adverse impacts on the airport operations and on any night-flying birds. We have provided a copy of the Draft EA to the U.S. Fish and Wildlife Service and have discussed with them the likelihood of our operations causing an adverse impact; they have indicated that they did not anticipate any impact on night-flying birds.

Comment 3: What is the potential for any release of sulfur gases during deep drilling activities; are there any regulations pertaining to release of gases during deep drilling activities; what are the contingency plans in the event of any gases being released.
Response: The primary sources of (non-biogenic) sulfur gases in Hawaii are associated with high temperature (>250°C) hydrothermal systems. We believe that the potential for encountering such a system, and the possible release of sulfur gases from it, is vanishingly small. As indicated in the Draft EA, the general location of the prospective drilling sites is as far away as possible from any known evidence of a rift zone or a caldera; these features are the only known sources of sustained, elevated subsurface temperatures in Hawaii. The earlier project encountered a negative temperature gradient with depth, with a minimum temperature of ~46°F, which further substantiates the absence of a nearby hydrothermal system. The rocks into which we will be drilling (at depths greater than 3,500 ft.) will be older than about 400,000 years, further reducing the likelihood of encountering substantially elevated temperatures. Further, the well will have pressure control equipment installed well before the hole depth exceeds that already drilled (and found to be cold in the prior research project); downhole temperature measurements will be made periodically to allow us to assess any possible increase in temperature and to determine whether further drilling can be done safely and without any significant danger of encountering temperatures or pressures that would exceed the capacity of the rig or the wellbore casing. If it is determined by the drilling engineer that a significant threat exists from the downhole temperatures, the drilling program will be modified to eliminate that threat or the drilling program will be suspended until it can be eliminated (Please see Section **7.3 Air Quality**, page 20).

Comment 4: Materials used in the drilling process are expected to be discharged into the shallow aquifer; please show the location of the discharge in relationship to the Department of Health's Underground Injection Control Line; would an Underground Injection Control Permit be required for this discharge.
Response: The materials that will be discharged into the shallow aquifer will be identical to, although smaller in quantity than, those typically released during the drilling of a water well. In discussions with the Drinking Water Branch of the Department of Health they have indicated to us that UIC permits are primarily intended to control wastewater injection and that the materials used in the drilling of a well are specifically excluded from the UIC regulations. We have also obtained a copy of the map used in UIC determinations and have included a copy here; the UIC line traces Kilauea Avenue which, at its closest point, lies about 2.5 km southwest of the prospective project sites and parallels East Palai Street approximately 3.5 km south of the prospective sites. Hence, the proposed project is located well below (makai), and down-gradient of the UIC line.

Comment 5: A shallow well will be drilled to obtain up to 35,000 gallons of water per day; what is the sustainable yield of the affected shallow aquifer; how would water quality an quantity be affected by this well drilling project.
Response: The freshwater resource in this area is derived from rainfall recharge into the Mauna Loa slope and is estimated by the U.S. Geological Survey to be on the order of billions of gallons per day. The withdrawal of 35,000 gallons per day from this aquifer for the relatively short period of time our drilling will be done will not significantly affect this aquifer (Please see Section **7.4 Water Quality**, page 22).

Comment 6: The groundwater below the project site may contain contaminants from the County Solid Waste facility; what is the overall impact of using and subsequently discharging this potentially contaminated water; what are the proposed mitigation measures.
Response: The drilling process will entail withdrawing freshwater from a shallow well, using it to mix clays and organic polymers to form a drilling fluid which will be almost immediately returned to the formation as the fluid is circulated down the drill string and washes the drill cuttings away from the bit. During the shallow interval of the hole the net impact of this process, as it regards any possible pollutants that might be present in the shallow water would be either zero (water is pumped out of one well and into another a few hundred feet away) or to dilute the trace contaminants by mixing with water deeper in the aquifer. During deeper drilling (>200 ft.) the drilling process would be removing the (potentially) contaminated water from the shallow aquifer: as indicated in the Draft EA, a series of casing strings will be cemented into the hole at a range of depth intervals and, as drilling penetrates beyond the casing depths, the fluids removed from the shallow aquifer will be lost to the formation only below the depth of the casing string. Hence, if the shallow water is contaminated, that water that is withdrawn from the shallow aquifer will be effectively injected below the shallow freshwater lens and into the underlying saltwater where it will be further diluted with salt water and will remain separated from any possible drinking water supplies (Please see Section **7.4 Water Quality**, page 22).

We do not believe that any mitigation measures need be applied to the removal of potential contaminants from the shallow freshwater system.

Comment 7: Please provide reasons for supporting the determination based on an analysis of the significance criteria in Section 11-200-12 of the Hawaii EIS Rules.
Response: We are aware of the requirement to provide such an analysis and have included this in the Determination section of the Final Environmental Assessment.

Mr. Luis Manrique of the Office of Hawaiian Affairs, telephone conversation:
After review of the Draft EA, Mr. Manrique noted that the parcels of land under consideration for the project drilling sites are located on former Crown (or ceded") lands and asked that we note this in the Final Environmental Assessment. He was queried whether there might be other cultural concerns regarding the project but he did not identify any.

U.S. Department of Transportation, Federal Aviation Administration:
Comment 1: Because our project is located near the Hilo International Airport runway, it is requested that the Hawaii Scientific Drilling Project submit an FAA Form 7460-1 "Notice of Proposed Construction or Alteration" for further review of the specific elements of the project.
Response: We have had extensive discussions with Mr. Larry Balbarino, the State of Hawaii Airports District Manager for the Hilo International Airport about our project and have been notified of this requirement. It is our intent to submit the FAA Form 7460-1 after we have selected a contractor and have the exact dimensions (elevation) of the drilling rig mast that will be required for submission of this form. Nonetheless, we appreciate your bringing this requirement to our attention; we see that we did not properly cite this planned submission in the Draft Environmental Assessment and we will correct that oversight (Please see Section **1.4 Planned Agency Submittals**, page 3).

Mr. Don Palaski, U.S. Department of the Interior, Fish and Wildlife Service: Reviews by his agency did not identify any concerns regarding the impacts of the proposed project on any aquatic or wildlife resources in the Hilo area.

Ms. Lolly Silva, Army Corps of Engineers: Reviews of the Draft Environmental Assessment indicate that there are no issues that fall under the jurisdiction of the Army Corps of Engineers.

APPENDIX A

Botanical Assessment Survey

FLORA AND FAUNA REPORT FOR HAWAII SCIENTIFIC DRILLING PROJECT HILO, HAWAII COUNTY

PREPARED FOR:

SCHOOL OF OCEAN & EARTH SCIENCE & TECHNOLOGY
UNIVERSITY OF HAWAII AT MANOA
HONOLULU, HAWAII

PREPARED BY:

GRANT GERRISH, Ph.D
NATURAL SCIENCES DIVISION
UNIVERSITY OF HAWAII AT HILO
HILO, HAWAII

October 21, 1996

TABLE OF CONTENTS

FLORA AND FAUNA REPORT FOR
HAWAII SCIENTIFIC DRILLING PROJECT
HILO, HAWAII COUNTY

EXECUTIVE SUMMARY

This study of the terrestrial flora and fauna of two alternative sites proposed for the Hawaii Scientific Drilling Project supports an Environmental Assessment being prepared by the School of Ocean & Earth Science & Technology. This flora and fauna study was made up of a literature review of appropriate documents and references and a biological field survey of the proposed sites and their proposed access routes. The proposed action is to establish access to the selected site, prepare the site and use it for drilling and associated research activities.

The two surveyed sites are in the vicinity of the Hawaii County Landfill and General Lyman Field (the Hilo Airport). The 'Mana Quarry Site,' is part of a quarry that has been mined down to the deepest practical depth. The 'Airport Site' on the southeast side of the Airport Access Road.

A total of 70 plant species were recorded at the two sites. Of these, 63 are alien species and 7 are native. The alien species that dominate the vegetation at and around both sites are very common weedy species of the Hilo area. The vegetation on the Mana Quarry site is a very sparse cover of alien grasses and herbs, with a few alien shrubs and tree saplings. Most of the substrate is barren rock. The vegetation on and around the Airport Site is predominantly weedy alien species. A very few individuals of the native ohia-lehua and hala grow near the proposed drilling site.

No endangered or rare native plants were found at either site, nor are any known to occur or to have occurred within the habitat types of the two sites. The only native bird or mammal observed on or near the two sites was the indigenous Kolea or Pacific Golden Plover. No endangered or rare birds or mammals were observed during the biological field survey, nor does the study area possess unique resources likely to attract such species. The 'Io (Hawaiian

Hawk) or the Hawaiian Hoary Bat may at times occur within the vicinity. Both of these species are Endangered, but both are well-adapted to human-altered landscapes. Two protected species of night-flying seabirds, the'Ua'U (Dark-Rumped Petrel) and the 'A'o (Newell's Shearwater) have been reported flying through the Hilo area and may pass above the sites. No streams or other bodies of open water or distinct wetlands were found within the two sites or their near vicinities.

In general, the flora and fauna of the two sites do not require any special protective measures. In the unlikely event that construction crews encounter an 'I'o nest, construction activity should be halted and the U.S. Fish and Wildlife Service contacted. All lighting on or near the site should be shielded to conform to County of Hawaii standards to prevent harm to night-flying seabirds.

INTRODUCTION

A study of the terrestrial flora and fauna of two alternative sites proposed for the Hawaii Scientific Drilling Project was conducted by biologist, Grant Gerrish, Ph.D. This biological study supports an Environmental Assessment (HRS 343) being prepared by the School of Ocean & Earth Science & Technology. The Environmental Assessment is part of the selection process that will choose one of the two sites for a proposed scientific drilling program.

