EXECUTIVE CHAMBERS

HONOLULU

GEORGE R. ARIYOSHI
GOVERNOR

August 26, 1982

Mr. Roy R. Takemoto, Chairman
Environmental Quality Commission
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Mr. Takemoto:

Based upon the recommendation of the Office of Environmental Quality Control, I am pleased to accept the environmental impact statement for the 10-meter telescope for millimeter and submillimeter astronomy on Mauna Kea as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes. This environmental impact statement will be a useful tool in deciding whether the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under applicable laws, and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the proposing agency to weigh carefully whether the societal benefits justify the environmental impact which will likely occur. These impacts are adequately described in the statement, and, together with the comments made by reviewers, provide a useful analysis of alternatives to the proposed action.

With warm personal regards, I remain,

Yours very truly,

George R. Ariyoshi

cc: The Honorable Fujio Matsuda

The University of Hawaii

A 10-METER TELESCOPE
FOR
MILLIMETER AND SUBMILLIMETER ASTRONOMY
AT
MAUNA KEA, HAMAKUA, HAWAII

California Institute of Technology

FINAL ENVIRONMENTAL IMPACT STATEMENT

August 1982

GROUP 70 • Architects • Planners • Interior Designers • 924 Bethel Street • Honolulu, HI 96813 • Phone (808) 533-1445

The University of Hawaii

A 10-Meter Telescope
for
Millimeter and Submillimeter Astronomy
at
Mauna Kea, Hamakua, Hawaii

for

California Institute of Technology

FINAL

ENVIRONMENTAL IMPACT STATEMENT

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The University of Hawaii

A 10-Meter Telescope

for

Millimeter and Submillimeter Astronomy

at

Mauna Kea, Hamakua, Hawaii

Harold Masumoto,
Vice President for Administration

August 1982

Prepared for

California Institute of Technology

by

Group 70

Honolulu, Hawaii

FINAL
ENVIRONMENTAL IMPACT STATEMENT
AUGUST 1982

PROJECT:	CALIFORNIA INSTITUTE OF TECHNOLOGY - 10-METER TELESCOPE FOR MILLIMETER AND SUBMILLIMETER ASTRONOMY
LOCATION:	MAUNA KEA, HAMAKUA, ISLAND OF HAWAII, STATE OF HAWAII
STATE PROPOSING AGENCY:	UNIVERSITY OF HAWAII VICE PRESIDENT FOR ADMINISTRATION 2444 DOLE STREET HONOLULU, HAWAII 96822 CONTACT: Walter Muraoka (808) 948-8216
FEDERAL LEAD AGENCY:	NATIONAL SCIENCE FOUNDATION OFFICE OF THE ASSISTANT DIRECTOR FOR ASTRONOMICAL, EARTH, AND OCEAN SCIENCES WASHINGTON, D.C. 20550 CONTACT: Adair Montgomery, Chairman Committee on Environmental Matters (202) 357-9752 (telephone inquiries) Written comments to be sent to State Proposing Agency
ACCEPTING AUTHORITY:	GEORGE ARIYOSHI GOVERNOR STATE OF HAWAII
CONSULTANT:	GROUP 70 924 BETHEL STREET HONOLULU, HAWAII 96813 CONTACT: Marilynn Metz (808) 533-4445

TABLE OF CONTENTS

ILLUSTRATIONS

TABLES

SUMMARY

The California Institute of Technology (Caltech) proposes to construct a submillimeter telescope on the summit of Mauna Kea, Hamakua, Hawaii. The telescope will consist of a 10.4 meter dish-shaped reflector housed in a 60-foot dome. The proposed 0.75 acre site is located within the Mauna Kea Science Reserve at approximately the 13,360 foot elevation of the mountain. Because this site is situated in a plateau between two cinder cones, the telescope will not be visible from Hilo, Waimea, Hawaii Volcanoes National Park or other lower areas of the island.

The Mauna Kea Science Reserve is owned by the State and is leased by the University of Hawaii. Because the Science Reserve is within a Conservation District the proposed project will require a Conservation District Use Permit from the Board of Land and Natural Resources (BLNR).

It is estimated that when the telescope becomes operational an average of five to seven persons will be present on the mountain at one time, operating in two shifts at the telescope site. They will require dormitory space at the mid-level for the purpose of acclimatization. A base support facility with a staff of approximately 6 persons will be established at Hilo.

In order to construct the facility it is estimated that approximately 100 cubic yards of earth material will have to be excavated for concrete footings, foundation, septic tank, tanks for fuel and water, and housing for a standby generator. The power needs of the facility can be met with the existing 850 kw generator. The conduit for the power line will be laid in a trench from the generator site to Caltech's site. Telephone communication will be accomplished by extending a line from the existing microwave system, located at the UH 88" telescope, to the Caltech site. The line will be buried in the existing utility trench which runs between the generator and the UH 88" facility. Sewage disposal will be by means of septic tank as is the practice at the existing telescope facilities. It is expected that 6-8 construction jobs will be generated for each phase of the construction process.

Caltech anticipates that all construction workers can be recruited in Hawaii. Some of these employees will be sent to Pasadena for training in the disassembly and assembly of the dish and dome. After the dome and telescope are checked out, these workers will assist in disassembling the whole system for shipment to Hawaii and reassembly at the site.

Construction and operation of the Caltech telescope will generate environmental impacts at the project site and within the Science Reserve. Construction related impacts will be primarily related to dust, noise and additional traffic on the summit access road. The dust is estimated to be an extremely small percentage of the total natural dust generation of the summit area. Noise related impacts will be minimized by having the contractor use equipment with proper noise muffling devices. Heavier than normal truck traffic will only continue for two or three weeks.

Excavation of trenches for utility conduits will impact the appearance of the area. Use of existing trenches and excavation of new ones in areas already disturbed will minimize the impact of these actions.

Any existing biotic communities within the construction area and along the utility trenches will be destroyed. However, there are no officially designated rare or endangered species of flora or arthropod fauna on the summit of Mauna Kea. Disturbance will be confined to specific areas directly related to construction and operation of the telescope.

The proposed telescope will operate in that part of the electromagnetic spectrum called the submillimeter, which lies between the radio and infrared bands. Study of the submillimeter band is possible only on very high, dry sites because the earth's atmosphere absorbs the radiation emitted by celestial objects in the submillimeter wavelength. The most important criteria in selecting a site for the submillimeter telescope are: 1) uniformly dry atmospheric conditions; 2) the necessary level of logistical support; 3) low latitude; and 4) good accessibility.

Several sites were considered for the proposed facility. Although each had one or more of the qualities desirable for optimum work in the submillimeter, Mauna Kea was selected because it was excellent in all aspects. Within the summit area, the proposed site was chosen because it is in an area which is sheltered from the wind. The site was also chosen because its flat terrain will require only minimal site preparation work

Caltech is the first new telescope proposed for the mountain since adoption of the Mauna Kea Plan, the policy plan for the mountain which was adopted by the BLNR in 1977. The University of Hawaii believes that the proposed Caltech telescope project, as described, is in accordance with the conditions imposed in this Plan. This EIS is intended to assist the Board of Land and Natural Resources in deciding whether the project's potential environmental impacts can be mitigated so that the use can be accommodated "without unacceptable damage to biotic and other natural values and historic values and the visual appearance of the mountain". (Mauna Kea Plan)

The University has formulated a Research Development Plan which will serve as the programmatic Master Plan for the continued development of the Mauna Kea Science Reserve. The Plan, which was adopted by the UH Board of Regents on 22 January 1982, was developed to reflect State policies such as those set out in the Mauna Kea Plan, the UH Manoa Academic Development Plan, and the Hale Pohaku Complex Development Plan. Caltech's facility is included in the Research Development Plan and is in accordance with the guidelines for new facilities in the Science Reserve that are outlined in the Plan. The Research Development Plan envisions a single EIS for all summit development to the year 2000. Caltech is proceeding with an EIS and CDUA of its own because it has an excellent opportunity to obtain funding for its project from the National Science Foundation (NSF) if certain requirements, including an acceptable EIS, can be completed by October 1982.

Caltech's action is not a phase or increment of a larger total undertaking. The research objectives of the action can be accomplished without any future telescopes being constructed on the mountain. The construction of the telescope will not commit the University or the Board of Land and Natural Resources to any further development on the mountain. Caltech will utilize the infrastructure that is already in place.

If Caltech is required to wait until some indeterminate time in the future when an overall summit EIS is completed, it could result in delaying the project for many years. Caltech is currently at the technological and scientific forefront of the new and exciting field of submillimeter wave astronomy, which is now drawing attention throughout the world. The new telescope will have an excellent opportunity to be the first to unravel the fascinating, but complex, problems of star formation. Both Caltech and UH have an excellent opportunity to make a significant contribution to astronomy if the project can be completed in a timely way.

The costs of the telescope dish and mount construction have been covered by previous National Science Foundation (NSF) grants and Caltech funds. The prior grants do not represent a commitment by NSF to fund the proposed project.

Caltech's application for funding from the NSF is currently under review. This document will be an integral part of their consideration. The financial request is for the cost of the dome construction, the shipping and site work, plus the operational expenses for the completed observatory. If the funding is granted on schedule and all permits are granted, construction of the dome could begin in early 1983, with operations beginning in 1985. Total construction costs are currently estimated to be approximately $2 million, of which approximately $200,000 will go the Hawaii salaries. Annual operating costs are estimated at close to $1 million of which approximately $500,000 will be spent in Hawaii.

PURPOSE OF THIS ENVIRONMENTAL IMPACT STATEMENT

This Environmental Impact Statement has been prepared to accomplish the following:

1. to comply with Chapter 343, Hawaii Revised Statutes;
2. to comply with the National Environmental Policy Act (NEPA);
3. to inform the public of the proposed 10.4 meter submillimeter telescope and to obtain comments on the proposed actions;
4. to assess the environmental setting of the project site and surrounding area;
5. to outline the possible environmental impacts of the proposed actions;
6. to outline mitigating actions for potential impacts;
7. to consider alternatives to the proposed project and the impacts of those alternatives; and,
8. to fulfill the environmental assessment requirements for a Conservation District Use Permit.

Comments received during the review were will be addressed and incorporated into or appended to this Final Environmental Impact Statement.

PART I: INTRODUCTION

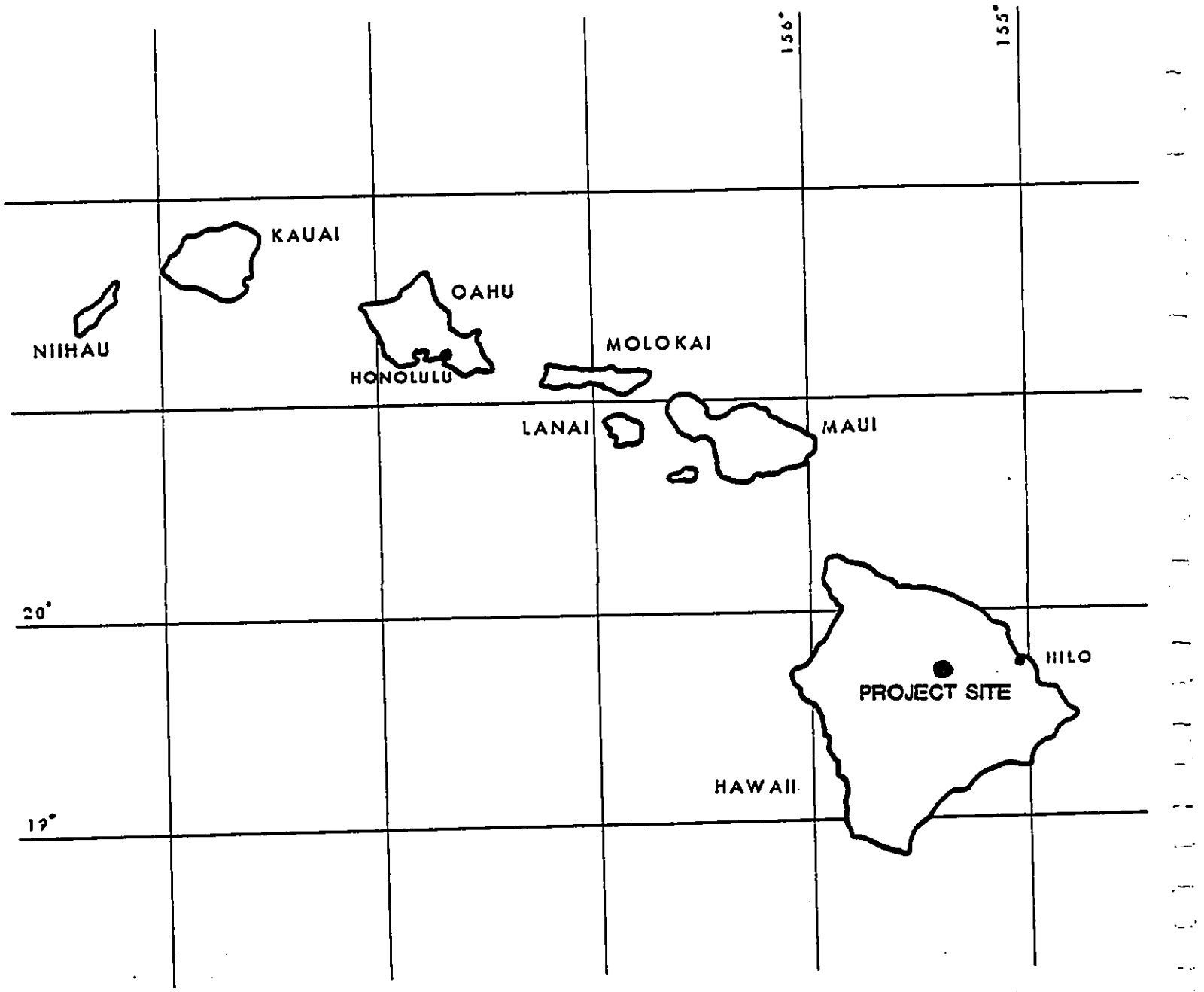
The California Institute of Technology (Caltech) proposes to construct a 10.4 meter submillimeter telescope on the summit of Mauna Kea, district of Hamakua, Island of Hawaii, State of Hawaii. (Figure 1). Mauna Kea has the distinction of being the tallest mountain in the world, rising approximately 30,000 feet from the ocean floor to the summit. In recent years its upper slopes have become a focus for a variety of uses.

The summit of Mauna Kea is recognized as one of the finest sites in the world for research astronomy. There are currently six telescopes in operation on the mountain. New support facilities for the astronomy programs are being built at Hale Pohaku at the 9,250 foot level.

The proposed Caltech telescope will operate in that part of the electromagnetic spectrum called the submillimeter, which lies between the radio and infrared bands. Submillimeter wavelength astronomy is a field which is emerging in the 1980's, promising to be a major contributor to both galactic and extragalactic science. It covers one of the few unexplored regions of the astronomical electromagnetic spectrum; unexplored because of the attenuating effects of the earth's atmosphere and the difficulties involved in constructing large telescopes to high accuracy and sensitive receivers at high frequencies.

Until now, submillimeter research has been carried out either with radio telescopes used somewhat above their optimum frequency, or with optical telescopes which are relatively small for submillimeter wavelengths. Recently, however, it has become feasible to construct large radio-style telescopes which will attain diffraction limited performance in the submillimeter. The development of an instrument capable of studying the submillimeter band has opened a whole new field of inquiry for astronomers. The telescope provides a new way to investigate the astronomical environment in regions inaccessible to optical methods because of extinction. When used as a continuum instrument, the telescope will effectively double the frequency range that is now available to radio astronomy. Such a diffraction limited 10 meter telescope, placed on a high, dry site, will operate at shorter wavelengths than any other radio telescope and will provide a great improvement in sensitivity over existing instruments.[1]

Astronomers are anxious to make observations in the submillimeter band. They now know that stars are formed within dense patches of gas in the galaxy, but the detailed processes by which the gas increases its density even further to form a condensation of particles which become the star and its planets, remain to be discovered. The best way to investigate these



STATE MAP

FIGURE NO. 1

CALTECH TELESCOPE E.I.S.

GROUP 70 8/82

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processes is by the study of the emission of radiation from the gas. Study of the submillimeter band will also be the only way to observe the characteristic emission lines of many of the most important molecules and atoms that make up gas patches. The telescope will encourage qualitatively different projects, which have heretofore been impossible because of the lack of instrumental sensitivity.

The submillimeter band is only available for study on a very high and very dry mountain, such as Mauna Kea, because the water vapor in the earth's atmosphere absorbs the radiation emitted by celestial objects in the wavelength region. The extremely dry air of Mauna Kea and its lack of sky "noise" make it especially well suited for infrared and submillimeter research. In the NASA 1971-1972 sky noise survey of eight observatory sites, Mauna Kea had the best low-noise conditions of any of the sites tested.[2] In addition to the excellent physical attributes of Mauna Kea, the presence of reliable logistical support and of a well established scientific community make Mauna Kea the preferred location for Caltech's telescope.

Construction is being completed on a new 10.4 meter telescope surface and back up structure. The combination of a 10.4 meter telescope with diffraction limited performance to 300 microns, on a site with atmospheric transparency of 300 microns, optimizes the current technological capabilities in the submillimeter and satisfies an astronomical requirement in the early 1980's in a relatively inexpensive manner.

The submillimeter telescope is the fourth in a set of four to be built by Caltech. As the last of four similar telescopes, this telescope will benefit from the experience gained from building and operation of the three previous ones which are now being used for aperture-synthesis radio interferometry at millimeter wave lengths. The successful construction and operation of the three dishes has proven that a dish having sufficient surface accuracy can be built to provide diffraction limited operation at 1 millimeter wavelengths. The Caltech administration has demonstrated its firm support for this project by making the major commitment to establish a new observatory.

Caltech's telescope will both complement and extend the capabilities of the existing instruments on Mauna Kea. As the first instrument capable of studying the submillimeter band, Caltech's telescope will create a capability not formerly existing at Mauna Kea.

The development of a new facility on Mauna Kea can benefit a wide range of programs at the University of Hawaii, not only those directly related to the telescopes, but also in professional and

technical training in related areas such as physics and geology. One immediate benefit of the presence of the Caltech submillimeter telescope will be the exposure of the staff and students of the University of Hawaii to this new field of astronomy and to the world's experts in this area who will be anxious to use the new facility. The University of Hawaii should be able to attract the very highest quality faculty and students in this field, since they will be in the best possible location to take advantage of the new telescope. Clearly, someone already in Hawaii has a great locational advantage in terms of time saved and ease of access than one who must travel several hours and miles to use the facility.

Caltech expects to rent laboratory and office space in Hilo in order to house its technical and scientific staff in Hawaii. Interactions between Caltech scientists and the staff and students of the University of Hawaii at Hilo would be welcomed. Those same staff and students would, of course, be eligible to use the Caltech telescope under the terms of the anticipated agreement with UH.

Caltech is one of the most famous institutions in the world for the study of astronomy. Caltech operates two optical observatories at Palomar and Big Bear, California, as well as the Owens Valley Radio Observatory. Together these constitute a unique and unprecedented concentration of scientific facilities in astronomy. In addition to these astronomical facilities, Caltech operates the Kellogg Radiation Laboratory which studies nuclear structure and reactions, and the Jet Propulsion Laboratory, famous for its contributions to America's Space Program.

PART II: PROJECT DESCRIPTION

The proposed telescope site is located within the Mauna Kea Science Reserve at approximately the 13,360 foot elevation, about 430 feet lower than the summit cinder cone (Puu Wekiu). (Figure 2). The University of Hawaii (UH) leases the Science Reserve from the State Board of Land and Natural Resources (BLNR). Caltech, as proposer for a site within this Reserve, will be required to negotiate a sublease with the UH. This sublease will be subject to the approval of the BLNR.

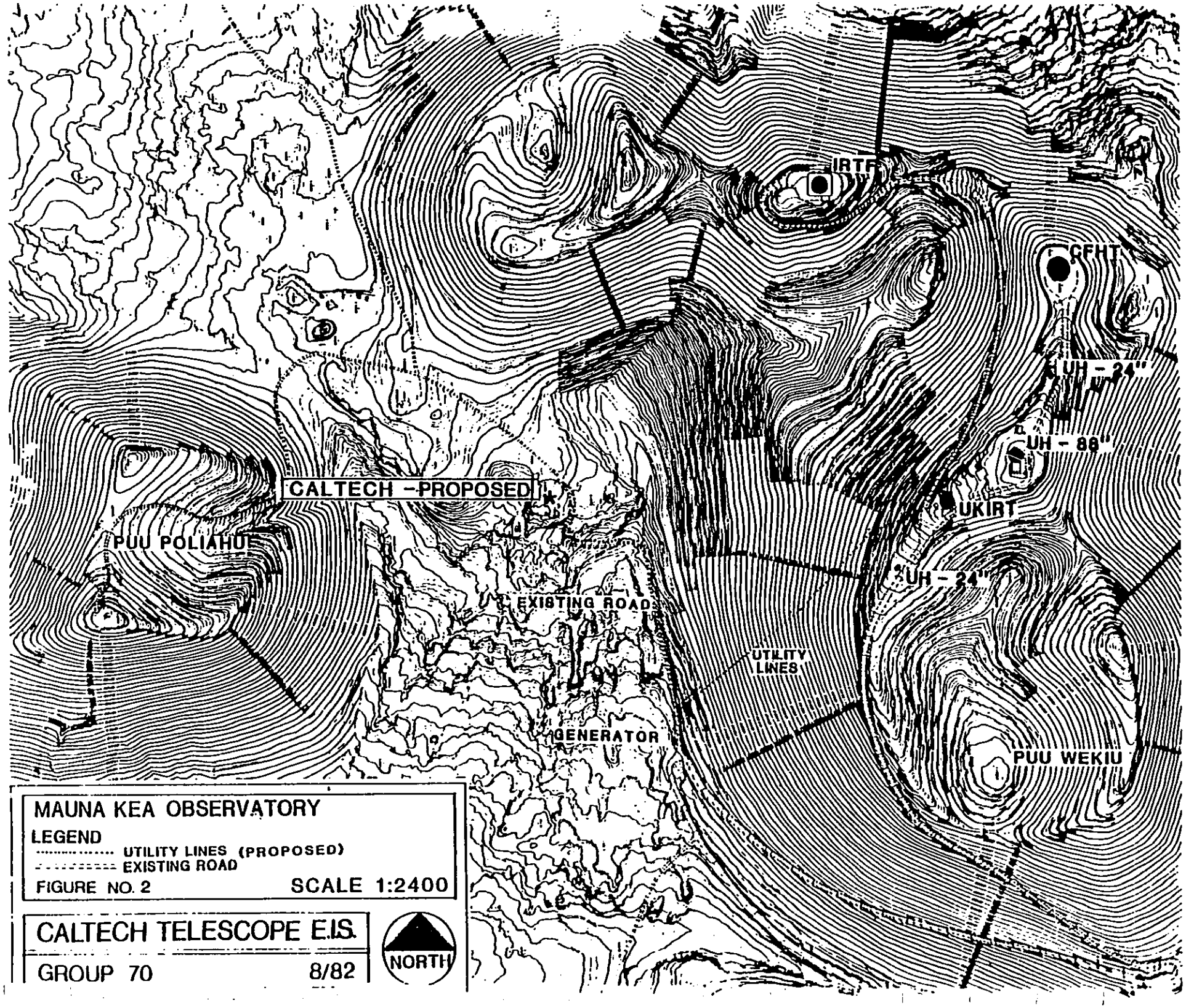
The telescope will consist of a 10.4 meter dish-shaped reflector housed in a 60 foot diameter dome. (Appendix A). The dome will rotate on circular rails at ground level. It will be a slotted aperture astronomical dome having the external appearance of a truncated sphere. The dome has been designed to fit around the telescope with minimum clearance and will also be able to open to clear the full aperture at all opening angles. It will have two movable shutter doors bridging the 10.6 meter wide slot; a spherical top-cap which will roll on rails toward the rear of the dome; and a front door shutter which will roll up and over the dome, nesting between the top-cap and the rear dome surface.

The interior of the dome will be fitted with four floors. These structural components will considerably increase the stiffness of the dome while providing adequate working space. A reinforced concrete footing will incorporate the telescope pad, the circular rail bed, and any needed subsurface facilities. The footing will be about 40 to 50 feet in diameter with a six foot wide circular apron-walkway joined to the outer edge. (Appendix A shows the dome's exterior elevations and schematic drawings of the interior.)

The dish is being fabricated at Caltech. The surface panels and back-up structure will be stored after manufacture and then shipped to Hawaii at the time of assembly. Since the dome will be a new element in the system it will be erected on the Caltech campus and fully tested before any attempt is made to erect it on the mountain top.

It is anticipated that the majority of the components of the dome will be manufactured by an industrial contractor. This same contractor will assist in the assembly of the dome, using local subcontractors in Hawaii and Pasadena. At the present time, Caltech is looking for a prime contractor to oversee the construction phases of the project. They would prefer to hire a national company with offices both in Hawaii and California. The contractor will perform the following tasks:

1. Assistance in color coding, mapping, disassembly and packing of the dome at the Caltech test site. (This task


IRTF
CFHT
UH - 24"
UH - 88"
UKIRT
CALTECH - PROPOSED
PUU POLIAHU
EXISTING ROAD
UTILITY LINES
GENERATOR
PUU WEKIU
UH - 24"
MAUNA KEA OBSERVATORY
LEGEND
UTILITY LINES (PROPOSED)
EXISTING ROAD
FIGURE NO. 2
SCALE 1:2400
CALTECH TELESCOPE E.I.S.
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is to familiarize the subcontractor with the dome structure in order to simplify later reassembly in Hawaii);

2. Site preparation on Mauna Kea to include grading, excavation, foundations, utility line extension, and paving of parking/staging areas in the vicinity of the observatory;

3. Unpacking and assembly of the dome on its foundations using parts and pre-fabricated sections according to the color coding scheme and map devised in (1) above;

4. Provision of utilities and conduits within the dome (electrical, telephone, control, and plumbing);

5. Placement and mounting of electrical and mechanical equipment associated with dome operation;

6. Installation and finishing of interior walls, ceilings, and floor surfaces;

7. Fixture installation;

8. Final finishing, touch-up and clean-up of construction area;

9. Activities in support of required final building inspections; and

10. Assistance in unpacking and installing the telescope mount on its foundation.

Caltech anticipates that all construction workers can be recruited in Hawaii. Some of these employees will be sent to Pasadena for training in the disassembly and assembly of the dish and dome. After the dome and telescope are checked out, these workers will assist in disassembling the whole system for shipment to Hawaii and reassembly at the site.

Construction workers who will be involved in site preparation and skilled artisans necessary to construct the project will be hired on the island of Hawaii. Approximately 6 to 8 employees will be hired for each phase of the construction process. Site preparation work is expected to take two to six weeks, depending on weather conditions, and construction of the dome and telescope will be completed in approximately two years. After tests on the site, operations are anticipated to begin shortly after construction is completed, sometime in 1985.

Although the 0.75 acre site selected for this telescope is essentially level, some grading and excavating will be necessary to prepare the area for construction. Unit loadings for the telescope

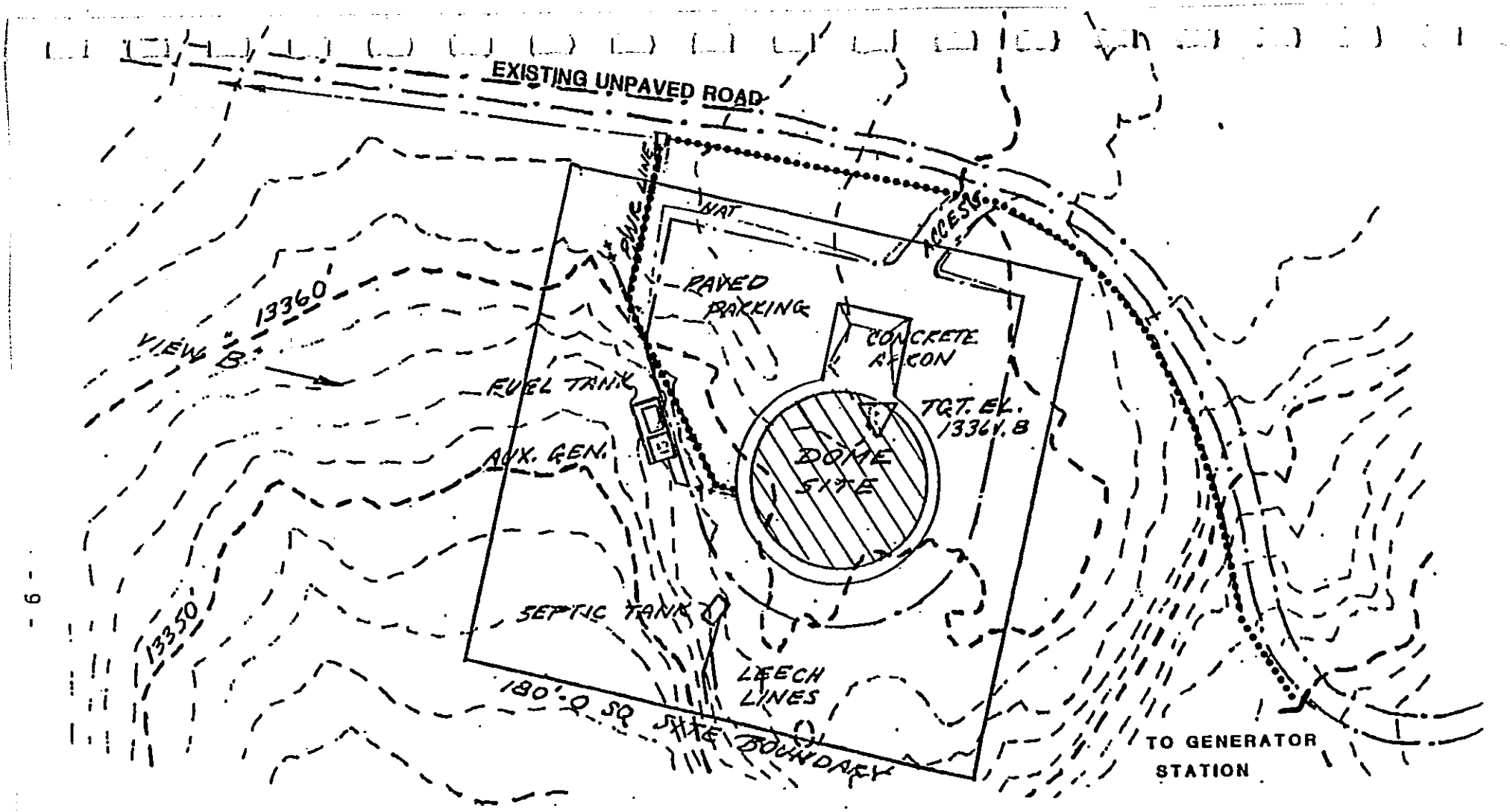
and dome are light (total building and telescope weight will be less than 250 tons), so minimal foundation work will be required. It is estimated that approximately 100 cubic yards will have to be excavated for concrete footings, foundations, an 850 gallon septic tank, housing for the 25 KW standby generator and 1,000 gallon fuel tank, and a 1,000-1,500 gallon water tank. Most of the excavated material will be used as fill or for balancing the site.

150 yards of concrete will be used in the construction of the facility. No concrete batching plant will be required. Dry mix concrete will be trucked to the summit in mixing trucks and water will be added at the site. Each mixing truck holds five yards of concrete, therefore, approximately 30 truckloads will be required. These will be transported to the summit in 3 to 6 truckloads per day, for a period of 5 to 10 days.

The facility will include a 6,000 square foot paved parking area with truck access and turnaround. A 14 x 30 foot paved driveway will provide access to the telescope site from the unpaved access road. A ten foot wide band around one-half the circumference of the building will also be paved. It is anticipated that bituminous macadam with a gravel surface will be the paving material used. This is similar to the pavement near the UH 88-inch and United Kingdom infrared telescope facility (UKIRT). The material was chosen because it has excellent durability. There has been no visible deterioration in the six to seven years since it was installed at UKIRT. An additional advantage of this paving material is its inconspicuous color, which is similar to the surrounding soil. No improvements are expected to be made to the unpaved access road at this time. (Figure 3 shows a preliminary site plan for the proposed telescope).