It is understood that the proposed action is to establish access to the selected site, prepare the site and use it for drilling and associated research activities. This proposed action would include grading the selected site to construct a location for the drilling rig, associated drilling activities and on-site research. It is proposed that the site would be used for drilling and research activities for about six years. Following use, the site would be restored by removal of all materials, including drill cuttings, if any, and regrading of the site.

This flora and fauna study is limited in scope to the potential direct impacts of the proposed action on the site or in the near vicinity of the site. This study specifically does not evaluate impacts on biological resources, if any, that may be caused by changes to the ground water.

METHODS AND SITE LOCATIONS

METHODS

This flora and fauna study was made up of a biological field survey of the two alternative sites and a literature review of appropriate documents and references.

The biological field survey consisted of a walking survey through the two sites. The small areas of the two allowed thorough observation. This survey covered the proposed sites themselves, a 50 foot (15 meter) buffer strip around the sites, the proposed access routes and a 15 foot (5 meter) buffer strip on either side of the routes. Observations of the vegetation of the general vicinity of the two sites were also made and reported. This survey was conducted during afternoon hours on October 3 and 4, 1996, by Dr. Grant Gerrish.

A list of vascular plant species found at each proposed site and along the proposed access to each site was compiled (Table 1). Casual observations of birds and mammals,

Plant nomenclature follows Wagner et al. (1990). The Federal Register (1996) was consulted to see if any plants or animals found were listed as Endangered or Threatened Species by the U.S. Fish and Wildlife Service. Finally, the National List (USFWS 1988) was consulted to determine the wetland indicator status of each plant species. Bird names are in accordance with the published list of the Hawaii Audubon Society (HAS 1989).

Site characteristics were determined by analysis of the topographic map (USGS 1981), the Hawaii Island soil survey (Sato et al 1973) and field observations.

SITE LOCATIONS

The two sites are in the part of Hilo commonly referred to as the "Industrial Area." Both sites are in the vicinity of the Hawaii County Landfill and General Lyman Field (the Hilo Airport). The two sites are about 100 m apart and both are located on sites that have been quarried for rock.

The first site, here called the 'Mana Quarry Site,' is a part of the parcel TMK 2-1-13:151. This site is within the quarry operated by Jas. Glover Company. It is a part of the quarry that

has been extensively mined down to the deepest practical depth. The proposed access down into the quarry would be by an earthen ramp connecting the site to Leilani Street. This ramp appears to have been built in conjunction with installation of a County water main (Dean Herlickson, Jas. Glover Co., Personal Communication) and is currently blocked by an earthen berm and overgrown with vegetation.

The second site, here called the 'Airport Site' is east of Kanoelehua Avenue on the southeast side of the Airport Access Road. The site is currently vacant, partially vegetated land. Access to this site would be provided by a little-used roadway that joins the Airport Access Road southwest of the Air National Guard facility at General Lyman Field.

RESULTS

SITE DESCRIPTIONS

The Mana Quarry site is within an active rock quarry. The proposed site is in an area that has already been mined to the maximum depth, approximately 15 m below the surrounding surface. At the time of the survey, most of the proposed site was under a large pile of mined rock. This rock would be moved before the site could be used. The original surface of the site would have been about 60 ft. above sea level (USGS 1981) with a soil mapped as Papai extremely stony muck (Typic Tropofolist) (Sato et al 1973). This soil was long ago stripped away, along with many meters of substrate. The ramp that would be used for access into the Mana Quarry Site also has a surface altered by grading.

The Airport site is also within a former quarry that was abandoned prior to 1970 (Donald Thomas, SOEST, personal communication). This site was not as extensively mined, but the substrate was heavily disturbed. The original surface was about 40 feet above sea level (USGS 1981) and the original soil was mapped as including Papai Series and Keaukaha Extremely Rocky Muck (Lithic Tropofolist) (Sato et al 1973). The existing roadway on to the site, proposed for access, is graded and partially paved.

FLORA

VEGETATION Overview Originally, the natural vegetation of all of the project area was Lowland Wet Forest (Gagne and Cuddihy 1990). Ohia-Lehua (Metrosideros polymorpha) is a dominant tree species in these forests. Hala (Pandanus tectorius) may also have been prevalent in areas with greater soil development.

A forest dominated by ohia-lehua and hala occurs at some locations in the general vicinity of the two proposed sites. Where ohia-hala forests occur near General Lyman Field or the Mana Quarry, many non-native trees and shrubs are also prevalent. It is not clear whether this is primary forest that has been heavily invaded by alien species or if the vegetation is a secondary forest of both native and alien species that have reinvaded the site following past clearing. The vegetation on the two sites and in their immediate vicinity is clearly secondary, only one or two individuals each of the native ohia and hala were found, both near the Airport Site.

A total of 70 vascular plant species were recorded at the two proposed sites and along their proposed access routes (Table 1). Of these, 63 are alien species (brought to Hawaii by people), 6 are indigenous (naturally occurring in Hawaii and elsewhere), and only 1 (Metrosideros polymorpha) is endemic (naturally occurring only in Hawaii). The Alien species that dominate the vegetation at and around both sites are, for the most part, very common weedy species of the Hilo area.

Mana Quarry Site The vegetation on the Mana Quarry drilling site is a very sparse cover of alien grasses and herbs, with a few alien shrubs and tree saplings. Most of the substrate is barren rock or crushed rock. The access ramp from Leilani Street to the quarry floor, on the other hand, is densely vegetated. Here, too, the species are all common alien species. Large melochia (Melochia umbellata) and gunpowder (Trema orientalis) trees dominate. The understory and groundcover are dense tangles of alien vines, grasses and herbs. From the bottom of the ramp in the quarry to the proposed drilling site, the vegetation is sparse weeds, as described above for the drilling site itself.

Airport Site The vegetation on and around the Airport Site is predominantly weedy alien species. The proposed drilling site itself is variably covered with secondary vegetation, including a number of fast growing trees, such as ironwood (Casuarina equisetifolia), guarumo (Cercropia obtusifolia), and others (Table 1). A very few (less than 5 each) individuals of the native ohia-lehua and hala grow within the buffer zones around the proposed drilling site and its access route.

ENDANGERED PLANTS No endangered or rare native plants were found within the study area. Examination of the list of endangered plants (Federal Register 1996) and analysis of the known locations and ranges of these species indicate that none are known to occur or to have occurred within the habitat types of the two sites.

FAUNA

BIRDS AND MAMMALS The only native bird or mammal observed on or near the two sites was the indigenous Kolea or Pacific Golden Plover (Pluvialis fulva). Kolea were frequently seen within and near the Mana Quarry site and occasionally seen at the airport site.

Alien birds seen include Japanese White-eye (Zosterops japonicus), Northern Cardinal (Cardinalis cardinalis), Spotted Dove (Streptopelia chinensis), House Sparrow (Passer domesticus), Common Myna (Acridotheres tristis) and Nutmeg Mannequin (Lonchura punctulata). Other common species of alien birds may utilize the site. No mammals were observed during the survey. It is reasonable to assume that alien mammals such as the Small Indian Mongoose, rats, mice and feral dogs and cat occasionally occur on the site.

ENDANGERED ANIMALS No threatened, endangered or rare birds or mammals were observed during the biological field survey, nor do the sites possess unique resources likely to attract such species. The widely distributed 'Io or Hawaiian Hawk (Buteo solitarius) or the Hawaiian Hoary Bat (Lasiurus cinereus semotus) may at times occur within the vicinity (Berger 1990, Tomich 1986). Both of these species are listed as Endangered (Federal Register 1996).

Both of these species are well-adapted to human-altered landscapes and make use of alien as well as native vegetation.

WETLANDS

No streams or other bodies of open water were found within or near the two alternative sites. No distinct wetland areas were found within the two alternative sites or in their near vicinities. The "Wetland Indicator" status of each plant species is given in Table 1 (USFWS 1988).

No poorly drained areas occur within the Mana Quarry site. Furthermore, the sparse vegetation lacks species indicative of wetlands. No plants classified as 'Facultative Wetland' or as 'Obligate Wetland' species (USFWS 1988) and used as indicators of possible wetland conditions (Corps of Engineers 1987) occur on this site. Two 'Facultative Wetland' species, California grass (Brachiaria mutica) and honohono (Commelina diffusa) were found in the understory on part of the proposed access route where soil compaction may slow drainage. Both of these plants are very common in east Hawaii on drained sites and are not strong indicators of wetland conditions. The location of these plants was on a sloping artificial surface of crushed rock with no indicators of wetland hydrology.

The mined and graded surface of the Airport Site also appears to be drained. No strong indicators of wetland conditions were found. One 'Facultative Wetland' species, California grass, was found within this Site. The access roadway to the Airport Site contains some very small poorly drained areas. These areas are puddles associated with the road surface or immediately adjacent to paved segments of the roadway. At the time of the survey, all of these puddles were completely dry. A dried crust of organic soil gave evidence of the former puddles as well as the presence of four Facultative Wetland and one Obligate Wetland species. Two of the Facultative Wetland species, umbrella sedge (Cyperus halpan) and beak rush (Rhynchospora caduca) are restricted to very wet or poorly drained site, and the Obligate Wetland species, spikerush (Eleocharis obtusa) is a very strong indicator of poor drainage. These three indicator species named above and the wetland hydrology indicators are limited to several small areas directly associated

with the roadway, i.e. puddles. These three or four puddles of not more than five square meters each are clearly produced by impeded drainage due to pavement or compacted gravel. The soil of these areas is very shallow to nonexistent and lacked hydric soil indicators at the time of the survey.

DISCUSSION AND RECOMMENDATIONS

BIOLOGICAL RESOURCE VALUES OF THE FLORA AND FAUNA

Resource values of flora and fauna can be either general or biodiversity. General resource value is the benefit that any plant and animal community provides, regardless of the plant and animal species present. These values include prevention of soil erosion, moderation of climatic extremes, biomass production and aesthetic values. Biodiversity refers to the number of species present or the variety of vegetation types within the landscape. In the Hawaiian Islands, communities considered to have biodiversity value are those that are 1) habitat to endangered or rare species, 2) unique communities that occur in only a few places or a limited area, 3) communities dominated by endemic species with a minimum of interruption by alien species or other human activities. In addition to these biodiversity values, listed Threatened or Endangered species and wetland communities are legally protected under State and Federal law.

VEGETATION

For the most part, the vegetation within or near the two proposed sites have only general resource value. These plant communities have little biodiversity value because they are not made up of plants endemic to the Hawaiian Islands nor are the communities themselves unique. Both sites have been heavily disturbed by human activity in the past. Both were cleared of native vegetation and excavated for quarrying and their access routes were cleared and graded and used as roads. They are now covered or partly covered by a secondary vegetation of nearly all alien plants.

RECOMMENDATION No special measures need be taken to protect the vegetation of the site to be selected. Appropriate measures should be taken to preserve the general resource values of the vegetation, especially to reduce the probability of soil erosion whenever vegetation is removed.

ENDANGERED PLANTS

No listed Threatened, Endangered or species otherwise considered rare were found within the project site. Only a few individuals of common endemic and indigenous species were found near the two sites (Table 1). The domination of the sites by introduced plants and their histories of repeated human disturbance make it unlikely that any rare plants would be at these sites. Furthermore, no rare species are known to occur or to have occurred in habitats similar to the two alternative sites.

RECOMMENDATION Because of the absence of endangered species on the proposed sites, no precautions need be taken regarding endangered plants.

FAUNA

The bird and mammal fauna of the two sites is made up almost entirely of common alien species. The only native species observed was the indigenous Kolea or Pacific Golden Plover. This is a relatively common species that utilizes a wide range of open vegetation type.

RECOMMENDATION No special measures need to be undertaken to protect the birds and animals observed on the site. Special considerations for rare animals that may be in the vicinity are detailed in the next section.

ENDANGERED ANIMALS

The only land mammal native to Hawaii is the Hawaiian Hoary Bat (Lasiurus cinereus semotus), which is a listed Endangered Species (Federal Register 1996). No dawn or evening observations were made during the field survey; this study detected no bats within the project area. The Hawaiian Hoary Bat is well-known in the general Hilo area. It is possible that the Hawaiian Hoary Bat roosts or forages within the project area. The distribution and habits of this bat are poorly known. It is known to be widely distributed on the island of Hawaii and is known to be a solitary rooster that utilizes alien as well as native tree species. Being relatively unspecialized in the type of habitat required for nesting and foraging, the Hawaiian Hoary Bat appears to be well-adapted to human-altered landscapes (Tomich 1986).

The 'Io (Hawaiian Hawk: Buteo solitarius) is known to nest and forage in the Hilo area (Berger 1990) and almost certainly forages at times above the project area. However, no known vegetation or other resource important to the 'Io is localized within the project site. The 'Io requires large trees for nest building (Griffin 1985). Most of the vegetation on or near the two sites do not contain such trees and, therefore, is not well-suited for nesting. Furthermore, all the plant species and community types within the project site are widely available elsewhere within the surrounding region.

It is unlikely that any other endangered or threatened native bird species utilize the site. The elevation of the site (40 to 60 feet above sea level) is well below the elevation where endemic forest birds occur (Scott and Stone 1988).

RECOMMENDATIONS 1) Because of the absence of endangered species on the proposed sites, no precautions need be taken to protect the plants and animals observed on either site or described as being likely users of the sites.

2) In the unlikely event that construction crews encounter an 'I'o defending a nest with noisy calls, construction activity should be halted and the U.S. Fish and Wildlife Service contacted.

If a nest is found within the project site, it should be left undisturbed until any 'I'o chicks have left the nest and the nest site has been abandoned.

3) The proposed action includes 24-hour-a-day operation of the drilling rig. All lighting on or near the site should be shielded to conform to County of Hawaii standards to prevent harm to night-flying seabirds, including the Endangered 'Ua'U (Dark-Rumped Petrel) and the Threatened *'A'o* (*Newell's* Shearwater). These legally protected birds have been reported flying through the Hilo area from the ocean to mountain nesting sites (Conant 1980).

WETLANDS

No bodies of water or regulated wetlands (Corps of Engineers 1987) were found on or near either site or their access routes.

Some indicators of wetland conditions were found along the access route to the Airport Site. These plant indicator species and hydrologic indicators were clearly associated with small, currently dry, puddles on the road surface or shoulder. These areas are nearly devoid of soil. Furthermore, these dry puddles do not appear to have any unique resource value, being vegetated with mostly alien weedy species and one indigenous species (spikerush).

RECOMMENDATION No special precautions are needed to protect wetlands or other bodies of water, since none occur on or adjacent to the sites or their access routes.

NOTE

Identification of impacts, if any, caused by changes in ground water is beyond the scope of this report.

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Table 1. List of vascular plants found at the two alternative sites proposed for SOEST exploratory well.

ORG = Origin (E = endemic, I = indigenous, P= Polynesian introduction, A = other alien); LF = Life Form (T = tree, S = shrub, H = herb, G = grass or grass-like, F = fern, L = liana or vine); WET = Wetland Indicator Status from National List (FWS 1988) (OBL = Obligate, FW = Facultative Wetland, F = Facultative, FU = Facultative Upland, NI = Not Indicator). Presence: X indicate species present at 1A = Mana Quarry Site, 1B = Along access to Mana Quarry Site, 2A = Airport Site, 2B = Along access to Airport Site.

Botanical Name Common Name	ORG	LF	WET	Presence 1A	1B	2A	2B
Ageratum conyzoides L. maile-honohono	A	H	FU	X		X	X
Arundinia bambusifolia (Roxb.) Lindl. bamboo orchid	A	H	FU			X	X
Bambusa sp. bamboo	A	T	NI	X			
Bidens pilosa ki nehe	A	H	NI		X	X	X
Brachiaria mutica (Forsk.) Stapf California grass	A	G	FW		X	X	
Buddleia asiatica Lour. butterfly bush	A	S	NI	X			
Castilleja arvensis Schlecht. & Cham. paintbrush	A	H	NI	X			
Casuarina equisetifolia L. paina, ironwood	A	T	FU			X	
Cecropia obtusifolia Bertol. guarumo	A	T	NI			X	
Chamaecrista nicitans (L.) Moench partridge pea	A	H	NI	X		X	X
Commelina diffusa N. L. Burm. honohono	A	H	FW		X		X

Table 1. (Continued) Plants at proposed SOEST drilling sites.

Botanical Name Common Name	ORG	LF	WET	Presence 1A	1B	2A	2B
Crotolaria juncea L. sunn hemp	A	H	NI	X		X	X
Cuscuta sandwichiana Choisy Kauna'oa, dodder	A	L	NI	X			X
Cyperus halpan L. umbrella sedge	A	G	FW				X
Desmodium sandwicense E. Mey. Spanish clover	A	H	FU	X	X	X	X
Desmodium tortuosum (Sw.) DC no common name	A	S	NI		X		
Digitaria violascens Link crabgrass	A	G	F	X		X	X
Eleocharis obtusa (Willd.) Schult. spikerush	I	G	OBL				X
Emilia sonchifolia (L.) DC Flora's paintbrush	A	H	NI	X			
Eucalyptus robusta Sm. swamp mahogany	A	T	FU	X	X		
Hyptis pectinata (L.) Poit. comb hyptis	A	S	NI		X	X	
Ipomoea indica (J. Burm.) Merr. morning glory	I	L	FU		X	X	
Justica betonica L. white shrimp plant	A	H	NI			X	X
Lantana camara L. lantana	A	S	NI				X
Leucaena leucocephala (Lam.) de Wit koa haole	A	S	NI			X	X
Macaranga mappa (L.) Mull. Arg. bingabing	A	T	F+		X	X	X

Table 1. (Continued) Plants at proposed SOEST drilling sites.

Botanical Name Common Name	ORG	LF	WET	Presence 1A	1B	2A	2B
Melastoma candidum D. Don melastoma	A	S	NI			X	X
Melinis minutiflora Beauv. molassesgrass	A	G	NI	X		X	X
Melochia umbellata (Houtt.) Staph. melochia	A	T	NI		X	X	X
Merrimia aegyptia (L.) Urb. koali kua hulu	A	L	NI		X		
Metrosideros polymorpha Gaud. var. incana 'ohi'a-lehua	E	T	F				X
Microsorium scolopendria (Burm.) Copel. laua'e	I	F	NI			X	X
Mimosa pudica L. sensitive plant	A	S	FU		X	X	X
Musa x paradisiaca L. banana	A	T	FU			X	
Nephrolepis hirsutula (Forst.) Presl swordfern	A	F	F		X	X	X
Paederia scandens (Lour.) Merr. maile pilau	A	L	NI		X	X	X
Pandanus tectorius S. Parkinson ex Z hala	I	T	F			X	X
Panicum repens L. wainaku grass	A	G	F	X			X
Paraserianthes falcataria (L.) Nielson albizia	A	T	NI		X	X	
Paspalum conjugatum Berg. Hilo grass	A	G	F			X	X

Table 1. (Continued) Plants at proposed SOEST drilling sites.