The telescope will require an average of 15 KW of electrical power with a 60 KW peak demand. These power needs can be met by the existing 850 KW generator, located nearby at the 13,000 foot elevation. Power will be distributed to the site via a conduit buried in a trench running approximately 1,300 linear feet alongside the unpaved spur road from the generator to the observatory.

Telephone communication will be accomplished by extending a line from the existing microwave system, located at the UH 88-inch telescope, to the Caltech site. This line will be installed in the existing utility trench which runs approximately 1,600 feet along the slopes of Puu Wekiu to the generator pad. From the generator to the observatory site the conduit will be buried in the same trench as the conduits that will supply power to the site. Handholes for allowing access to the conduits will be required at intervals of 400 feet. Those along the existing utility trench can be installed adjacent to those already in place. (Figure 2 shows the proposed utility plan to serve the telescope site and Figure 4 gives cross sections and details of the conduits).



SCALE 0 50 100

LEGEND

..... UTILITY LINES

PRELIMINARY SITE PLAN

FIGURE NO. 3

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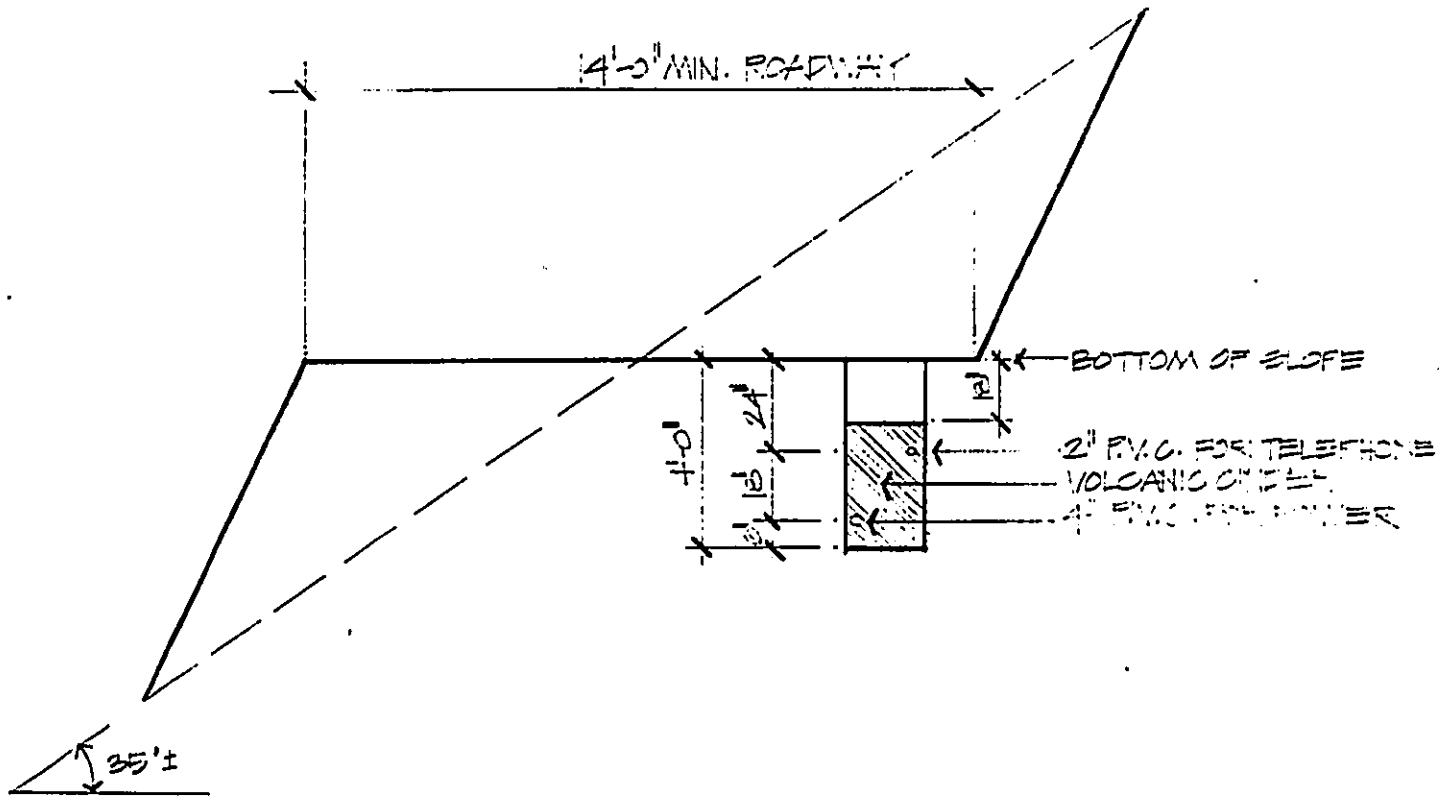

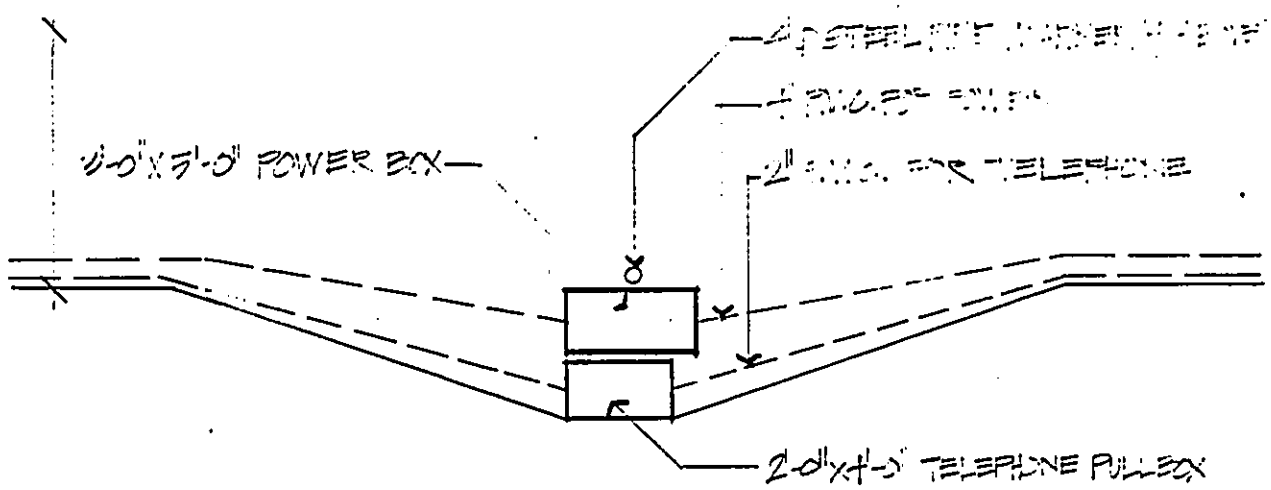

DETAIL OF CONDUIT LINES

FIGURE NO. 4

CALTECH TELESCOPE E.I.S.

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An estimated five to seven persons will probably be present on the mountain at one time, operating in two shifts at the telescope site. These persons include visiting astronomers as well as engineers and technicians. They will require dormitory space at the mid-level facility at Hale Pohaku so that they can remain acclimatized during their on-duty periods.

A base support facility with a staff of approximately 6 persons will also be required. The availability of direct mainland flights, the presence of small industries necessary for logistical support, and the presence of a four year University of Hawaii campus nearby have led Caltech to select Hilo as the preferred base camp location.

The costs of the telescope dish and mount construction have been covered by previous National Science Foundation (NSF) grants and Caltech funds. The prior grants do not represent a commitment by NSF to fund the proposed project.

Caltech's application for funding from the NSF is currently under review. This document will be an integral part of their consideration. The financial request is for the cost of the dome construction, the shipping and site work, plus the operational expenses for the completed observatory. If the funding is granted on schedule and all permits are granted, construction of the dome could begin in early 1983, with operations beginning in 1985. Total construction costs are currently estimated to be approximately $2 million, of which approximately $200,000 will go to Hawaii salaries. Annual operating costs are estimated at close to $1 million of which approximately $500,000 will be spent in Hawaii.

PART III: ALTERNATIVES TO PROPOSED ACTION

A. NO ACTION

The submillimeter telescope has been designed to acquire a specific type of data. There are no alternative means for obtaining this information; if the telescope is not built, the information cannot be acquired at this time from other sources.

No action by Caltech on this specific proposal would not necessarily preclude the possibility of development of the site by another applicant. Several organizations have expressed an interest in locating facilities in the Mauna Kea Science Reserve.

Mauna Kea is internationally recognized as a superior site for ground-based astronomy and, therefore, it can be anticipated that the State will receive requests from within the United States and from foreign countries for permission to locate telescopes there. It is probable that the University and the State will approve some of these requests if they meet the criteria set by the Mauna Kea Plan for locating a facility at the summit.

If a telescope is not placed on this Mauna Kea site by Caltech, the immediate area will remain undisturbed for the time being. Because the site is within the area designated in the University of Hawaii's Research Development Plan as having the best properties for millimeter wavelength telescopes, it will continue to be a highly suitable location for other telescopes of this type.

B. ALTERNATIVE ACTIONS

1.0 Sharing of Existing Astronomical Facilities

The sharing of telescope time to accomplish Caltech's research objectives is not possible because there are no other telescopes designed for diffraction limited work at submillimeter wavelengths. The field of submillimeter astronomy is embryonic and, therefore, existing telescopes are not capable of performing the research which the 10.4 meter telescope is designed to accomplish. There are several reasons for this:

(1) The earth's atmosphere is highly attenuated in this region of the spectrum so that one must use high, dry sites. Most existing telescopes are not ideally sited;

(2) Large radio telescopes do not have sufficiently accurate surfaces for these short wavelengths. Optical telescopes are, by comparison, small, so that only a limited number of objects can be studied. The limitations on resolution and wavelength range can

only be removed by the construction of a larger telescope with a more precise surface; and

(3) Techniques have only recently been developed to allow sensitive detection of signals in this wavelength range, particularly for spectroscopic studies.

Although the proposed telescope will be the fourth in a series of four submillimeter telescopes to be constructed, it is the only one designed to optimize the partial transparency of the earth's atmosphere at 300 microns. Construction and operation of the earlier three instruments, which are located at Caltech's Owens Valley Radio Observatory, allowed Caltech to gain considerable experience with this particular type of telescope.

Owens Valley is neither high nor dry enough to allow these telescopes to perform the same research programs that will be possible for the telescope that is being designed for installation on Mauna Kea. Besides being the only telescope designed for diffraction limited work at the shorter wavelengths, the 10.4 meter submillimeter telescope will probably be the last one designed for this particular type of work for many years to come.

2.0 Infrared Astronomy Satellite

The infrared astronomy satellite (IRAS), a major NASA astronomy effort, is planned to be launched in December 1982. It is designed to survey the entire sky at wavelengths of 12, 24, 60 and 100 microns. Although its functions will be supportive of the submillimeter telescope, it will not be capable of duplicating the work for which the Caltech telescope is designed. The satellite will survey the entire sky, whereas the submillimeter telescope will investigate elements discovered during that survey in greater detail.

3.0 Large Far-Infrared Space Telescope

An alternative action to building the proposed submillimeter telescope is waiting and acquiring the information from the far-infrared space telescope which has been suggested as a possible part of future space shuttle flights. This is not a desirable alternative, since development of this telescope is not expected much before the year 2000, and optimum use of it will depend on less expensive ground-based studies, such as the proposed project, which should precede it.

C. ALTERNATIVE LOCATIONS

1.0 Selection Criteria

The goal for site selection is to make available the full far-infrared coverage to 300 microns so that maximum astronomical use is obtained from a telescope whose diffraction limit will also be set at 300 microns.

The location requirements of the submillimeter telescope are so critical that even small negative departures from the required conditions can seriously restrict the ability of the instrument to realize its designed capabilities. The number of alternate locations that can be considered is, therefore, very limited.

The most important locational characteristics for a telescope designed to study the submillimeter band are:

(a) Uniformly dry atmospheric conditions

Because the water vapor in the earth's atmosphere absorbs radiation from space, submillimeter telescopes must be located in areas dry enough to ensure maximum practical usefulness. The earth-based astronomer must concentrate his observations in a number of specific atmospheric "windows", located between the oxygen and water absorption features. The transmission and, to some extent, the width of these windows depends upon the site altitude and the amount of water vapor above that site.[3]

At 1.5 millimeter or less precipitable water vapor, all of the atmospheric "windows" are available for study by a submillimeter telescope. Consistently dry air with a minimum of "pockets" of moisture enables astronomers to study the full range of the submillimeter for which the telescope is designed. Because each different part of the sky is available for observation only at its own corresponding season, the atmosphere should be uniformly dry, without major seasonal variations.

(b) Low latitude

Latitude should be less than 37° N since more northerly sites would unduly restrict observing at southerly declinations. Also, since a large part of observing time of the submillimeter telescope will be spent on galactic problems (galactic structure, molecular clouds) it is advantageous to locate the

telescope at a low latitude, since the nucleus and inner part of the Galaxy both lie below the celestial equator.

(c) Elevation

Elevation should be greater than 9000 ft. above sea level. Lower elevations are inferior from the standpoint of water vapor. (In the absence of actual water-vapor measurements for a given site, the altitude may be used as a reasonable working criteria for rejection).

(d) Accessibility

The site should be within 50 miles of an established community which could serve as a base for the observing station. Ground travel time would necessarily be excessive for more remote sites. Because different parts of the sky become available for viewing during different seasons, all year accessibility is important. Travel time to the site from the nearest major airport should not exceed 3-4 hours with less than 2 preferable.

(e) Development of site as astronomical center

In addition to inherent locational qualities, an observatory site needs a broad range of logistical support if it is to serve effectively. Specifically needed are access roads, reliable utilities, and, if necessary, a mid-level accommodation for acclimatization. The number and type of telescopes already present also has some influence on the quality of an observatory location. The existence of other telescopes creates job opportunities for necessary support personnel such as engineers, electronics technicians, and computer programmers. The presence of other telescopes may also facilitate more flexible research options.

Table I illustrates how these criteria can be quantified and ranked so that various sites can be evaluated and intercompared based on their particular scores on each characteristic. The table is essentially self-explanatory, however, the bases for quantifying certain criteria require further explanation:

(a) Atmospheric Dryness and Seasonal Variation: Data was extracted from the Infrared Sky Noise Survey by

TABLE I

EVALUATION OF LOCATIONAL CRITERIA FOR MILLIMETER AND SUBMILLIMETER TELESCOPES

Criterion	EXCELLENT Grade "A"	GOOD Grade "B"	FAIR Grade "C"	POOR Grade "D"
Atmospheric Dryness:				
1. a) # days 1.5mm	60	30-60	15-30	15
b) altitude	11,000 ft.	9,000-11,000	7,000-9,000	7,000
2. seasonal variation	little	some	much	great
Latitude:				
Galactic center altitude at transit, degrees	45	35-45	30-35	30
Accessibility:				
1. hours by car from nearest major airport	2	2-4	4-6	6
2. months accessible by road	12	10-11	8-10	8
Development:	several major astronomical telescopes	some astronomical telescopes	some technical, no telescopes	little or none

SOURCE: Compiled by T.G. Phillips, California Institute of Technology

Westphal which was conducted during the early 1970's.[4] The survey included most of the sites that are still worthy of consideration for installing major infrared or millimeter-wave telescopes, and is the only unbiased reasonable comprehensive survey to date. The dryness of the various Westphal Survey sites is shown in Figures 5 and 6, which give the cumulative number of days per year for which the daytime preciptable water was less than a given amount. Figure 6 weights the drier days more heavily because they are more valuable. Weights of 4 for less than one precipitable millimeter, 2 for less than 2, 1 for less than 3, 1/2 for less than 4, and zero for the remaining values were used.

(b) Latitude: This criterion is quantified in terms of the altitude, in degrees, at which the Galactic center transits. Altitudes less than about 45° rapidly become less useful, both because of the greater amount of (water-containing) atmosphere in the line of sight, and because a lower altitude of transit implies a shorter observing time available. Latitude also affects the fraction of the total sky available at the site.

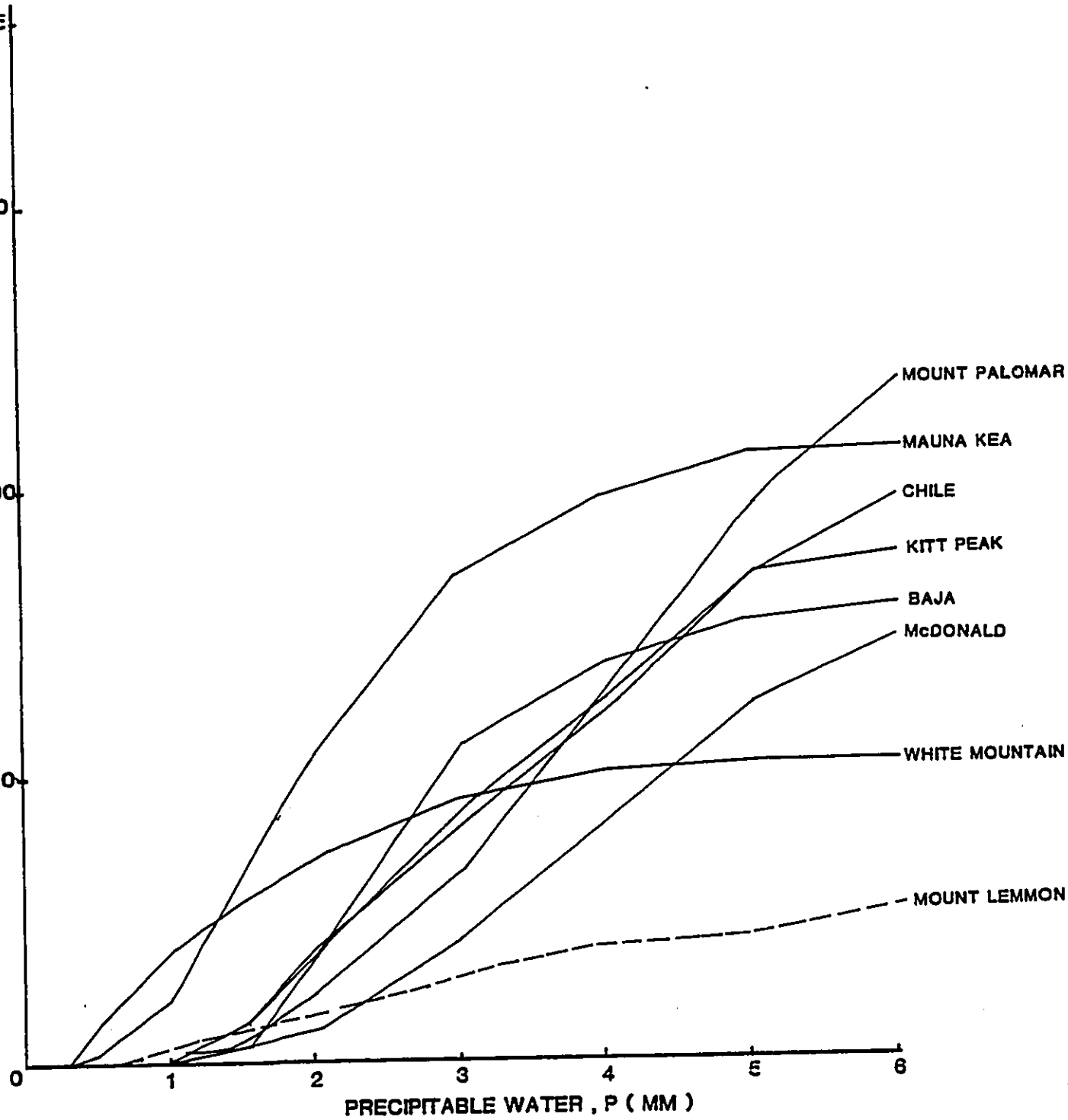
2.0 Analysis of Alternative Locations

Caltech evaluated each of the Westphal survey sites using the criteria established in Table I. Table II presents the results of this evaluation. A brief description of each site follows:

2.1 Kitt Peak, Tucson, Arizona

Description: Located at the 6,875 foot altitude in the Baboquivari mountain range, west of Tucson Arizona, Kitt Peak National Observatory, is the site of five major optical and optical/infrared telescopes. The National Radio Astronomy Observatory operates a 11-meter radio-telescope there which is also used at millimeter wavelengths.

Water Vapor: Based on the Westphal survey as weighted (Figure 6) the atmospheric dryness at Kitt Peak can be considered good for submillimeter observations. The wettest period of the year, however, occurs during the summer, when the galactic center transits at night, thus closing the submillimeter windows more frequently at the optimum season for galactic astronomy.



SELECTED ASTRONOMICAL OBSERVATORY SITES CUMULATIVE NUMBER OF DAYS PER YEAR WITH DAYTIME PRECIPITABLE WATER LESS THAN GIVEN AMOUNT

FIGURE NO. 5

(SOURCE : WESTPHAL 1972)

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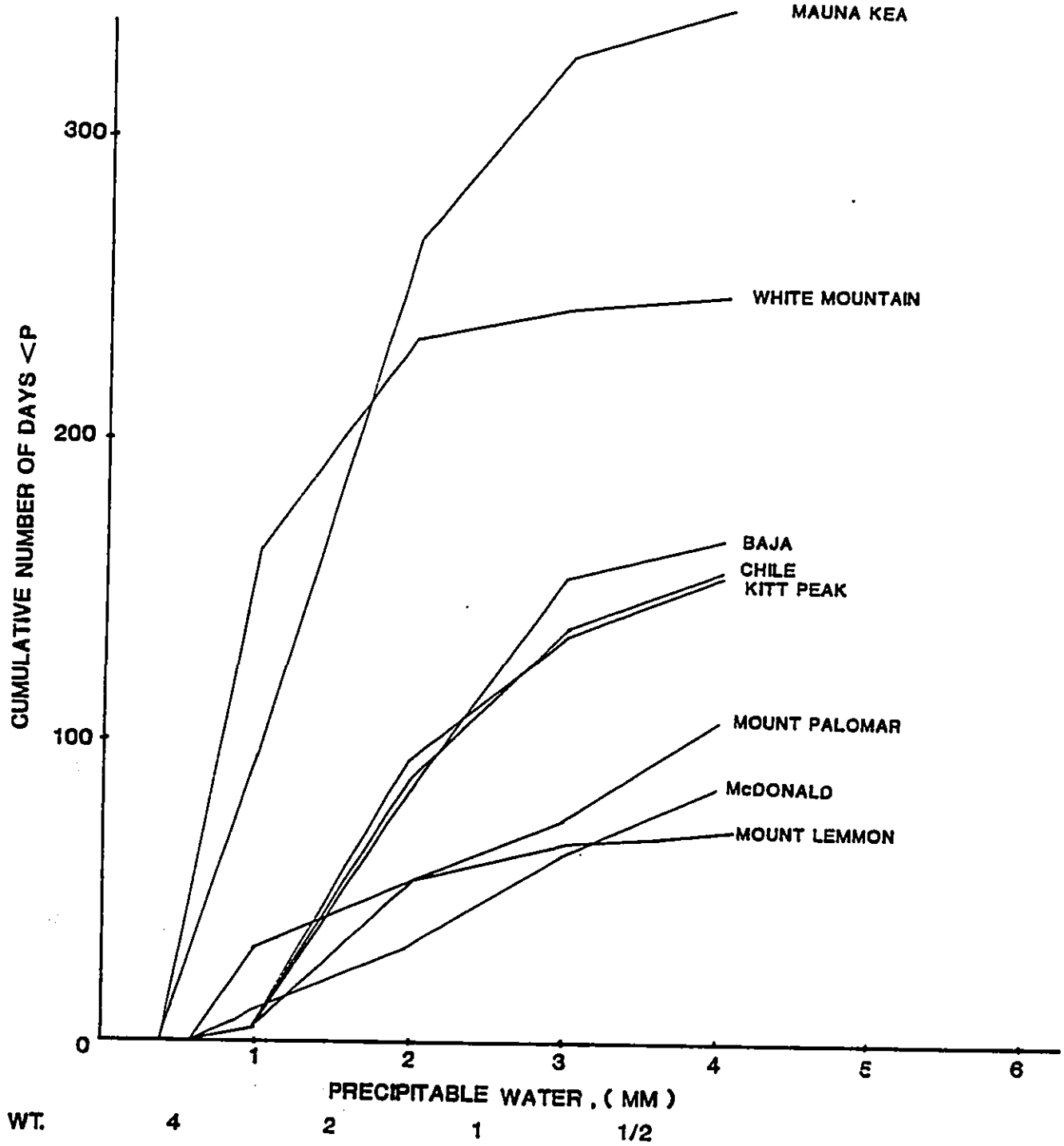
8/82



(SOURCE : T.G. PHILLIPS)

SELECTED ASTRONOMICAL OBSERVATORY SITES. WEIGHTED CUMULATIVE AVERAGE NUMBER OF DAYS WITH WATER VAPOR LESS THAN GIVEN AMOUNT
FIGURE NO. 6

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TABLE II

EVALUATION OF ALTERNATIVE LOCATIONS

SITE	ATMOSPHERIC DRYNESS			LATITUDE	ACCESSIBILITY		DEVELOPMENT
	# of Days <1.5mm[a]	Altitude	Seasonal Variation		Distance to Nearest Airport	Months Accessible by Road	
Arizona							
Kitt Peak National Observatory	B	D	B	C	A	A	A
Mt. Lemmon	B	B	B	C	A	B	B
California							
Mt. Palomar	C	D	B	C	A	A	A
White Mountain	A	A	C	D	B	D	D
Chile							
Cerro Tololo	B	C	B	A	A	A	A
Las Campanas	B	C	B	A	B	A	A
Hawaii							
Mauna Kea	A	A	A	A	B	A	A
Mexico (Baja California)							
San Pedro Martir	B	B	B	C	C	C	B
Texas							
Mt. Locke	C	D	B	C	C	A	A

a Based on weighted cumulative days - Figure 6

Latitude: The galactic center transits at an altitude of 32°, fair for observing in the submillimeter.

Accessibility: Kitt Peak is a well developed site, easily accessible all year long from Tucson, Arizona.

2.2 Mt. Lemmon, Tucson, Arizona

Description: The University of Arizona has established an observatory located on a 9,000 foot peak in the Santa Catalina mountain near Tucson, Arizona. It is considered an excellent site for Infrared Astronomy and the University has installed powerful telescopes and equipment there.

Water Vapor: Based on the weighted Westphal survey, the atmospheric dryness at Mt. Lemmon ranks at the lowest end of the range that it can be considered good for submillimeter observations.

Latitude: The galactic center transits at an altitude of 31°, fair for observations in the submillimeter.

Accessibility: The site is moderately developed and accessible from Tucson, by road 10-11 months of the year.

2.3 Mt. Palomar, California

Description: Hale Observatories were established on Mt. Palomar, altitude 5,600 feet, by Caltech in 1948. The world's largest optical reflecting telescope, 200", is located there. Two Schmidt wide angle telescopes (48" and 18") are also located there. A 60" optical telescope was added in 1972. The 200" optical telescope has been used for observing at millimeter wavelengths.

Water Vapor: The low altitude, seasonal variation, and minimum number of days with less than 1.5 millimeter water vapor, make the site fair to poor for observations in the submillimeter.

Latitude: The galactic center altitude at transit is 30°, fair for submillimeter observations.

Accessible: Mt. Palomar is a well developed site which is easily accessible all year long from both Pasadena and San Diego California. The proximity of Mt. Palomar to major California population centers is reducing the effectiveness of the 200" telescope because of deteriorating sky conditions caused by lights and pollution.

2.4 White Mountain, California

Description: The White Mountain summit site is located on White Mountain Peak at an elevation of 14,250 feet in the White Mountain Range of California. The nearest town is Bishop, California, approximately 3 hours by automobile from the summit. There is no development on the site.

Water Vapor: Based on the Westphal survey, the White Mountain summit site is one of the two driest surveyed and thus excellent for work in the submillimeter.

Latitude: The galactic center transits the area at an altitude of 26°, poor for submillimeter astronomy.

Accessibility: The summit is accessible by four wheel drive vehicle only during the summer months via a 26 mile gravelroad. During the winter, surface travel is possible only by tracked snow vehicles because of the unstabilized road surface, the heavy snowfall, and the lack of snow removal equipment. Because there is no development at the White Mountain summit, no road improvements have been made.

2.5 Cerro Tololo, Chile

Description: The Cerro Tololo Inter-American Observatory, operated by the Association of Universities for Research in Astronomy, was established in 1963. The Observatory is located 60 miles northeast of La Serena, Chile, at the 7,250 foot level on the western slopes of the Andes. There are presently 8 telescopes and support facilities located there.

Water Vapor: The level of water vapor at Cerro Tololo, although good based on weighted Westphal survey, allows for only occasional work at wavelengths in the 650-300 micron range, which is the major fraction of the submillimeter band.

Latitude: This site, located at 30° 10' S Lat., 70° 49' W Long, and has full southern sky coverage. The Galactic center altitude at transit is 86° making the site excellent for submillimeter astronomy by this criterion.

Accessibility: The observatory site is accessible year round via road, a 1-1/2 hour drive from La Serena.

2.6 Cerro Las Campanas, Chile

Description: The Cerro Las Campanas Observatory, operated by the Carnegie Institution, is located at the 8,200 foot elevation on a northwest ridge in the Andes Mountains. There are presently four telescopes and supporting facilities located there.

Water Vapor: Based on the weighted Westphal survey, the site could be rated good based on atmospheric dryness.

Latitude: The galactic center altitude at transit is 86° making the site excellent for submillimeter observations based on this criterion.

Accessibility: The observatory is a two and a half hour drive (120 miles) from the field headquarters in La Serena.

2.7 San Pedro Martir, Mexico (Baja, California)

Description: The Mexican National Observatory is located in the Sierra San Pedro Martir, at an altitude of 9,252 feet. The site occupies one of the peaks along the main ridge of the Sierra San Pedro Martir and overlooks San Felipe Valley to the east. There is an 84" telescope located there.

Water Vapor: Based on the criteria in Table I and data from the weighted Westphal survey, the site can be considered good for observations in the submillimenter band.

Latitude: The galactic center altitude at transit is 33°, fair for submillimeter astronomy.

Accessibility: Accessibility is poor, four to five hours drive, much of it over dirt road, from Ensenada.

2.8 Mt. Locke, Texas

Description: The University of Texas operates the McDonald Observatory on Mt. Locke at Fort Davis Texas, approximately 160 miles southeast of El Paso. The observatory, at an altitude of 6,800 feet, consists of four optical telescopes and one 4.9 meter millimeter wave telescope.

Water Vapor: The site is only fair for observations in the submillimeter based on the atmospheric dryness criterion.

Latitude: The galactic center altitude at transit is 33°, fair for submillimeter astronomy.

Accessibility: Accessibility is good.

2.9 Mauna Kea, Hawaii

Description: The summit of Mauna Kea, altitude 13,796 feet, is the location of four major optical and infrared telescopes representing three foreign countries as well as the United States. The University of Hawaii is the holder of the master lease for the Mauna Kea Science Reserve within which the facilities are located.

Water vapor: Mauna Kea is one of the driest known sites for astronomy and experiences relatively little seasonal dryness variation. Data from the Westphal survey of Mauna Kea (1971 - 1972) showed that for roughly one-third of the observing time the median precitipable water vapor column was less than 1 mm, which means roughly one third of the time should be good enough for submillimeter operation in all of the windows.[5] (Figure 6)

Latitude: Mauna Kea's location near the equator (19° 49' N Lat.; 155° 28' W Long.) gives it excellent overall sky coverage and permits observations of the entire galactic plane. The Galactic center transits at 45°, excellent for submillimeter observations.

Accessibility: The observatory is accessible all year by four wheel drive vehicle. Although the site is distant from the mainland U.S., especially the East Coast, it has good airline connections at Hilo, the nearest city.