Botanical Name Common Name	ORG	LF	WET	Presence 1A	1B	2A	2B
Paspalum scrobiculatum L. ricegrass	I	G	F			X	
Paspalum urvillei Steud. vaseygrass	A	G	F	X			
Passiflora suberosa L. huehue haole	A	L	NI				X
Pennisetum purpureum Schumach. elephant grass	A	G	FU		X	X	X
Persea americana Mill. avocado	A	T	NI				X
Philodendron Schott sp. philodendron	A	L	NI		X		
Phlebodium aureum (L.) J. Sm. laua'e-haole	A	F	NI			X	
Pluchea symphytifolia (Mill.) Gillis sourbush	A	S	F	X			X
Polygala paniculata L. Milkwort	A	H	NI			X	
Psidium cattleianum Sabine waiawi, yellow strawberry guava	A	T	F			X	X
Psidium guajava L. common guava	A	T	FU				X
Pteris vittata L. pteris	A	F	NI	X			
Pycreus polystachyos (Rottb.) P. Beauv. no common name	I	G	F	X		X	X
Richardia brasiliensis Gomes no common name	A	H	NI	X			
Ricinis communis L. castor bean	A	T	FU		X		

Table 1. (Continued) Plants at proposed SOEST drilling sites.

Botanical Name Common Name	ORG	LF	WET	Presence 1A	1B	2A	2B
Rhynchelytrum repens (Willd.) Hubb. Natal redtop	A	G	NI	X			X
Rhynchospora caduca Elliot beak-rush	A	G	FW				X
Saciolepis indica (L.) Chase Glenwoodgrass	A	G	F			X	X
Schinus terebinthifolius Raddi christmasberry	A	T	FU			X	X
Schizachyrium condensatum (Kunth) Nees little bluestem	A	G	NI	X			X
Setaria palmifolia (Koen.) Stapf palmgrass	A	G	FU		X		
Shefflera actinophylla (Endl.) Harms octopus tree	A	T	NI				X
Spathoglottis plicata Blume Philippine ground orchid	A	H	F			X	X
Spermacoce assurgens Ruiz & Pav. buttonweed	A	H	F	X			
Sporobolus indicus (L.) R. Br. West Indian dropseed	A	G	NI			X	X
Stachytarpheta urticifolia (Salisb.) Sims no common name	A	S	F			X	X
Syzigium cumini (L.) Skeels Java plum	A	T	FU			X	X
Themeda villosa (Poir.) A. Camus Lyon's grass	A	G	NI				X
Trema orientalis (L.) Bl. gunpowder tree	A	T	NI		X	X	X
Wedelia trilobata (L.) Hitchc. wedelia	A	H	FU		X	X	X

APPENDIX B

Historic Sites Clearance for Prospective Sites

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

October 4, 1996

Mr. Donald Thomas
University of Hawai`i at Manoa
Hawai`i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road
Honolulu, Hawaii 96822

LOG NO: 18200 ✓
DOC NO: 9609PM24

Dear Mr. Thomas:

SUBJECT: Proposed Drilling Project
Waiakea, South Hilo, Hawaii Island
TMK: 2-1-13:151 and 2-1-12:9

Thank you for your letter of September 24, 1996, and the opportunity to review and comment on the proposed drilling project at the eastern edge of the "Mana Quarry Site" and at a second area at General Lyman Airfield.

You note that both sites have been used for quarrying operations for a period of about thirty years. Because of the degree of disturbance we believe that it is highly unlikely that any significant historic sites would remain at either location. On this basis, we believe that the proposed drilling project will have "no effect" on significant historic sites.

If you have any questions please contact Patrick McCoy (587-0006).

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

PM:jk

APPENDIX C

Letters Received During Comment Period and
Initiating Agency Responses

JAS. W. GLOVER, LTD.

GENERAL CONTRACTOR

PHONE NO. (808) 935-0871
Lic. No. ABC-3
FAX NO. (808) 961-9237
HILO OPERATIONS
890 LEILANI STREET • HILO, HAWAII 96720

December 24, 1996

The Office of Environmental Quality Control
235 S. Beretania Street, #702
Honolulu, Hawaii 96813

Subject: Hawaii Scientific Drilling Project Site A,
TMK: 2-1-13:151
South Hilo, Island of Hawaii

Gentlemen:

This is in reference to the above project which is adjacent to the Mana Quarry Site.

Jas. W. Glover, Ltd., which is the present lessee of the Mana Quarry Site at TMK: 2-1-12:4, has no objections to the drilling project. We support the concept of the research program.

In order to provide a measure of security for the project site, we suggest that a 6' chain link fence and a gate be installed along the common boundary between TMK: 2-1-13: 151 and TMK: 2-1-12:4.

Please call us, should you have any questions.

Very truly yours,

JAS. W. GLOVER, LTD.

Byron Fujimoto
Vice-President, C.O.O.

Post-It™ brand fax transmittal memo 7671	# of pages ▸ 1
To Don Thomas	From OEQC
Co.	Co.
Dept.	Phone #
Fax # 961-3380	Fax #

University of Hawai'i at Mānoa

Hawai'i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

February 5, 1997

Mr. Byron Fujimoto
Jas. Glover Ltd.
890 Leilani St.
Hilo, HI 96720

Dear Mr. Fujimoto:

Thank you for your letter commenting on the Draft Environmental Assessment for the Hawaii Scientific Drilling Program. As required by the EA review process, I will summarize your comments and offer responses that will be included in the Final Environmental Assessment.

Your comments related to the project are as follows:
Comment 1: The Jas. Glover Co. has no objections to the drilling project and supports the concept of the research program.
Response: Thank you for your expression of support. We believe that the drilling data recovered may prove to have significant value to the Hilo community and may provide useful data to your company and other lessees in the immediate area.

Comment 2: In order to provide a measure of security for the project site, Glover suggests that a 6' chain link fence and gate be installed along the common boundary between TMK:2-1-13:151 and TMK: 2-1-12:4.
Response: If the drilling project ultimately uses the site (Site A) on TMK: 2-1-13:151, we will definitely be installing some form of security fence around the site. In that event, we plan to meet with you or your operations manager to discuss the form of fencing that would be used and its final configuration.

Thank you again for your comments on our Draft Environmental Assessment. I hope that the above discussion will adequately address your concerns and comments. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas

484 Kanoelehua Avenue
Hilo, Hawaii 96720
December 9, 1996

The Office of Environmental
Quality Control
235 S. Beretania St. #702
Honolulu, Hawaii 96813

SUBJECT: PRELIM. DRAFT ENVIRON. ASSESSMENT (NOV 1996)
DRAFT ENVIRONMENTAL ASSESSMENT (DEC 1996)

The Preliminary Draft Environmental Assessment for a drilling program in the area of the Glover/Hilo rubbish dump road covered scientific research proposals. Negative impacts generated by the earlier 1993 project, if any, are not noted. Also, any negative impact of quarrying work up to 1968, if any, is not noted.

Draft Environmental Assessment for the Hawaii Scientific Drilling Project:

The report outlines the potential impacts and mitigating measures. The University of Hawaii, University of California-Berkeley and California Institute of Technology are collaborators of the research to learn about the geological history of Hawaii and the process of the formation of Hawaii volcanoes. It is noted that drilling of the research wells A & B are to be done in three six-month intervals covering six years period. The drilling intervals will be now and then with twelve to eighteen months periods to allow rock sample analysis and downhole measurement in the drillhole. Various studies to be measured in the downhole formations will continue for several years after drillhole completion.

It is noted that earlier quarrying extended into 1968 in the Site B area. Earlier drilling project in the area was done in 1993, which was funded by the National Science Foundation.

Start of the drilling operations is noted to be in July 1997. Follow-on work utilizing the boreholes is noted to extend over several years. Understanding is that responsibility of the sites and reseach work lie with the scientists.

Yours truly,

Arthur T. Isemoto
Waiakea Houselot
Lower Association

cc: Donald M. Thomas
University of Hawaii at Hilo
Center for the Study of
Active Volcanoes
Hilo, Hawaii 96720-4091

University of Hawai'i at Mānoa

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February 5, 1997

Mr. Arthur Isemoto
484 Kanoelehua Ave.
Hilo, HI 96720

Dear Mr. Isemoto:

Thank you for your letter commenting on the Draft Environmental Assessment for the Hawaii Scientific Drilling Program. As required by the EA review process, I need to summarize your comments and offer responses that will be included in the Final Environmental Assessment.

Your comments related to the project were as follows:
Comment 1: Negative impacts generated by the earlier 1993 drilling project in Keaukaha were not noted.
Response: Thank you for pointing this out. We definitely should have included a statement in the Draft EA regarding the level of impact from the earlier project (Please see Sections **7.1 Introduction**, page 19 and **7.5 Noise**, page 23). In fact, that project caused few adverse impacts during or after the drilling effort. Noise emissions were controlled at a level that did not generate any disturbance to the surrounding community; drilling activities did not detectably impact the water quality in Hilo Bay nor did it impact the groundwater quality in a shallow observation hole that was drilled within 30 m of the deeper well. As in the present case, the site chosen for the earlier project had been heavily impacted by prior activities and our site preparation work resulted in the removal and clean-up of a substantial amount of debris and "junk" that had been dumped at the site as well as the removal of a number of weedy tree species that had grown over the site. Socioeconomic impacts were transitory: we provided direct employment to two Hilo residents as well as about $50,000 in contract work to local companies during the project; we also provided freshwater to the residents of the homeless village that was located along the "Breakwater Road" during the project as well. Other positive impacts that came from the earlier work was a better understanding of the geology and the lava flow hazards in the Hilo area as well as new discoveries about the groundwater hydrology beneath this part of the island.

Comment 2: The negative impacts of quarrying work up to 1968 were not noted.
Response: You are again correct. Although we do not have any records of the condition of this part of Hilo prior to the quarrying activities, it is likely that the land surface would have been part of the coastal rainforest as exists further out beyond the Keaukaha area and the airport property. This type of forest would have been dominated by ohia and other native lowland plants and shrubs. As indicated in our Botanical Survey, the current condition of the abandoned quarry

(Site B) is that it is heavily infested with non-native trees, grasses, and vines that have invaded the area since the quarrying operation was terminated. The botanical assessment of the abandoned quarry identified only a few (substantially less than 1% of the total number of plants) native species present in the area (Please see Section **7.1 Introduction**, page 19). In the Glover quarry, which is currently in use (Site A), most of the surface is barren, having been cleared when the rock was mined out of the formation.

Comment 3: You have summarized the plans for the Hawaii Scientific Drilling Project, the organizations involved, and the projected time table for the program.
Response: Your summary is generally correct although there appears to be one minor misunderstanding of the intended plan. We have evaluated two possible sites that are considered to be equally acceptable to us for the drilling program. However, we expect to drill the observation hole at only one of these sites (Please see Section **5.1 Summary of the Hawaii Pilot Hole Project**, page 6). Our intent is to proceed with the environmental review for both sites and, at the conclusion of that process, we will choose whichever site appears to be most environmentally acceptable. If the review process indicates that both are equally acceptable, then we will choose the site for which our site preparation costs are expected to be smallest.

Thank you again for your comments on our Draft Environmental Assessment. I hope that the above discussion will adequately address your concerns and comments. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas

Stephen K. Yamashiro
Mayor

Virginia Goldstein
Director

Norman Olesen
Deputy Director

County of Hawaii
PLANNING DEPARTMENT
25 Aupuni Street, Room 109 • Hilo, Hawaii 96720-4252
(808) 961-8288 • Fax (808) 961-9615

November 13, 1996

Mr. Donald M. Thomas
Hawaii Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa
2525 Correa Road
Honolulu, HI 96822

Dear Mr. Thomas:

Preliminary Draft Environmental Assessment for the
Hawaii Scientific Drilling Project
TMK: 2-1-12: 9 & 2-1-13: 151; Waiakea, South Hilo, Hawaii

Thank you for your letter dated November 4, 1996, requesting our review and comment of the above-described document.

We have no objections or comments regarding the information and findings contained within the preliminary draft environmental assessment.

Thank you for providing our office with the opportunity to comment. Should you have any questions, please feel free to contact Daryn Arai of this office.

Sincerely,

VIRGINIA GOLDSTEIN
Planning Director

DSA:cmr
f:\wpwin60\dsa\LUHMan01.dsa

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

MICHAEL D. WILSON
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT S COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT
WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

December 4, 1996

LD-NAV
REF.: DEAUOH.RCM

Dr. Donald M. Thomas
University of Hawaii at Manoa
Hawaii Institute of Geophysics
And Planetology
2525 Correa Road
Honolulu Hawaii 96822

Dear Dr. Thomas:

SUBJECT: Review: Preliminary Draft Environmental Assessment
Applicant: The University of Hawaii
Participants: School of Ocean and Earth Science and Technology; University of California at Berkely and Cal Tech University
Project: Hawaii Scientific Drilling
Location: South Hilo District, Island of Hawaii
Tax Map Key: 2-1-12: 9 and 2-1-13: 151

Thank you for allowing us the opportunity to review and comment on the University of Hawaii's Preliminary Draft Environmental Assessment for the proposed Hawaii Scientific Drilling project on the Island of Hawaii.

The Department of Land and Natural Resources has no comments or objections to offer on the subject matter at this time.

Should you have any questions, please feel free to contact Nick Vaccaro at 587-0438.

HAWAII: Earth's best !

Aloha,

Gilbert S. Coloma-Agaran
MICHAEL D. WILSON

c: Hawaii Board Member
Colbert M. Matsumoto

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

November 29, 1996

Mr. Donald M. Thomas
University of Hawaii at Manoa
Hawaii Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road
Honolulu, HI 96822

PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT FOR THE
PROPOSED DRILLING PROJECT
WAIAKEA, SOUTH HILO, HAWAII ISLAND
TAX MAP KEY 2-1-13:151 AND 2-1-12:9

We have reviewed the subject Draft Environmental Assessment.

For your information, Well No. 4202-02 located within Tax Map Key No. 2-1-12:9 at latitude 194240 and longitude 1550252 is owned by the Department of Water Supply and presently is not in use.

Milton D. Pavao, P.E.
Manager

WA:dms

copy - Mr. Ralph T. Horii, Jr., University of Hawaii
Dr. C. B. Raleigh, University of Hawaii

...Water brings progress...

University of Hawai'i at Mānoa

Hawai'i Institute of Geop[illegible]sics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

December 27, 1996

Mr. Milton Pavao
Manager, Dept. of Water Supply
County of Hawaii
25 Aupuni St.
Hilo, HI 96720

Dear Mr. Pavao:

Thank you for your letter of November 29, 1996. I appreciate your informing me of the location and status of well 4202-02. I will check with your staff to make sure that I have this well accurately located on our maps in the Final Environmental Assessment and will include your comments in the Final EA.

Thank you again for taking the time to review the Preliminary Draft EA. The summary of the project will be published by OEQC on December 8th. I will be forwarding a copy of the Draft EA to your staff for review in the event that they wish to make any additional comments through the official review process.

Sincerely yours,

Donald M. Thomas

BENJAMIN J. CAYETANO
GOVERNOR
STATE OF HAWAII

KALI WATSON
CHAIRMAN
HAWAIIAN HOMES COMMISSION

JOBIE M. K. M. YAMAGUCHI
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P.O. BOX 1879
HONOLULU, HAWAII 96805

November 26, 1996

Donald M. Thomas, Ph.D.
Hawaii Institute of Geophysics
and Planetology
School of Ocean and Earth Science
and Technology
2525 Correa Road
Honolulu, Hawaii 96822

Dear Dr. Thomas:

Subject: Hawaii Scientific Drilling Project

Thank you for allowing our review of the preliminary draft environmental assessment for the subject project, which is proposed on state lands near the Hilo Airport, in close proximity to parcels under the jurisdiction of the Department of Hawaiian Home Lands (DHHL). These include areas adjacent to Prospective Drill Site A: TMK 2-1-13:29 and the nearly all of the parcels under Tax Map Plat 2-1-25. (See attached map, Figure 1d.)

Following are our concerns, questions, and comments:

1. Description of the Action (Page iv, Executive Summary): Suggest that the estimated cost of the project and anticipated source of funds be included at the end of this section.

2. Noise (Page v, Executive Summary; page 21, 7.5 Noise): Further mitigation steps should be taken if complaints of excessive nighttime noise from 24-hours-per-day drilling is received; e.g., installation of mufflers, or stop drilling when people need to sleep.

3. Socio-Economic Impact (Page vi, Executive Summary; page 22, 7.8 Socio-Economic): We are pleased to learn that the project may provide jobs to local residents.

4. Schedule and Follow-on Work: (Page 12) Please confirm my understanding that the duration of the project will be at least 10 years and that recycling of the proposed well as a source for domestic or agricultural water is not likely.

If you have any questions, please call me at 586-3837.