3.0 Summary and Evaluation of Alternative Locations

White Mountain, California, Cerro Tololo and Las Campanas, Chile, and Mauna Kea, Hawaii are the four sites which were selected for intercomparison in greater detail using the criteria of water vapor, accessibility, development of the site as an astronomical center, and latitude. White Mountain was not selected because of lack of adequate infrastructure. Although each site possesses one or more of the necessary criteria for successful operation of a submillimeter telescope, Mauna Kea is the preferred location because:

1. Its dry atmosphere, (comparable only to White Mountain), yields superior transmissions of infrared and millimeter wave radiation. The ability to study the galactic center

is of paramount importance. The tropical latitude of Mauna Kea enables astronomers to study such important areas of the sky under better conditions and for longer periods of time than would be possible with telescopes located at more northerly latitudes. In the Southwest, the wettest period of the year occurs during the summer, when the galactic center transits at night. At Mauna Kea, the best weather occurs during spring and summer, the optimum season for galactic astronomy;

2. Its accessibility is good, especially when compared to the difficult access of White Mountain, which was the only other location considered that had comparable water vapor levels; and,

3. The site possesses the necessary level of logistical support.

D. ALTERNATE SITES AT THE MAUNA KEA SUMMIT

In the summit area of Mauna Kea, alternate available sites were considered for the proposed telescope. Protection from wind, local water vapor level, and ease of construction were the elements that were evaluated. The University's Research Development Plan outlines the areas suitable for two main classes of telescopes and designates the areas unsuitable for any kind of development. (Figure 7 shows suitable areas).

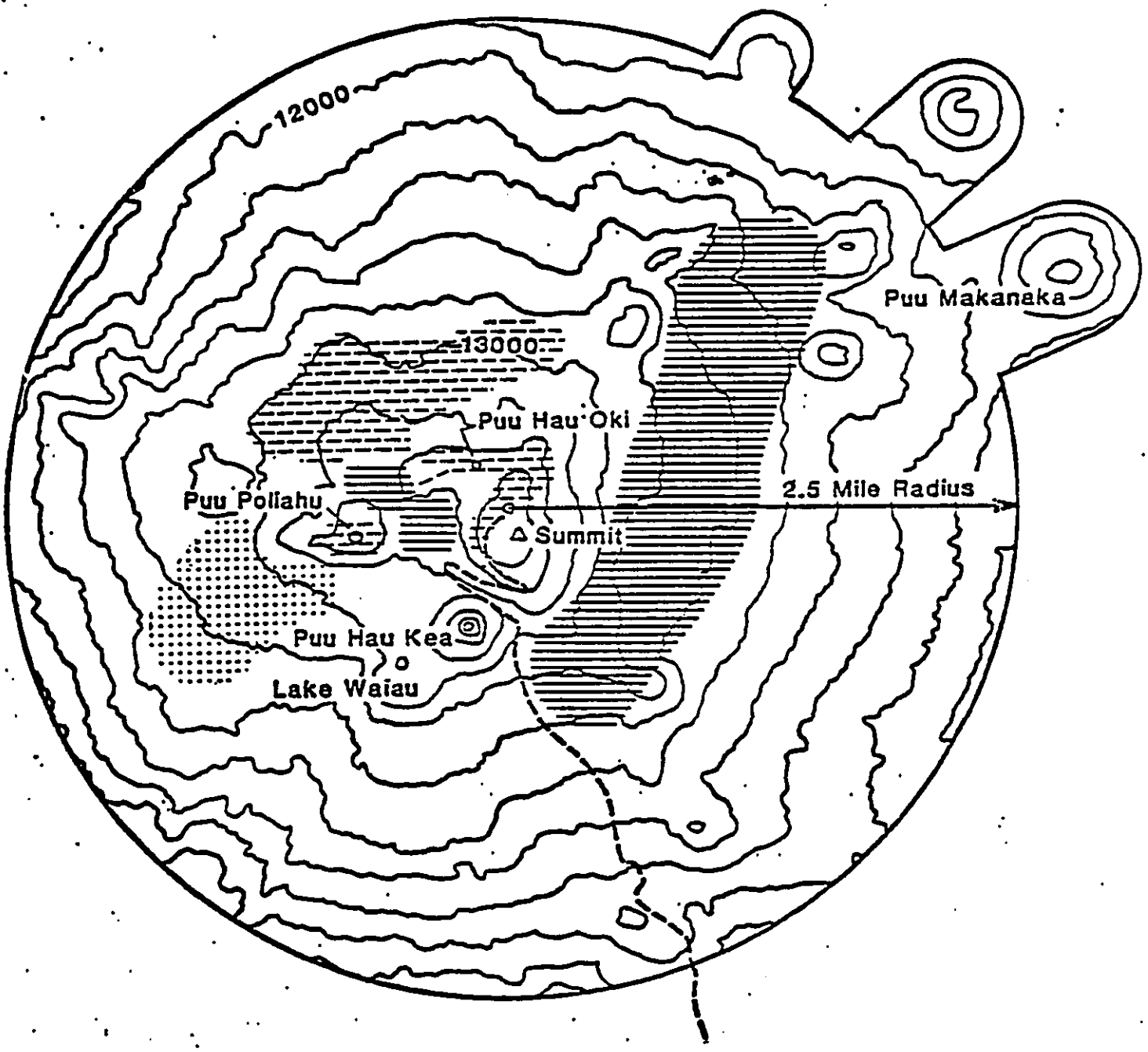
1.0 Site Selection Criteria

1.1 Wind speed

Submillimeter telescopes are sensitive to wind speed. High winds vibrate the telescope and make collection of data difficult. Caltech's dome is a relatively small structure, and when it is in the open configuration high winds can cause problems. More sheltered sites are needed for these telescopes than for optical telescopes. At Mauna Kea, this implies location at the base of cinder cones, a location which averages approximately one-half the wind velocity that the summit peaks experience.

1.2 Ease of construction

Submillimeter telescopes do not need to be located on peaks, which are difficult to construct upon, because they do not require the unobstructed horizon and smooth flow of air which ensures a steady telescope image for optical telescopes. They are not as sensitive to atmospheric turbulence and extraneous light as optical telescopes are.



LEGEND

AREAS LESS SUITABLE FOR TELESCOPES : 'BUFFER ZONE'

AREAS WITH BEST PROPERTIES FOR OPTICAL TELESCOPES

AREAS WITH ACCEPTABLE PROPERTIES OPTICAL TELESCOPES

AREAS WITH BEST PROPERTIES FOR MILLIMETER WAVELENGTH TELESCOPES

REPRODUCED WITH MINOR MODIFICATIONS FROM THE MAUNA KEA PLAN, D.L.N.R.

AREAS SUITABLE FOR ASTRONOMICAL RESEARCH

FIGURE NO. 7

CALTECH TELESCOPE E.I.S.

GROUP 70 8/82

NORTH

Lower, more level sites at the summit are, therefore, desirable, both from a technical and an environmental point of view.

1.3 Local water vapor level

Variations in water vapor at the summit are caused by local terrain, which affects air flow patterns and the occurrence of ground fogs. Measurements of local water vapor levels were done with a hand held infrared hygrometer to determine the driest possible site at the summit.

2.0 Analysis of Alternative Sites (Figure 8)

The following sites within the Mauna Kea Science Reserve were considered and rejected as less suitable than the selected site:

2.1 Hillock sites beside the NASA Infrared Facility

These sites were evaluated and rejected because no road serves the sites, and the sites are also exposed to winds.

2.2 Between the existing optical telescopes on the ridge

Besides being exposed, the ridge does not have enough remaining space for Caltech's telescope.

2.3 Plateau sites to the north

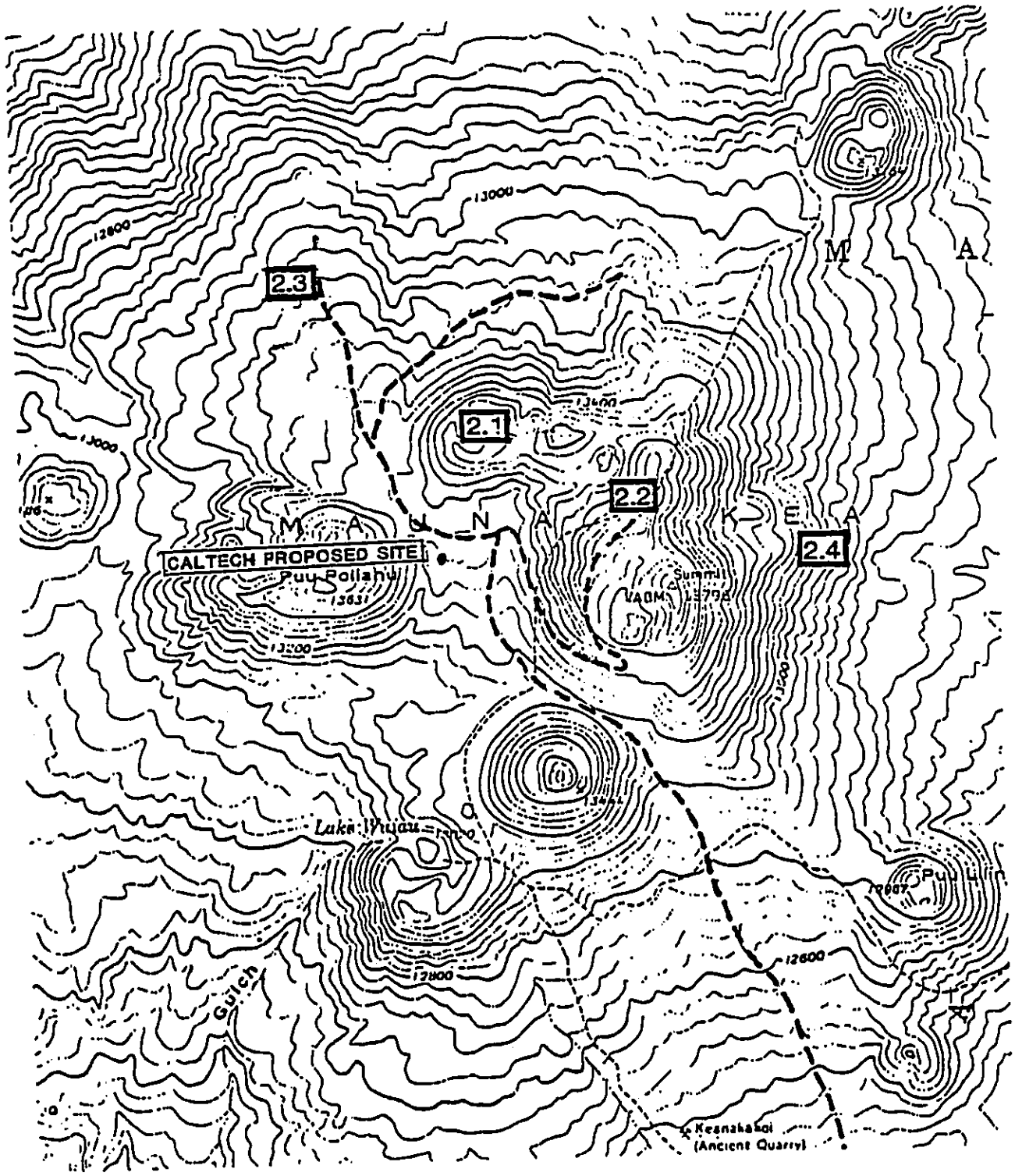
These sites were rejected because they are at a lower altitude, offer no special advantages, and would be more expensive to develop.

2.4 East plateau

Designated in the Research Development Plan as an area with ideal conditions for radio and submillimeter telescopes, the East plateau was not considered by Caltech because it lies at a lower altitude than the site by Puu Poliahu and is somewhat more exposed.

3.0 Summary and Evaluation of Alternative Sites on Mauna Kea

Caltech selected a relatively flat site at the base of Puu Poliahu (Figure 8) because: (1) it has the necessary protection from the wind; and (2) it has a water vapor level suitable for submillimeter astronomy. When compared to the eastern plateau, which has comparable conditions of water vapor and wind



SCALE : 1 = 24,000

ALTERNATE SITES AT THE MAUNA KEA SUMMIT

FIGURE NO. 8

CALTECH TELESCOPE E.I.S.

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NORTH

protection, the Caltech site has the important advantage of being in an area where the visual impact and the construction impacts of the dome will be minimal. The level terrain and location of the site will minimize the amount of land that needs to be disturbed, and the environmental impacts of the action can be correspondingly minimized.

PART IV: DESCRIPTION OF THE ENVIRONMENT

A. THE REGION

The island of Hawaii is the most recently formed of the Hawaiian Islands. Commonly referred to as the Big Island, it was built by five volcanoes and has nearly twice the land area of the other seven major islands combined. The island of Hawaii is located approximately 200 miles southeast of Oahu, the island which contains the capital city of Honolulu and world famous Waikiki Beach.

Agriculture has played an important role in the Big Island's economy, with sugar and ranching as the leaders in this area. Recently, other forms of diversified agriculture such as macadamia nuts, papaya, and cut flowers have experienced considerable growth.

The research and development industry on the island has been growing in recent years. Growth of this industry will help diversify Hawaii County's economy. This is necessary because the visitor industry, which has been the largest contributor to the Big Island's economic growth in the past decade, is highly sensitive to exogenous factors, such as national recessions.

The population of the Big Island is 92,053 (1980 census). Hilo, the largest city on the island (population 35,269), is located on the eastern coast and is a one and one half to two hour drive to the summit of Mauna Kea. The University of Hawaii has a four year campus in Hilo.

B. MAUNA KEA

The summit of Mauna Kea is the highest point in the Pacific basin. It rises over 30,000 feet from the ocean floor to the summit and the highest of its many cinder cones (Puu Wekiu) towers 13,796 feet above sea level. It is one of the two most voluminous volcanoes in the world, the other being its sister peak, Mauna Loa. The seasonally snow-covered slopes of Mauna Kea above the 10,000 foot elevation are utilized for skiing and snow play. Native Hawaiian ecosystems, including rare plants and birds, are found between the 6,000 foot elevation and the summit. Several species are found nowhere else in the world. Over 30,000 acres of the mamane/naio forest area of the mountain have been designated as the critical habitat of the rare and endangered Palila, Psittirostra bailleui, (Federal Register, August, 1977). This bird is found nowhere else in the world.

Hunting of pigs and game birds is a traditional use within and on the perimeter of the Mamane/Naio Forest. General recreation, photography, and sightseeing are also becoming popular uses of the mountain. The mountain's unique volcanic and glacial history and

its remarkable ecosystems makes it an ideal site for scientific field research.

The summit of Mauna Kea is recognized as one of the finest sites in the world for astronomical research, because the skies above it are very dry, free from clouds and atmospheric pollutants, and very dark. There are six telescopes on the summit at the present time. Temporary mid-elevation facilities for astronomers, technicians, and maintenance personnel who operate and maintain these facilities are located at Hale Pohaku at the 9,200 foot elevation of the mountain.

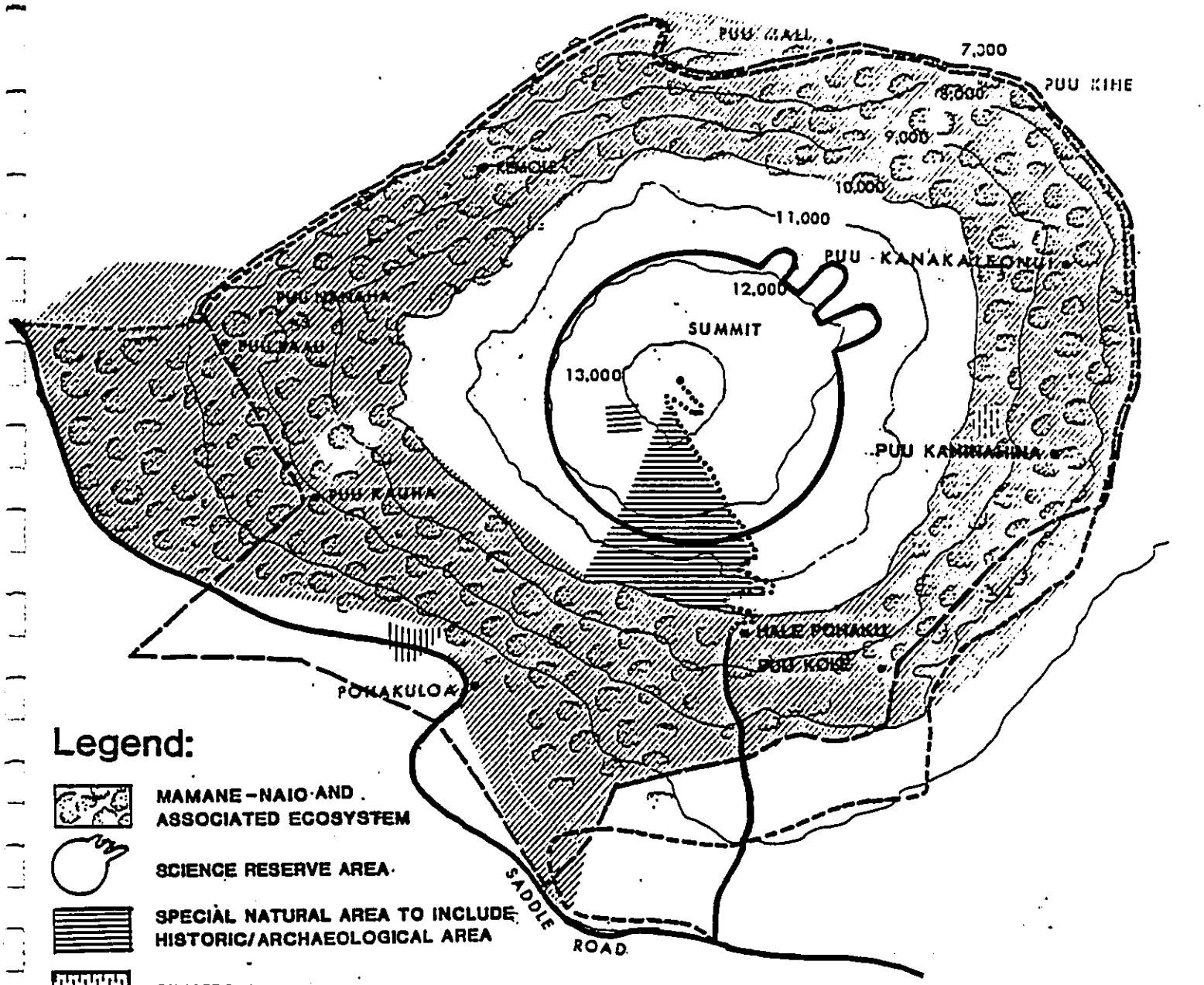
C. MAUNA KEA SCIENCE RESERVE

The project site is located on conservation land owned by the State of Hawaii and under the jurisdiction of the Board of Land and Natural Resources (BLNR). (TMK: 4-4-15:9, Por.) On November 1967, the Board of Land and Natural Resources approved a 65 year lease (beginning January 1, 1968) with the UH Institute for Astronomy for all lands above the 12,000 foot elevation of the mountain. The lease refers to these lands as the Mauna Kea Science Reserve. The Reserve was established as "a scientific complex, including without limitation thereof an observatory, and as a scientific reserve being more specifically a buffer zone to prevent the intrusion of activities inimical to said scientific complex." (General Lease No. S-4191)

The leased area is basically circular in shape, having a radius of 2.5 miles. (Figure 9) Most of the Reserve is designated as a Resource subzone under Regulation 4 of the Department of Land and Natural Resources (DLNR) which provides for land use within the State Conservation District. The objective of this subzone is to develop areas, with proper management, to ensure sustained use of the natural resources. The portion of the Science Reserve that is also a part of the Ice Age Natural Area Reserve is designated as a Protective subzone.

The Science Reserve is not part of a Special Management Area under the Coastal Zone Management Act. All proposed facilities within the Reserve, however, are subject to regulation under County, State and Federal laws on Historic Sites, Natural Area Reserves, and Conservation Districts.

As lessee of the Reserve, UH is not empowered to approve applications for proposed facilities in the Science Reserve, it can only reject them. The approval function is reserved to the BLNR which controls the use of all Conservation District land through the Conservation District Use Application (CDUA) process. The University's recommendations concerning proposed facilities in the Reserve are one part of the information available to the BLNR in making its determination. If a proposed facility is approved by the University and the BLNR, the conditions for the use of land and the



MAUNA KEA PLAN MANAGEMENT AREAS AND CRITICAL HABITAT OF THE PALILA

FIGURE NO. 9

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relative responsibilities and obligations of the parties involved are contained in three documents: a sublease, an operating agreement, and a site development agreement.

A CDUA for the Caltech project was filed June 10, 1982.

D. DESCRIPTION OF THE EXISTING BIO-PHYSICAL AND SOCIO CULTURAL ENVIRONMENT

1.0 Geology

A preliminary geological evaluation of the summit area and the proposed telescope site was prepared by Dames & Moore. Their letter report appears as Appendix B of this Environmental Impact Statement. The following information is excerpted from this report:

The rocks of Mauna Kea have evolved to a relatively mature stage. The most recently erupted rocks possess higher alkali and silica contents than the basalts which comprise the main mass of the volcano. Mauna Kea has been dormant for at least 3,500 years although occasional weak seismicity and the general evolutionary characteristics do not preclude future eruptions. The subaerial portion of Mauna Kea has been dated at least 315,000 $\pm$ 50,000 years.

The principal rock type of the summit area of Mauna Kea is hawaiite which commonly forms clinkery aa lava flows or cinder cones up to 600 feet high with fragments up to 10 feet in size. The occurrence of lava tubes in such aa flows is rare.

In a 1973 foundation study for the Canada-France-Hawaii Telescope (CFHT), Dames & Moore Inc. made four test borings at the telescope site. In general, they indicated sand and gravel size volcanic ash and cinders with occasional clinkers at the surface, layers of weak to well cemented material, some layers with numerous cobble-size clinkers, and hard lava at depths varying from 39 to 51 feet.

Based on available photographs and interviews with University of Hawaii researchers, the proposed site is interpreted to be an aa lava flow which vented in the vicinity of the site and flowed primarily northwest with one lobe extending at the south. The flow surface has been subject to subsequent glaciation and the original flow paths of the lava are obscured. This aa flow overlies a slightly older flow which also moved to the south and southwest - surrounding Lake Waiau and filling the area between Puu Waiau, Puu Poliahu and Puu Hau Kea and partially covered the north and west rim of Puu Waiau.

2.0 Climate

2.1 Precipitation

Precipitation at the summit averages approximately 15 inches annually. Most of this is in the form of freezing fog or snow which can fall during any month of the year. Snowfalls are more common during the cooler half-year (October to April). Records kept by the University of Hawaii, Institute for Astronomy show that between April 1 and December 1 weather only causes minor interruptions in working schedules and then mostly because of high winds. From December through March, however, storms have in the past deposited several feet of snow on the summit, occasionally down to 9,000 feet. Snow in the summit area can cause schedule disruptions due to the difficulty of removing it from the road. Major snowfalls which caused blockage of the summit road have occurred in at least seven of the past ten years. To date, 1982 has been particularly severe, with 10 road closings between January and March.

2.2 Temperature/Wind

The weather at the summit of Mauna Kea is mild for such a high altitude site. During most of the year, the mean temperature is a few degrees above freezing. The highest and lowest air temperatures ever recorded through 1973 were 18°C and -13°C respectively. The extremes in monthly average temperature ranges from 11°C maximum to -4°C minimum.

The prevailing winds at the summit exhibit a diurnal pattern. Daytime winds are predominately from the west/northwest and night winds from the east/southeast. Velocities range from 10 to 30 miles per hour, but most frequently are between 10 and 15 miles per hour. During severe winter storms, winds occasionally exceed 100 miles per hour on exposed summit areas such as the top of cinder cones.

The following table (Table III) shows the average daily temperature and nighttime wind velocities at the Mauna Kea Summit as compiled by Morrison, Murphy, Cruikshank, et. al.

TABLE III

AVERAGE DAILY TEMPERATURE AND NIGHTTIME WIND VELOCITIES

Month	T_{max}(°C) (1965-69)	T_{min}(°C) (1965-69)	Nighttime Wind Speed (mph) (1965-69)
Jan	3	-4	11
Feb	3	-4	20
Mar	5	-1	17
Apr	5	-3	24
May	5	-1	17
Jun	10	0	15
Jul	10	0	15
Aug	11	-1	13
Sep	11	+1	13
Oct	10	0	15
Nov	6	-3	13
Dec	3	-4	19

Source: D. Morrison, R.E. Murphy, D.P. Cruikshank, W.M. Sinton, and T.Z. Martin, "Evaluation of Mauna Kea, Hawaii, as an Observatory Site", Publications of the Astronomical Society of the Pacific, Vol. 85, No. 505, (June 1973): 255 - 67.

3.0 Topography

The Mauna Kea Science Reserve includes a number of cinder cones of varying sizes and shapes along the rift zones that descend from the summit. Slopes in the area vary from flat plateaus to close to vertical slopes on the cinder cones. Puu Wekiu, the summit cinder cone, rises several hundred feet above the surrounding lava plateau. Both the inner and outer slopes of this cone average about 28 degrees. The project site is on a plateau between two cinder cones and is relatively flat. (Figure 2)

The surfaces of the lava flows and cinder cones of Mauna Kea are broken, strewn with rubble, and highly permeable. Runoff at the summit is extremely limited because of low precipitation and high permeability of the existing land types. No drainage improvements are required.

During periods of rain and snow melt, runoff occurs at elevations lower than the summit via existing ground contours, natural drainage patterns, and culverts in the summit access road. Because run-off has caused serious erosion problems at

Hale Pohaku, drainage improvements are being designed in conjunction with the development of the permanent mid-elevation facility there.

4.0 Hydrology and Permafrost

4.1 Permafrost

"Permafrost has been found in the Summit Cinder Cone and negative thermal gradients at the United Kingdom telescope site imply permafrost at depth. However, the extent of permafrost on the summit beyond these localities and its contribution to groundwater is not known." (Dames & Moore - Appendix B)

4.2 Groundwater

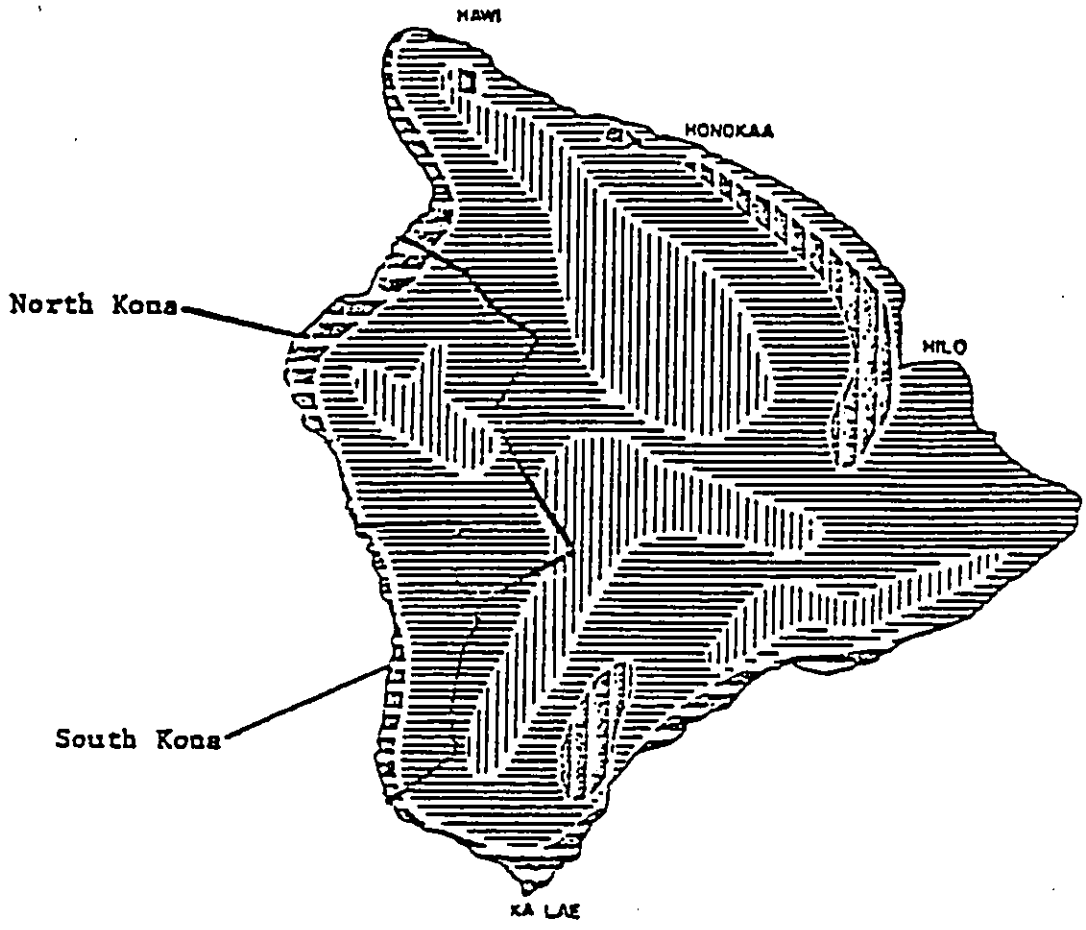
Groundwater, per se, has not been encountered in the summit area. A generalized map showing the locations of various groundwaters on the island of Hawaii, as conceived by Stearns and MacDonald, is presented as Figure 10. [6]

4.3 Surface Water

The only perennial surface water present on the summit is Lake Waiau, a small body of water in the crater of Waiau cinder cone, located at approximately the 13,020 foot elevation. This lake is 4,000 feet from the telescope site and at an elevation 280 feet lower than the site.

The lake is approximately 240 feet in diameter and 8 feet deep at overflow stage. Its origin is considered to be due to either: (1) water ponding above a permafrost layer or, (2) water perched above hyaloclastitic tuff which occurs in the base portions of Puu Waiau (Appendix B). The water of the lake is greenish-blue in color and is somewhat cloudy. The lake is believed to be fed mainly by snow melt. [7]

Woodcock (1980) presents groundwater and surface water level data for the waters of Puu Waiau crater and lake over 13 years. Groundwater levels from piezometers along the south and east margins of the lake indicate primary flow into the lake from the east (groundwater measurements along the north and west margins of the lake are not available). This water moves through the lake and out to the southwest feeding Pohakuloa Gulch.



EXPLANATION

BRACKISH BASAL WATER

BASAL WATER FLOATING ON SALT WATER

WATER CONFINED BY DIKES AND NOT FLOATING ON SALT WATER

WATER PERCHED ON ASH, SOIL OR ALLUVIUM AND UNDERLAIN WITH BASAL WATER

ISLAND OF HAWAII / GENERALIZED MAP SHOWING LOCATIONS OF VARIOUS GROUND WATERS
(STEARNS & MACDONALD - 1946)
FIGURE NO. 10

SOURCE : (STEARNS)

CALTECH TELESCOPE E.I.S.
8/82

NORTH

The biological water quality of Lake Waiau follows an annual cycle from which some inferences can be made regarding groundwater flow, as follows:

"1. In summer, the lake level drops and an upward head from groundwater beneath the lake sediments tends to circulate nutrients up into the water column. A phytoplankton bloom results.

2. In spring, melt water fills the lake, and curtails the bloom. During recent drought conditions (about six years ago), however, this bloom was extreme due to the low volume of melt waters which failed to check the biological activity during the spring thaw. It has taken to 2 to 3 years for the lake to begin to re-establish its normal cycle. This indicates that natural variations of water flow and significant natural biological activity do occur within Lake Waiau." (Dames & Moore - Appendix B)

The influence of an array of physical and chemical factors on diatom populations and phytoplankton productivity in Lake Waiau was studied by Jane Ellen Massey and reported in her dissertation for Doctor of Philosophy in Botanical Sciences, May 1978.[8]

5.0 Air Quality

The summit area, between the 12,000 and 13,796 foot elevation, is well above the 7,000 foot tradewind inversion and thus pollutants such as smog, smoke, dust and salt spray do not cause any particular problem as long as they are generated below the inversion level. Atmospheric pollutants at the summit of Mauna Kea are generally locally generated by automobiles, trucks, the generator and other internal combustion engines. Generator exhaust at sea-level includes 0.1 pounds per hour of unburned hydrocarbons, 2.4 pounds per hour of carbon monoxide, and 20.3 pounds per hour of noxious oxides. Quantities are approximately 1/3 less at 13,000 feet. These pollutants tend to disperse rapidly because of the prevailing wind patterns in the area.

6.0 Vegetation

There are no officially designated endangered plant species on the summit. A report on the vegetation at the summit of Mauna Kea, based on archival research, was prepared by Dr. C.W. Smith and Mr. Paul Kores under the auspices of the Bishop Museum

Department of Botany. Their report appears as Appendix C of this Environmental Impact Statement. The information that follows is essentially excerpted from this report.