Sincerely yours,

Darrell Yagodich, Administrator
DHHL Planning Office

Attach

4170L16

Attachment

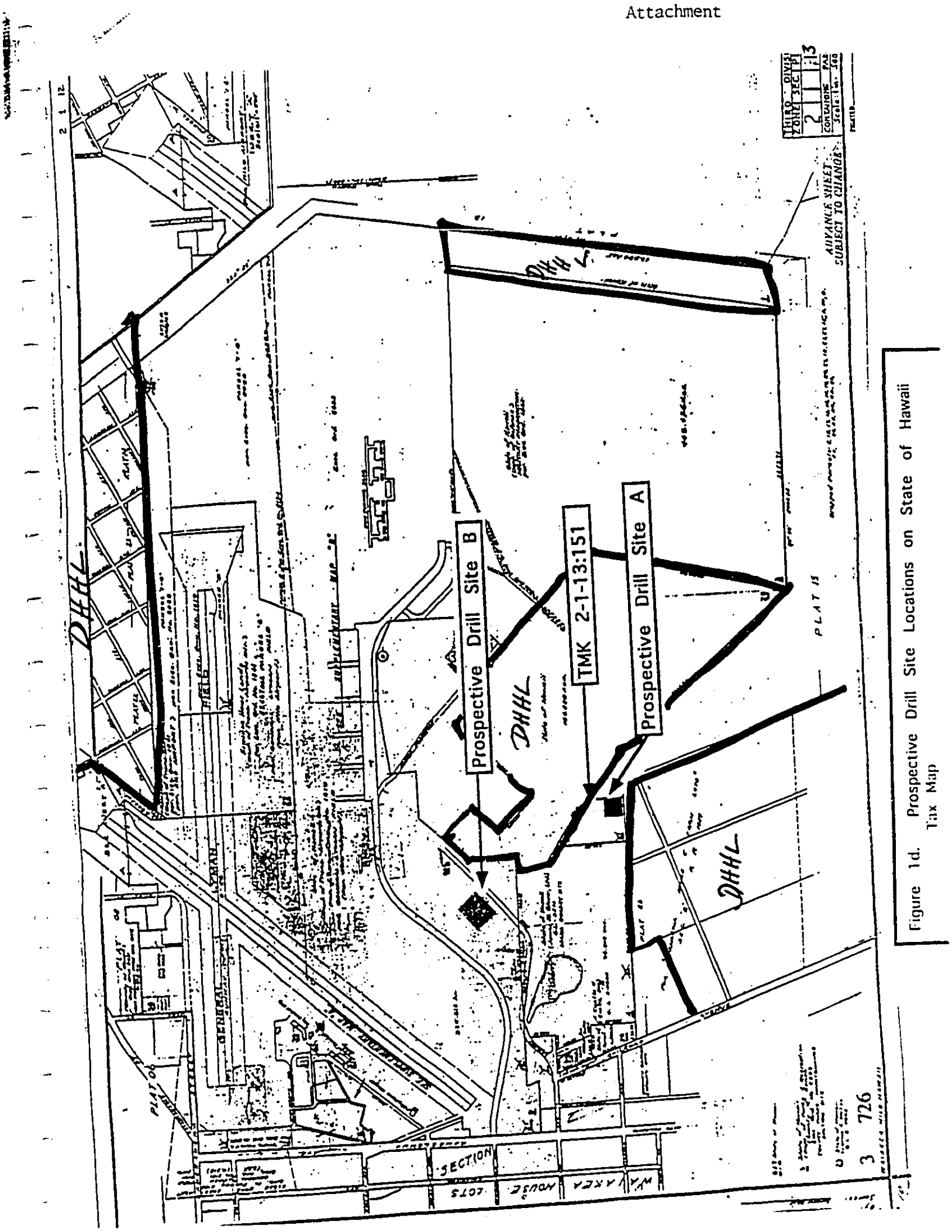

Figure 1d. Prospective Drill Site Locations on State of Hawaii Tax Map

University of Hawai'i at Mānoa

Hawai'i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

Mr. Darrell Yagodich
DHHL Planning Office
P.O. Box 1879
Honolulu, HI 96805

February 5, 1997

Dear Mr. Yagodich:

Thank you for your letter commenting on the Preliminary Draft Environmental Assessment for the Hawaii Scientific Drilling Program. Because I did not receive your comments in time to include them in the Draft Environmental Assessment, I will treat them as though they had been submitted as part of the formal Draft Environmental Assessment review and include the suggested changes and additions in the Final Environmental Assessment.

Your comments related to the project were as follows:
Comment 1: In Description of the Action, you suggested that we should include the estimated cost of the project and source of funds for the work.
Response: We appreciate the suggestion and will include that information in the Final EA (see Section **5.1 Summary of the Hawaii Pilot Hole Project,** page 6). The total cost of the program is about $11 million with about $4 million to be used for the drilling and $7 million to be devoted to scientific analyses of the cores and experiments that will be conducted in the hole. The source of funds for the work will be the National Science Foundation, which has given approval for about $9.5 million and, and the International Scientific Drilling Program which has indicated that they will provide the balance.

Comment 2: Further mitigative steps should be taken if complaints of excessive nighttime noise are received.
Response: You are correct. One of the primary (and most effective) mitigation actions we have taken for noise control is the choice of the prospective drilling sites in locations as far as possible from the residential areas of Hilo and their location in quarries where the noise source will be surrounded by higher ground; a further advantage is that the residential areas are located upwind of the site during the quietest night-time hours (when drainage winds from Mauna Loa and Mauna Kea will blow from the west north-west toward the south east) which will further reduce noise propagation into the community from the project site. We believe that noise from our operations at either of the prospective locations will be undetectable in the surrounding communities. Nonetheless, we will be meeting with residents from the nearby communities prior to and after the start-up of the project to determine whether any disturbance is being generated; if so, then we will require the contractor to install additional high-performance mufflers on the rig

and other power equipment and to install noise muffling screens around the primary noise generators on the site. Should these efforts be inadequate to alleviate the disturbance, then a noise consultant will be hired who will be asked to make more sophisticated modifications to the site or equipment that will eliminate the disturbance (Please see section **7.5 Noise**, page 24).

We note, too, that the prior drilling project was located within about 200 m (600 ft.) of the *Keaukaha community with a nearly direct line of sight between the rig and the community.* We operated at that site for approximately seven weeks without generating a single noise complaint. During the course of that project we inquired directly of the closest members of the community whether our noise caused them any problems; none of the individuals we spoke with indicated that they could detect a noticable noise from the project at their homes (Please see Section **7.5 Noise**, page 23). The current project will be located more than 1000 m away from the nearest residence and will be surrounded by rock walls; we are certain that we will be able to minimize the noise emissions from our activities to a level that will not be noticeable by the community even during nighttime hours.

Comment 3: You have endorsed our intent to provide jobs to the Hawaii community.
Response: As in the prior project, we intend to hire as many staff for the drilling and scientific work from the local labor pool as possible. We hope that this project will enable the younger staff and entry level workers to obtain experience that will ultimately lead to permanent employment.

Comment 4: You ask that we confirm that the duration of the project will be at least 10 years and that recycling of the well as a source for domestic or agricultural water is not likely.
Response: At the present time, we are expecting to conduct drilling and testing activities in the well for a period of about six years at which time we will install scientific equipment in the well (e.g. seismometers or dilatometers) that will enable us to monitor the volcano more effectively; the duration of data collection from those instruments is likely to be for a period of at least several (5 to 10) more years. We would also point out that, by the time the well is completed, the surface diameter of the casing will be about 5" and the upper part of the hole, where fresh water would likely be located, will be cased with three strings of casing. As a result, an expensive plugging job (to isolate the bottom 14,000 ft. of hole), and an expensive perforation job (to gain access to the shallow water resource) would have to be conducted before it would be possible to extract even a minor amount of water from the small diameter of the well casing. In summary, the hole that will remain at the end of the drilling program would have a minimal (if not a net negative) value as a water well when compared with other water sources in the Hilo area.

Thank you again for your comments on our Draft Environmental Assessment. I hope that the above discussion will adequately address your concerns and comments. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
ENVIRONMENTAL PLANNING OFFICE
HAWAII STATE DEPARTMENT OF HEALTH
919 ALA MOANA BLVD., 3RD FLOOR
HONOLULU, HI 96814-4912

FACSIMILE TRANSMITTAL

DATE: 11/25/96 NO. OF PAGES (w/ cover sheet): 3

TO: Don Thomas

OFFICE:

FAX: 956-3188 PHONE:

FROM: Art Bouckham

OFFICE:

PHONE: (808) 586-4349 FAX: (808) 586-4370

MESSAGE: Comments so far for the Hawaii Scientific Drilling Project. We do have 2 more branches to hear from: Noise & Drinking Water.

NOTE: If this transmittal was illegible or incomplete, please call the sender.

NOV 2 0 1996

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to:
EMD - CAB

November 19, 1996

96-A473

TO: Art Bauckham
Environmental Planning Office

FROM: Wilfred K. Nagamine
Manager, Clean Air Branch

SUBJECT: Reference No. 96-197
Preliminary Draft Environmental Assessment for the
Hawaii Scientific Drilling Project
South Hilo District, Island of Hawaii

In response to the Hawaii Institute of Geophysics and Planetology's letter dated November 4, 1996, regarding a preliminary draft environmental assessment for the subject facility, the Clean Air Branch has the following comments:

1. Depending on the size and emissions, the drilling rig's diesel engine may require an air permit.

2. The draft environmental assessment (EA) should address the potential for air emissions and the mitigative measures that will be taken should a geothermal resource be encountered during drilling operations.

If you have any questions regarding this matter, please contact Mr. Darin Lum at 586-4200.

DL/gk

Water Pollution

1. The applicant should contact the Army Corps of Engineers to identify whether a federal permit (including a Department of Army permit) is required for this project. If a federal permit is required, then a Section 401 Water Quality Certification is required from the State Department of Health, pursuant to Section 401 (a)(1) of the federal Water Pollution Control Act (commonly known as the Clean Water Act.

2. A National Pollutant Discharge Elimination System (NPDES) permit is required for any discharge to waters of the State including the following:

   a. Storm water discharges relating to construction activities for projects equal to or greater than five acres;

   b. Storm water discharges from industrial activities;

   c. Construction dewatering activities;

   d. Cooling water discharges less than one million gallons per day;

   e. Groundwater remediation activities; and

   f. Hydrotesting water.

Any person requesting to be covered by a NPDES general permit for any of the above activities should file a Notice of Intent with the Department's Clean Water Branch at least 30 days prior to commencement of any discharge to waters of the State.

Any questions regarding this matter should be directed to Mr. Denis Lau, Branch Chief, Clean Water Branch at 586-4309.

University of Hawai'i at Mānoa

Hawai'i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

February 5, 1997

Mr. Art Bauckham
Environmental Planning Office
Department of Health
P.O. Box 3378
Honolulu, HI 96801

Dear Mr. Bauckham:

Thank you for faxing over the comments from the DoH Clean Air Branch and Clean Water Branch on our Preliminary Draft Environmental Assessment for the Hawaii Scientific Drilling Program. As I indicated to you on the telephone, I did not receive the comments in time to include them in the Draft Environmental Assessment but will treat them as though they were submitted for the Draft EA.

The comments related to the project were as follows:

Comment 1: Depending on the size and emissions, the drilling rig's diesel engine may require an air permit.

Response: We are aware of the possibility that we will need to obtain an air permit for the diesel engines that will be used for the project. We will submit a formal request for a determination on that issue in several months after we have selected a specific drilling contractor and have firm data on the size of the power train supplying the drilling rig, mud pumps, and other ancillary equipment at the site. This possible requirement has been included in Section **1.4 Planned Agency Submittals** on Page 2 of the Final Environmental Assessment.

Comment 2: The EA should address the potential for air emissions and mitigative measures that will be taken should a geothermal resource be encountered during drilling operations.