6.1 Bryophyte and Lichen Flora

Lichens and bryophytes are the principal components of the flora at the summit of Mauna Kea. The climatic conditions at that altitude tend to be so severe as to exclude most higher plants. The lichen and bryophyte flora are known to be very sparse on the Mauna Kea summit except where shaded from high winds and direct sunlight. The greatest abundance of species is usually found at the bases of and between the large boulders in the area. Six mosses have been reported in the general area:

Amphidium tortuosum
Andreaea acutifolia
Encalypta rhabdocarpa
Grimmia sp.
Pohlia cruda
Racomitrium lanuginosum

The lichen flora includes:

Baeomyces skottsbergii
Diploschistes lutescens
Lecanora polytropa
Lecidea skottsbergii
Rhizocarpon geographicum
Umbilicaria hawaiiensis
Umbilicaria magnussonii

Less than half of the species listed above are endemic to Hawaii. The two *Umbilicariae*, however, are of concern because they are endemic to the islands, and because the upper elevations of Mauna Kea may be the only remaining suitable habitat for them. Photographs of the proposed Caltech telescope site indicate that the area is a very likely site for all of the species listed above.

6.2 Higher Plants

One native species (*Argrostis sandwicensis* Hbd.) has been reported above the 13,200 foot elevation on Mauna Kea and is present only in extremely low density. Other native species occur in the 10,000 to 11,500 foot range (e.g., *Raillardiax arborea* Gray and *R. Struthioloides* Gray) and may extend their altitudinal distribution by occupying areas with favorable microclimates. Their presence near

the summit has never been documented. The project site is not suitable for native pteridophytes (ferns) or phanerogams (seed bearing plants).

7.0 Fauna

7.1 Avi-Fauna

Due to the limited amount of vegetation at the summit, few birds have been observed in the Science Reserve Area. The chukar partridge inhabits bare and rocky slopes at timberline and higher elevations. It is possible that this game bird transits the summit area.

The Hawaiian Dark-Rumped Petrel or 'Ua'u (Pterodroma phaeopygia sandwichensis) is an endangered endemic subspecies which was recently rediscovered on Mauna Kea, Haleakala, and Lanai. The 'Ua'u is believed to have once had well established breeding populations on all of the major Hawaiian Islands.

Earlier reported to nest between 1,500 and 5,000 feet on Mauna Kea, it now appears that the 'Ua'u only digs its burrows at higher sites where the predator population is less dense. None have been sighted near the project site. A draft of a Recovery Plan for the "Hawaiian Dark-Rumped Petrel and Newell's Shearwater" by Thomas Telfer is in the process of agency review. Preliminary recommendations note predator control as the key to removing the species from endangered status.

7.2 Mammals

The Hawaiian Hoary Bat (Lasiurus cinereus semotus) is an endangered species that exists primarily on the island of Hawaii. Sightings have also been reported on Oahu, Maui, and Kauai. [9] The bats apparently prefer habitats of open or mixed character and venture consistently out over the open ocean. Bats have been seen from sea level to 13,200 feet on the island of Hawaii [10] but are most common from sea level to 4,000 feet. None have been observed in the summit area.

7.3 Arthropods

There are no officially designated endangered species of arthropod fauna present at the summit. A provisional assessment of the arthropod fauna of the area to be impacted by the proposed Caltech telescope was prepared by Francis G. Howarth, Ph.D. of the Bishop Museum. His

complete report appears as Appendix D in this Environmental Impact Statement. The following is excerpted from this report and other cited sources:

Recent biological investigations of the summit area have resulted in the discovery of a neogeoaeolian ecosystem on Mauna Kea. (An aeolian ecosystem on young, unvegetated lava flows.) The major component of the fauna of the aeolian ecosystem on the summit is composed of arthropods. About 12 species appear to be maintaining permanent populations in this ecosystem: three species of spiders, four species of mites, two species of springtails, one species of bark louse, and two true bugs.

One true bug, a highly aberrant new species of the world wide genus Nysius, was recently discovered at the summit. The habitat of this new bug is most commonly under large boulders and among cinders. None were observed at the project site during the field surveys conducted by Dr. Howarth, March 8 and 9, 1982.

Two species of springtails and four species of mites were found in the soil at the Caltech site. Because they are not authoritatively identified, no conclusions can be drawn of their significance. Two active aeolian animals were observed under rocks: a native Hawaiian lycosid wolf spider and an anystid mite.

Primitive animal groups, such as small crustaceans and fly midges, inhabit Lake Waiau.[11] Lake Waiau is located approximately 0.75 miles from the project site at an elevation approximately 280 feet lower.

8.0 Hazards

Mauna Kea is located in Earthquake Zone 3 (on a scale of 0 - 3 in the zone of highest seismic occurrence and danger). All construction work is subject to provisions of the "Uniform Building Code" which requires that all structures be designed and constructed to meet Zone 3 requirements.

In 1966, Dames & Moore performed a scientific investigation of the summit for the University of Hawaii in order to determine whether observatory operations would be feasible there. They concluded that an observatory could operate successfully with a foundation system designed to minimize the magnitude of ground vibrations transmitted to the telescope.[12]

Mauna Kea has progressed to a later stage in its volcanic life cycle, a stage characterized by short and stubby flows,

larger and more numerous cinder cones and less frequent eruptions. Based on the infrequency of its eruptions in the recent past, the probability of Mauna Kea erupting in the next several decades is very low. If Mauna Kea does erupt again some time in the future, its eruptions will likely be of the explosive type that produces abundant blocks and ash that cover areas near the eruptive site with large and small fragments.[13]

9.0 Archaeology/Anthropology/Natural History

9.1 National Natural Landmark

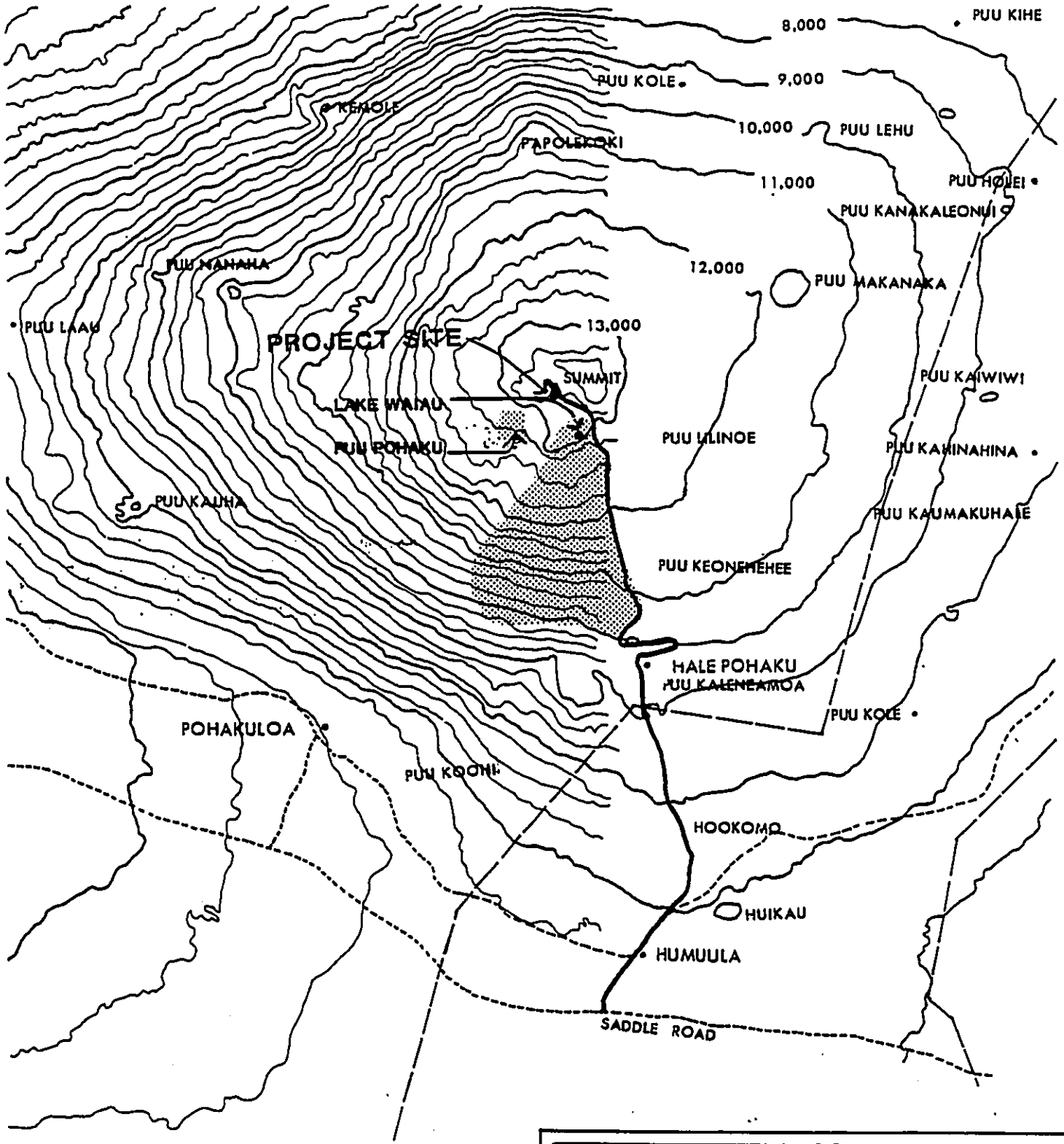
Mauna Kea has been designated as a National Natural Landmark and is listed in the National Registry of Natural Landmarks. But, in spite of the listing, Mauna Kea, among other landmarks also designated, is not a registered landmark, since the Board of Land and Natural Resources has not officially agreed to the designation.

9.2 Mauna Kea Ice Age Natural Area Reserve

9.21 Description

The Mauna Kea Ice Age Natural Area Reserve is located between the elevations of 10,400 and 13,200 feet (Figure 11). It extends into a portion of the summit area that is leased to the University of Hawaii as the Mauna Kea Science Reserve. The west boundary of this reserve is the western ridge of Pohakuloa gulch and the east boundary is along the summit road from a 100 foot distance. Pu'u Pohaku, located about a mile to the northwest, is a satellite section of this reserve. The Natural Area Reserve designated for the area described was approved by the Board of Land and Natural Resources November 9, 1978. A Conservation District Use Application for the area was approved by the Board in 1981. On November 16, 1981, the Governor signed an Executive Order establishing the Mauna Kea Ice Age Natural Area Reserve.[14]

The main ice age features located in the reserve are Pohakuloa Gulch (formed by glacial meltwater), glacial moraine and meltwater deposits of fine sediments (present down to the 10,500 foot elevation), and the glacially sculptured features of cinder cones and lava flows. The Keanakakoi Adze Quarry, an ancient Hawaiian Historic Place, and Lake Waiau, one of the highest lakes in the United States, are other features of the Reserve.



LEGEND

MAUNA KEA ICE AGE
(NATURAL AREA RESERVE)

MAUNA KEA ICE AGE NATURAL RESERVE

FIGURE NO. 11

CALTECH TELESCOPE E.I.S.

GROUP 70 8/82

NORTH

9.22 Keanakakoi Adze Quarry

The Keanakakoi Adze Quarry is located within the Natural Area Reserve at the 12,400 foot elevation. The quarry site is listed on the National Register of Historic Places. There are a variety of ancient Hawaiian culture remains, dating back to about 1,000 A.D., that are scattered throughout this quarry. These include religious shrines and rock shelters of different types, which were established in conjunction with a series of adze (tool) quarries and workshops.[15]

The site was a very important and extensive center of Hawaiian adze manufacturing. Scientists at the Bishop Museum have been collecting information about the process of obtaining raw material and of the manufacture of this important class of stone tools. During their survey, excavations, and analysis of the Quarry they found the first evidence of Hawaiian rock art on the upper slopes of the volcano. There was also evidence of intermittent, short-term habitation in the numerous rockshelters including artifacts and well preserved food remains.[16]

"The Mauna Kea Adze Quarry is probably one of the nation's least known but most important National Historic Landmarks, from both a research and interpretive point of view. It is the only landmark of its kind in the United States. Moreover, it is probably one of the largest and most complex stone tool quarries in the world." (McCoy 1976) [17]

9.23 Lake Waiau

Lake Waiau, elevation 13,020 feet, is one of the highest lakes in the United States. It is one of the few natural perennial fresh water bodies in Hawaii. In addition to being a significant geological feature of the area, Lake Waiau has been regarded by the Hawaiians as a sacred place and as a cultural tie with the past. In ancient times it was the repository of umbilical cords which were deposited in the lake after appropriate ceremonies which followed tortuous climbs to the summit area.[18]

9.3 Archaeology of the Summit and the Caltech Site

An archaeological survey of the proposed site was carried out by the Department of Anthropology of the Bishop Museum on 17 July 1982. No archaeological sites were found on the project site.

During a concurrent survey (which was conducted under a separate contract in conjunction with the preparation of a Master Plan for the Mauna Kea Science Reserve), two previously unrecorded sites were located approximately 450 feet and 700 feet, respectively, to the south/southwest of the Caltech site. A more detailed description of these and many other newly-discovered sites on the summit and assessments of their culture-historical significance will be incorporated into the Mauna Kea Science Reserve Master Plan. (Appendix E presents the Bishop Museum Report of the reconnaissance survey of the Caltech site).

E. EXISTING USES OF THE PROJECT AREA

1.0 Astronomy

"The entire area leased as the Mauna Kea Science Reserve will be used primarily for scientific research, in accordance with lease arrangements with the University of Hawaii." (Mauna Kea Plan) There are six telescopes in operation at the summit at the present time. In addition to the domes that house these telescopes, there are auxiliary buildings associated with each facility. (Figure 2).

The principal characteristics of the telescopes, as described by the University of Hawaii Institute for Astronomy, are:

Two small (0.61 meter) instruments, provided to UH by the U.S. Air Force and by NASA in the late 1960s, are used by faculty and students in a variety of programs where the light-gathering power of the larger telescopes is not necessary.

The UH 2.2-meter telescope, the primary instrument available to University of Hawaii faculty and students. It was constructed, and is now operated, with State and Federal funds.

The Canada-France-Hawaii 3.6-meter Telescope (CFHT) which serves as the principal telescope for ground-based astronomers in Canada and France; and also plays an important role in the UH research and graduate training program through the University's membership in the CFHT Corporation. Eighty-eight percent of the operating costs are shared equally between Canada and France, who paid for the total cost of construction of the facility. The University is responsible for the remaining 12 percent of the operating costs. Use of the telescope is shared in the same proportion as the contributions towards the operating costs.

The two infrared telescopes, the 3.0-meter NASA-funded Infrared Telescope Facility (IRTF), and the 3.8-meter United Kingdom Infrared Telescope (UKIRT), are designed for studies of cooler celestial objects such as planets and stars in the process of formation. The cost of IRTF's construction and operation were and are funded entirely by NASA. The University's Institute for Astronomy managed the telescope construction under contract to NASA, and now operates the telescope as a nationally-available facility with 25 percent of the observing time being granted to UH astronomers. The UKIRT is funded entirely by the British government; under the terms of the agreement UH scientists receive 15 percent of the UKIRT observing time.

2.0 Other Scientific Research

Mauna Kea has a number of natural resources which make it a laboratory of particular interest to scientists from various disciplines. Geologists are interested in its unique volcanic and glacial history. Its altitude, weather and atmosphere make it an interesting laboratory for the study of meteorology. As the highest insular volcano in the world, Mauna Kea with its remnant endemic ecosystems represents a unique research environment for biologists and botanists.

3.0 Skiing and Snow Play

The Mauna Kea Plan states that winter snow-play and skiing will be permitted at appropriate summit areas. Many island residents and visitors participate in snow activities during the winter season. Members of the Ski Association and Ski Patrol have noted a marked increase in snow-play participants over the past few seasons. The Ski Association works closely with the Institute for Astronomy in order to make certain that skiing does not interfere with astronomical operations.

4.0 Other Uses

Sightseeing, photography and hiking are among some of the other uses for the summit area. The use of "off-road" vehicles has become increasingly popular. This activity has left scars on the cinder slopes and cones.

F. INFRASTRUCTURE AND SERVICES

1.0 Access

1.1 Summit Access

Access to the telescopes is from Saddle Road, Route 20, which connects Hilo to Mamalahoa Highway, Route 19.