Response: As indicated in the Final EA (Section **7.3 Air Quality**, pg. 20 and 21), we believe that the likelihood of encountering a geothermal system during drilling is extremely small for a number of reasons. In summary these include: 1) geothermal systems in Hawaii are found in areas of rift zones and calderas where magma has been intruded underground where is slowly cools; the prospective locations are located as far as possible away from any known evidence of rift zone (or caldera) intrusive activity on the island and, hence, should be free of any significant intruded magma. 2) The recent drilling project at Keaukaha, which penetrated to a depth of 3,464 ft., encountered a negative temperature gradient (the temperature decreased with depth over most of the hole) with a minimum temperature of about 46°F; this further substantiates our belief that an

active hydrothermal system is not present below the present site. It should also be understood that the deeper portion of the hole (below about 1500 ft.) will be drilling into lava flows from Mauna Kea volcano. These flow units were shown by the earlier drilling to be at least 100,000 years to more than 400,000 years old; we believe that the much greater age of these lavas further reduces the likelihood of encountering any significant residual heat in the project area. Nonetheless, we will be conducting temperature surveys in the hole during the drilling exercise that will allow us to measure the maximum downhole temperatures as we progress to depths greater than 3,500 ft; we will also be periodically performing detailed temperature surveys in the hole over the entire depth drilled. This will allow us to continually project temperatures downward and to anticipate any unexpected temperature increases and prepare for elevated temperatures if they are encountered. The drilling program will also be recovering a continuous sequence of core from the the hole which will be analyzed as the hole is being drilled; this will provide us with additional information with which to assess the likelihood of encountering current or fossil hydrothermal systems. Further, well control equipment will be installed at the wellhead that will be able to prevent the release of any fluids during drilling if a high temperature or high pressure zone is encountered. We have also designed the well to be able to withstand any reasonably expected pressures that could be encountered in the formation during the drilling process; hence, in the unlikely event that we do encounter unexpectedly high temperatures, we believe that we will be able to prevent the emissions of any fluids or gases from the well. Finally, we will have a drilling engineer on site or on call in Hilo during the entire drilling process; if conditions develop that suggest that a threat of elevated temperatures or pressures exists in the well, he will be able to advise us of any changes we need to make to ensure that discharges from the well can be precluded.

Comment 3: The applicant should contact the Army Corps of Engineers to determine whether a federal permit is required for the project.
Response: The Army Corps of Engineers has been contacted and is currently reviewing the Draft Environmental Assessment for the project. We are presently awaiting their comments and questions concerning the project.

Comment 4: A National Pollutant Discharge Elimination System (NPDES) permit is required for certain types of discharges to waters of the State and, if required, an NPDES permit should be obtained.
Response: We have discussed this issue with staff of the Department of Health and it is our understanding that an NPDES permit would be required if these types of discharge are expected to flow into any surface water body or into a storm drain that would lead to a surface water body. Both prospective drilling sites are in closed topographic depressions (quarries) that lie 5 m to >10 m below the local grade level and there are no surface water bodies that flow into or through either area. Further, we do not expect to generate any of the types of water discharge listed (storm water related to construction activities, storm discharge from industrial activities,

construction dewatering, cooling water discharges, groundwater remediation activities, and hydrotesting water) that could be released from the site into any surface water body near the prospective sites. Nonetheless, we will meet with the Clean Water Branch staff to further brief them on the project and confirm the absence of any significant impact from the proposed project.

Thank you again for your comments on our Draft Environmental Assessment. I hope that the above discussion will adequately address your concerns and comments. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIIKE
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96801

In reply, please refer to

December 12, 1996 96-197/epo

Mr. Donald M. Thomas
University of Hawaii at Manoa
Hawaii Institute of Geophysics and Planetology
2525 Correa Road
Honolulu, Hawaii 96822

Dear Mr. Thomas:

Subject: Preliminary Draft Environmental Assessment
Hawaii Scientific Drilling Project
South Hilo District, Hawaii
TMK: 2-1-13: por. 151

Thank you for allowing us to review and comment on the proposed project. We have the following comments to offer:

Noise Pollution

Drilling activities must comply with the provisions of Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control."

a. The contractor must obtain a noise permit and/or variance if the noise levels from the drilling activities are expected to exceed the allowable levels of the rules.

b. The contractor must comply with the requirements as specified in the rules and the conditions issued with the permit.

Should there be any questions on this matter, please contact Mr. Jerry Haruno, Environmental Health Program Manager, Noise, Radiation and Indoor Air Quality Branch at 586-4701.

Water Pollution

1. The applicant should contact the Army Corps of Engineers to identify whether a federal permit (including a Department of Army permit) is required for this project. If a federal permit is required, then a Section 401 Water Quality Certification is required from the State Department of Health, pursuant to Section 401 (a)(1) of the federal Water Pollution Control Act (commonly known as the Clean Water Act).

2. A National Pollutant Discharge Elimination System (NPDES) permit is required for any discharge to waters of the State including the following:

   a. Storm water discharges relating to construction activities for projects equal to or greater than five acres;

   b. Storm water discharges from industrial activities;

   c. Construction dewatering activities;

   d. Cooling water discharges less than one million gallons per day;

   e. Groundwater remediation activities; and

   f. Hydrotesting water.

Any person requesting to be covered by a NPDES general permit for any of the above activities should file a Notice of Intent with the Department's Clean Water Branch at least 30 days prior to commencement of any discharge to waters of the State.

Should there be any questions on this matter, please contact Mr. Denis Lau, Branch Chief, Clean Water Branch at 586-4309.

Sincerely,

BRUCE S. ANDERSON, Ph.D.
Deputy Director of Environmental Health

c: NR&IAQ Branch
CW Branch

University of Hawai'i at Mānoa

Hawai'i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

February 5, 1997

Dr. Bruce Anderson
Deputy Director of Environmental Health
Department of Health
P.O. Box 3378
Honolulu, HI 96801

Dear Dr. Anderson:

Thank you for your letter commenting on the Draft Environmental Assessment for the Hawaii Scientific Drilling Program.

Your comments related to the project were as follows:
Comment 1: Drilling activities must comply with provisions of the Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control."
Response: As indicated in the Draft EA, the specific sites under consideration for the project were chosen to minimize its potential impacts on the surrounding communities. Included in our consideration of both sites was the advantage of having the drilling activities occur in a topographic depression (an excavated quarry) that will greatly reduce the radiation of noise off the site and into the community. Nonetheless, we are aware of the new regulations governing noise emissions from drilling and construction activities and have requested copies of Chapter 11-46 and copies of the application documents required for a noise permit. We expect to meet with DOH staff to discuss the requirements for the proposed project and to submit all necessary permit applications or variance applications (Please see Section **1.4 Planned Agency Submittals**, page 2 and Section **7.5 Noise**, pages 23 and 24).

Comment 2: The applicant should contact the Army Corps of Engineers to determine whether a federal permit is required for the project.
Response: The Army Corps of Engineers has been contacted and is currently reviewing the Draft Environmental Assessment for the project. We are presently awaiting their comments and questions.

Comment 3: A National Pollutant Discharge Elimination System (NPDES) permit is required for certain types of discharges to waters of the State and, if required, an NPDES permit should be obtained.
Response: We have discussed this issue with staff of the Department of Health and it is our understanding that an NPDES permit would be required if these types of discharge are expected

to flow into any surface water body or into a storm drain that would lead to a surface water body. Both prospective drilling sites are in closed topographic depressions that lie 5 m to >10 m below the local grade level and there are no surface water bodies that flow into or through either area. We do not anticipate that any of the types of water discharge listed (storm water related to construction activities, storm discharge from industrial activities, construction dewatering, cooling water discharges, groundwater remediation activities, and hydrotesting water) could be released from the site into any surface water body near the prospective sites. Nonetheless, we will meet with the Clean Water Branch staff to further brief them on the project and confirm the absence of any significant impact from the proposed project.

Thank you again for your comments on our Draft Environmental Assessment. I hope that the above discussion will adequately address your concerns and comments. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas

BENJAMIN J. CAYETANO
GOVERNOR

GARY GILL
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

DEC 26 1996

December 23, 1996

Mr. Eugene S. Imai
Senior Vice President for Administration
University of Hawaii
244 Dole Street
Honolulu, Hawaii 96822

Mr. Imai:

Subject: Draft Environmental Assessment for the Hawaii Scientific Drilling Project, Hilo, Hawaii

Thank you for the opportunity to review the subject document. We have the following comments.

1. Deep drilling into Hawaiian volcanoes may have issues relating to native Hawaiian culture. Please consult with the Office of Hawaiian Affairs to identify any concerns and mitigate potential impacts.

2. Lighting on the drilling rig may impact flying animals such birds and bats. Please consult with the U.S. Fish and Wildlife Service regarding this matter.

3. What is the potential for any release of sulfur gases? Are there any regulations pertaining to release of gases during deep drilling operations? What are the contingency plans in the event any gases are released?

4. Materials used in the drilling process are expected to be discharged into the shallow aquifer. Please show the location of this discharge in relationship to the Department of Health's Underground Injection Control Line. Would an Underground Injection Control permit be required for this discharge?

5. A shallow well will be drilled to obtain up to 35,000 gallons of water per day. What is the sustainable yield of the affected shallow aquifer? How would water quality and quantity be affected by this well drilling project?

6. According to the environmental assessment, the groundwater below the project site may contain contaminants from the County Solid Waste facility. What is the overall impact of using and subsequently discharging this potentially contaminated water? What are the proposed mitigation measures?

7. Please provide reasons for supporting the determination based on an analysis of the significance criteria in section 11-200-12 of the 1996 Hawaii EIS Rules.

Should you have any questions, please call Jeyan Thirugnanam at 586-4185. Thank you.

Sincerely,

Gary Gill
Director

c: Dr. C.B. Raleigh, SOEST

University of Hawai'i at Mānoa

Hawai'i Institute of Geoph ics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road • Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-8760 • Facsimile: (808) 956-3188

February 4, 1997

Mr. Gary Gill
Office of Environmental Quality Control
220 S. King St. 4th Fl.
Honolulu, HI 96813

Dear Mr. Gill:

Thank you for your recent comments regarding the Draft Environmental Assessment for the Hawaii Scientific Drilling Program that will be conducted in Hilo, Hawaii. As with other comment letters received, we will summarize your comments and our response below and include modifications and changes, along with this letter, in the Final Environmental Assessment.

Comment 1: Deep drilling into Hawaiian volcanoes may have issues relating to native Hawaiian culture; you suggest that we consult with the Office of Hawaiian Affairs to identify any concerns and mitigate any impacts.
Response: We are aware of the potential for conflicts that might arise from the drilling program. We have, however, taken a somewhat different approach than that suggested and have directly consulted with members of the Hawaiian community on the Big Island. Specifically, we have discussed the project extensively with Mr. Patrick Kahawaiolaa, a very active member of the Keaukaha community who is quite concerned with issues related to the use of Hawaiian lands. We have also briefed Ms. Pualani Kanahele, a widely respected expert on issues related to Hawaiian history and culture, and specifically asked if there might be any reason for concern in the Hawaiian community over the proposed drilling project. Neither individual indicated any overriding concern about the proposed activity and only requested that we take care not to adversely impact individuals in the Hawaiian community that may use either of the prospective locations for purposes of gathering of natural materials. We have also provided a copy of the Draft Environmental Assessment to the Office of Hawaiian Affairs for their review and the only issue that they have raised in our discussions of the project has been the acknowledgement that the parcels under consideration for the project are former Crown (ceded) lands (Please see Section **7.8 Socio-Economic**, page 24).

Comment 2: Lighting on the rig may impact flying animals; you suggest that we consult with U.S. Fish and Wildlife Service regarding this matter.
Response: We are aware of this issue. As indicated in the Draft Environmental Assessment, a biotic survey was conducted at the site and no evidence of native bird nesting was observed; it

was also indicated that this area was not in a flight corridor that is known to be frequented by night-flying birds. It is further noted that the contractor supplying the drilling services will be required to shield all rig (working) lights to avoid adverse impacts on the airport operations and on any night-flying birds. We have provided a copy of the Draft EA to the U.S. Fish and Wildlife Service and have discussed with them the likelihood of our operations causing an adverse impact; they have indicated that they did not anticipate any impact on night-flying birds.

Comment 3: What is the potential for any release of sulfur gases during deep drilling activities; are there any regulations pertaining to release of gases during deep drilling activities; what are the contingency plans in the event of any gases being released.
Response: The primary sources of (non-biogenic) sulfur gases in Hawaii are associated with high temperature (>250°C) hydrothermal systems. We believe that the potential for encountering such a system, and the possible release of sulfur gases from it, is vanishingly small. As indicated in the Draft EA, the general location of the prospective drilling sites is as far away as possible from any known evidence of a rift zone or a caldera; these features are the only known sources of sustained, elevated subsurface temperatures in Hawaii. The earlier project encountered a negative temperature gradient with depth, with a minimum temperature of ~46°F, which further substantiates the absence of a nearby hydrothermal system. The rocks into which we will be drilling (at depths greater than 3,500 ft.) will be older than about 400,000 years, further reducing the likelihood of encountering substantially elevated temperatures. Further, the well will have pressure control equipment installed well before the hole depth exceeds that already drilled (and found to be cold in the prior research project); downhole temperature measurements will be made periodically to allow us to assess any possible increase in temperature and to determine whether further drilling can be done safely and without any significant danger of encountering temperatures or pressures that would exceed the capacity of the rig or the wellbore casing. If it is determined by the drilling engineer that a significant threat exists from the downhole temperatures, the drilling program will be modified to eliminate that threat or the drilling program will be suspended until it can be eliminated (Please see Section **7.3 Air Quality**, page 20).

Comment 4: Materials used in the drilling process are expected to be discharged into the shallow aquifer; please show the location of the discharge in relationship to the Department of Health's Underground Injection Control Line; would an Underground Injection Control Permit be required for this discharge.
Response: The materials that will be discharged into the shallow aquifer will be identical to, although smaller in quantity than, those typically released during the drilling of a water well. In discussions with the Drinking Water Branch of the Department of Health they have indicated to us that UIC permits are primarily intended to control wastewater injection and that the materials used in the drilling of a well are specifically excluded from the UIC regulations. We have also obtained a copy of the map used in UIC determinations and have included a copy here; the UIC line traces Kilauea Avenue which, at its closest point, lies about 2.5 km southwest of the

prospective project sites and parallels East Palai Street approximately 3.5 km south of the prospective sites. Hence, the proposed project is located well below (makai), and down-gradient of the UIC line.

Comment 5: A shallow well will be drilled to obtain up to 35,000 gallons of water per day; what is the sustainable yield of the affected shallow aquifer; how would water quality an quantity be affected by this well drilling project.
Response: The freshwater resource in this area is derived from rainfall recharge into the Mauna Loa slope and is estimated by the U.S. Geological Survey to be on the order of billions of gallons per day. The withdrawal of 35,000 gallons per day from this aquifer for the relatively short period of time our drilling will be done will not significantly affect this aquifer (Please see Section 7.4 **Water Quality**, page 22).

Comment 6: The groundwater below the project site may contain contaminants from the County Solid Waste facility; what is the overall impact of using and subsequently discharging this potentially contaminated water; what are the proposed mitigation measures.
Response: The drilling process will entail withdrawing freshwater from a shallow well, using it to mix clays and organic polymers to form a drilling fluid which will be almost immediately returned to the formation as the fluid is circulated down the drill string and washes the drill cuttings away from the bit. During the shallow interval of the hole the net impact of this process, as it regards any possible pollutants that might be present in the shallow water would be either zero (water is pumped out of one well and into another a few hundred feet away) or to dilute the trace contaminants by mixing with water deeper in the aquifer. During deeper drilling (>200 ft.) the drilling process would be removing the (potentially) contaminated water from the shallow aquifer: as indicated in the Draft EA, a series of casing strings will be cemented into the hole at a range of depth intervals and, as drilling penetrates beyond the casing depths, the fluids removed from the shallow aquifer will be lost to the formation only below the depth of the casing string. Hence, if the shallow water is contaminated, that water that is withdrawn from the shallow aquifer will be effectively injected below the shallow freshwater lens and into the underlying saltwater where it will be further diluted with salt water and will remain separated from any possible drinking water supplies (Please see Section 7.4 **Water Quality**, page 22).

We do not believe that any mitigation measures need be applied to the removal of potential contaminants from the shallow freshwater system.

Comment 7: Please provide reasons for supporting the determination based on an analysis of the significance criteria in Section 11-200-12 of the Hawaii EIS Rules.
Response: We are aware of the requirement to provide such an analysis and have included this in the Determination section of the Final Environmental Assessment.

Thank you for your review and comments regarding the Draft Environmental Assessment for the Hawaii Scientific Drilling Project. Should you have any further questions regarding this submission, please contact Dr. Raleigh at 956-6182 or Dr. Donald Thomas at 956-6482.

Sincerely yours,

Donald M. Thomas
For: Dr. C. B. Raleigh

U.S. Department
of Transportation
Federal Aviation
Administration

Western-Pacific Region
Box 50109
Honolulu, HI 96850-4983

January 10, 1997

Mr. Donald M. Thomas
University of Hawai'i at Manoa
Hawai'i Institute of Geophysics and Planetology
School of Ocean and Earth Science and Technology
2525 Correa Road
Honolulu, Hawaii 96822

Dear Mr. Thomas:

As discussed with you earlier, the Federal Aviation Administration (FAA) has reviewed your Draft Environmental Assessment for the Hawaii Scientific Drilling Project which was forwarded by your letter of December 5, 1996.

When possible, it is requested that FAA Form 7460-1 "Notice of Proposed Construction or Alteration" be submitted for further review of specific elements of your project as its location is in close proximity to Hilo International Airport.

We appreciate this opportunity to comment on your project. Please contact me at 541-1236, if there are any questions or ways we may be of assistance.

Sincerely,

Darice B. N. Young
Realty Contracting Officer, AHNL-54B

cc: The Office of Environmental Quality Control
235 S. Beretania Street, #702
Honolulu, HI 96813

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

To: Donald M. Thomas	# of pages ▸ 1
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February 5, 1997

Ms. Darice B.N. Young
Realty Contracting Officer, AHNL-54B
U.S. Dept. Of Transportation
P.O. Box 50109
Honolulu, HI 96850-4983

Dear Ms. Young:

Thank you for your letter commenting on the Draft Environmental Assessment for the Hawaii Scientific Drilling Program. As required by the EA review process, I will summarize your comments and offer responses that will be included in the Final Environmental Assessment.

Your comments related to the project are as foliows:
Comment 1: Because our project is located near the Hilo International Airport Runway, it is requested that the Hawaii Scientific Drilling Project submit an FAA Form 7460-1 "Notice of Proposed Construction or Alteration" for further review of the specific elements of the project.
Response: We have had extensive discussions with Mr. Larry Balbarino, the State of Hawaii Airports District Manager for the Hilo International Airport about our project and have been notified of this requirement. It is our intent to submit the FAA Form 7460-1 after we have selected a contractor and have the exact dimensions (elevation) of the drilling rig mast that will be required for submission of this form. Nonetheless, we appreciate your bringing this requirement to our attention; we see that we did not properly cite this planned submission in the Draft Environmental Assessment and we will correct that oversight (Please see Section 1.4 **Planned Agency Submittals**, page 3).

Thank you again for your comments on our Draft Environmental Assessment. If you should have additional questions on the project, please feel free to contact me at your convenience.

Sincerely yours,

Donald M. Thomas