From Saddle Road at Puu Huluhulu, a paved road extends approximately six miles to Hale Pohaku. From there, an 8.5 mile unpaved one-lane road extends to the summit. In 1976 the road was partially realigned from the original Mauna Kea Access Road built in 1967. Repair work was done in 1980. Funds are now being sought for safety improvements to the shoulders and embankments of the road.

1.2 Roads Within Science Reserve

Roads within the Science Reserve are currently unpaved. An existing spur from the main summit road will be used to provide access to the Caltech site. This road is shown in Figure 2.

2.0 Water

Water must be trucked to the summit from Hilo. Each telescope has its own water storage tank and distribution system. The various tanks require approximately three trips a week by a 5,000 gallon water truck to keep them filled.

3.0 Power

Power to the summit is supplied by an 850 KV generator located at the base of the north side of Puu Hau Kea at the 13,200 foot elevation. (Figure 2). Two 12 KV underground power lines run from the generator to the summit area. At the summit, the distribution transformer is mounted on a concrete pad next to the utility building near the UH 88-inch telescope. The power is distributed through underground conduits to the existing facilities.[19] The diesel fuel for the generator is stored in a 11,000 gallon tank which is filled every ten to fifteen days by a fuel truck from Hilo.[20]

4.0 Communications

Telephone communication to the summit is by a microwave system. One common microwave antenna, located on the UH 88-inch telescope facility, serves the existing six telescopes. This antenna, approximately four feet in diameter, is mounted atop a six foot pole which in turn is mounted on a 40 foot building. The electronics for the system are located on the first floor of the 88-inch telescope building. Conduits containing the telephone lines are buried in the same trench as the power conduits.

5.0 Sewage Disposal

Each of the four large existing observatories has its own septic tank. The two smaller UH telescopes share the UH 88" septic tank.

6.0 Solid Waste

Solid waste generated by the facilities is primarily composed of waste paper, spent food containers and very limited amounts of waste food. The solid waste generated at the summit is carried down to Hale Pohaku by telescope personnel. From there it is trucked daily to a dumpster located at the Mauna Kea observatory headquarters in Hilo.

7.0 Protective Services

The University of Hawaii Institute for Astronomy, is responsible for the security of its area and the safety of astronomy personnel. Each observatory is responsible for the security of its own facility. Personnel at the individual telescopes are responsible for fire protection within their respective facilities. Large portable fire extinguishers are available in each observatory.

An emergency room has been designed as a part of the commons area within Hale Pohaku to provide space for the treatment of injuries and illnesses. A fire contingency plan is for the Hale Pohaku area is in the process of being developed.

G. RELATED FACILITIES

1.0 Mid-Elevation Facilities at Hale Pohaku

Construction of a permanent University of Hawaii, Institute for Astronomy, Mid-Elevation Facility at Hale Pohaku began in May 1982. The new buildings will replace the temporary structures which are now being used by astronomy personnel for sleeping, eating, and telescope-related research activities.

The new facility will consist of sleeping areas which will accommodate 59 persons; a common area which will contain dining, lounging, kitchen and other facilities shared by all users; a research support area with offices and preparation areas to facilitate functions that must be performed during telescope operations; and a maintenance area which will house the generator and provide space for minor equipment repairs and other repair and maintenance functions. Other more extensive and elaborate facilties for the research program are provided at UH Manoa and the base support facilities at Hilo and Waimea.

A mid-level facility is required so that astronomy personnel who work in the rarefied atmosphere of the 13,796 foot summit can remain acclimatized during their on-duty periods. The elevation of Hale Pohaku, 9,200 feet, was determined to be

the most suitable altitude for the purpose of acclimatization. Recent studies being conducted by the United Kingdom have verified this fact. Acclimatization is important because individuals going directly from sea level to nearly 14,000 feet can suffer from mountain sickness (Serouche), loss of mental acuity, and difficulty in concentration. These effects could result in reduction of capability to function effectively at the high elevations.

An information/interpretive station is also planned for development at Hale Pohaku. The station will provide the public with information about natural and man-made features which are located at the summit and elsewhere on Mauna Kea. Warnings will be posted at the station about the dangers of the high altitude and cold and the risks of driving to the summit in other than four-wheel drive vehicles.

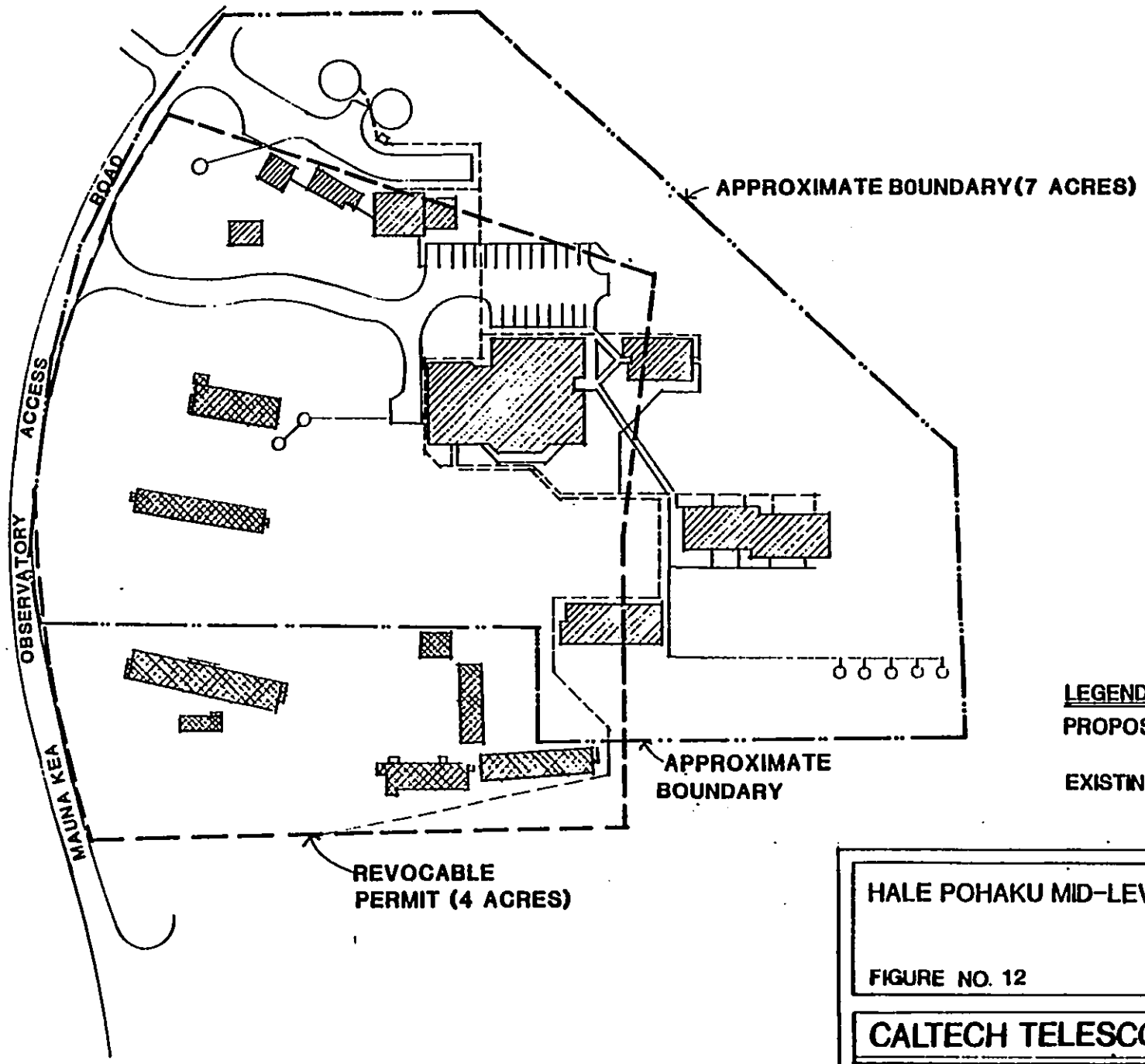
Hale Pohaku is located within the boundaries of the Mamane/Naio Forest Eco-System Management Area which was established by the Mauna Kea Plan (1977). (Figure 12) It is also within the critical habitat of the rare and endangered Palila (Psittirostra bailleui), a bird which is found nowhere else in the world. Development within a federally recognized critical habitat of an endangered species is subject to the rules and regulations of Section 7 of the Endangered Species Act of 1973 (U.S.C. 1536) and 1978 amendments to the Act, if a federal presence is involved in the project. NASA completed its consultation with the Fish and Wildlife Service prior to approval of the Hale Pohaku EIS.

2.0 Base Support Facilities

Many activities required to support astronomical research programs do not require summit or mid-level locations. These functions, which include administration, major computer processing operations, and extensive research and laboratory analysis, can be accomplished elsewhere. The Canada-France-Hawaii telescope (CFHT) base facility is presently located in Waimea. The UKIRT base support services are located in Hilo. The NASA funded IRTF and the UH 88-inch facility are operated by the University of Hawaii out of the Institute for Astronomy in Honolulu.

H. SOCIO-ECONOMIC FACTORS

Capital expenditures of the existing telescopes have generated approximately $52 million (1978 dollars) from outside sources. In addition, operating funds have been expended on the Big Island to support the infrastructure and telescope operations.



LEGEND/ NO SCALE

PROPOSED BUILDINGS

EXISTING BUILDINGS

HALE POHAKU MID-LEVEL FACILITIES

FIGURE NO. 12

CALTECH TELESCOPE E.I.S.

GROUP 70 8/82

NORTH

The employment generated by astronomical developments adds to the total employment base, and also adds to the variety of employment opportunities available in Hawaii. A cursory check done by the Department of Research and Development of the County of Hawaii shows that the types of employment made possible by the establishment of astronomy facilities on Mauna Kea include the following: astronomers, engineers, electronics technicians, instrumentation technicians, precision machinists, and mechanical designers. In addition to these high technology types of employment, direct jobs have been created for administrative, maintenance, and support personnel.[21]

The presence of the existing telescopes on Mauna Kea has benefited the University of Hawaii at Hilo (UHH) in several ways. For example, the CFHT and UKIRT observatories have provided opportunities during the last two summers for research participation by selected participants in the NSF-Student Science Training Program at UHH. This interaction was judged to be highly successful. The UHH has also called upon astronomers for lectures, seminars and informal workshops and interactions with its students. The same type of interaction takes place on the UH Manoa campus when visiting scientists are there. Indirectly, the proximity of the research facility to the University at Hilo has enabled Hilo campus students to get first-hand exposure to advanced research.[22]

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

A. MAUNA KEA PLAN

In the early 1970's it was recognized that an overall Mauna Kea plan was necessary in order to control development on the mountain and to resolve the conflicting demands of various users who wanted to use the mountain for their activities. Extensive citizen participation in the planning process followed. The main objective of the process was to "Determine the compatibility of Mauna Kea's resources to accommodate various uses without unacceptable damage to biotic and other natural values and historic values and the visual appearance of the mountain." (Mauna Kea Plan) The Mauna Kea Plan, a policy framework for the management of Mauna Kea, was adopted by the Board of Land and Natural Resources on February 11, 1977. It was a direct outgrowth of this participatory process.

The area covered by the Mauna Kea Plan includes all of the Conservation District land on the mountain from the summit down to the Saddle Road. The policy plan created five management areas, each appropriate to specific uses or combination of uses. (Figure 9). They are:

1. Mamane/Naio Forest Ecosystem Management Area;
2. Science Reserve Management Area;
3. Special Natural Area and Historic/Archaeological Management Area;
4. Silversword Management Area; and
5. Military Management Area.

The Plan states that the entire area leased as the Mauna Kea Science Reserve will be used primarily for scientific research, in accordance with current lease arrangements with the University of Hawaii. The development of the potential of the Mauna Kea summit area is to be consistent with the constraints implied by the physical characteristics of the mountain. Applications for any facility beyond the six existing and approved telescopes shall be accompanied by a comprehensive justification showing:

(1) Public benefit to the people of Hawaii, in terms of employment sources, educational pursuit, and overall economic development;

(2) Public necessity in terms of cooperative use of facilities and overall advancement of science and research;

(3) Evidence that Mauna Kea is the best site for such facility; and,

(4) Compatibility with other uses of Mauna Kea and within the terms of the lease between the University of Hawaii and the Board of Land and Natural Resources.

Caltech is the first new telescope proposed for the mountain since adoption of the Mauna Kea Plan. The University of Hawaii believes that the proposed Caltech telescope project, as described, is in accordance with the conditions imposed in this Plan. This EIS is intended to assist the Board of Land and Natural Resources in deciding whether the project's potential environmental impacts can be mitigated so that the use can be accommodated "without unacceptable damage to biotic and other natural values and historic values and the visual appearance of the mountain". (Mauna Kea Plan)

B. RESEARCH DEVELOPMENT PLAN FOR MAUNA KEA SCIENCE RESERVE AND RELATED FACILITIES

The University has formulated a Research Development Plan which will serve as the programmatic Master Plan for the continued development of the Mauna Kea Science Reserve. The Plan, which was adopted by the UH Board of Regents on 22 January 1982, was developed to reflect State policies such as those set out in the Mauna Kea Plan, the UH Manoa Academic Development Plan, and the Hale Pohaku Complex Development Plan.

The Research Development Plan projects a total of 13 major telescopes on the mountain by the year 2000. Caltech's telescope is included in this plan. Although the Plan envisions a single EIS for all summit development to the year 2000, Caltech is proceeding with an EIS and CDUA of its own because it has an excellent opportunity to obtain funding for its project from the National Science Foundation (NSF) if certain requirements, including an acceptable EIS, can be completed by October 1982. (The NSF requires that an EIS accompany the proposal throughout the approval process).

If Caltech is required to wait until some indeterminate time in the future when an overall summit EIS is complete, it could result in delaying the project for many years. Caltech is currently at the technological and scientific forefront of the new and exciting field of submillimeter wave astronomy, which is now drawing attention throughout the world. The new telescope will have an excellent opportunity to be the first to unravel the fascinating, but complex, problems of star formation. Both Caltech and UH have an excellent opportunity to make a significant contribution to astronomy if the project can be completed in a timely way.

Caltech's proposed facility meets the University's guidelines contained in the Research Development Plan for locating facilities within the Science Reserve because:

1. The proposed installation serves significant, identified needs;

2. The identified objectives are achievable and the proposal realistic;

3. The proposed installation matches, in its unique qualities, the excellent properties of the site;

4. Mauna Kea is the best site for the facility;

5. The proposed facility enhances the overall capabilities of the Mauna Kea Science Reserve;

6. Caltech has taken note of public policies and the concerns of interested groups in Hawaii in formulating the proposal;

7. The installation fills a unique and desired place in the UH program; and,

8. The proposed facility is financially self-supporting and contributes to overall operation of the Mauna Kea Science Reserve and related infrastructure costs.

C. CHAPTER 343 HRS - EIS REGULATIONS

Chapter 343 HRS, Section 1:22 lists situations in which a group of proposed actions should be treated as a single action; these situations and an explanation of their applicability to the Caltech project, follow:

(1) "The component actions are phases or increments of a larger total undertaking" - The research objectives of this action will be accomplished without requiring or stimulating the development of any further telescopes on the mountain. Caltech's telescope will complement and extend the capabilities of the existing telescopes on Mauna Kea as well as create a capability not formerly existing there.

(2) "An individual project is a necessary precedent to a larger project" - The Caltech project will utilize the existing infrastructure that is already in place at the summit. Being able to utilize existing infrastructure capacity rather than being the first development on a particular site was essential to locating this particular instrument on Mauna Kea.

(3) "An individual project represents a commitment to a larger project" - Construction and operation of the Caltech 10.4 meter telescope will not commit the University or the Board of Land and Natural Resources to any further development on the mountain. Caltech's funding is independent of other activities on the mountain.

(4) The actions in question are essentially identical and a single statement will adequately address the impacts of each individual action and those of the group of actions as a whole" - The Mauna Kea Plan, the policy plan for the mountain, states that each application for a new facility within the Science Reserve will be evaluated on its own merits. "Application for any proposed facility beyond the existing and approved telescopes shall be accompanied by a comprehensive justification. . ." (Mauna Kea Plan).

D. CHAPTER 344 HRS - STATE ENVIRONMENTAL POLICY ACT

Chapter 344 HRS, Section 3 establishes a state policy that will encourage productive but non-damaging use of the environment. The relationship of the proposed action to the state environmental policy, follows:

(1) "Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augumenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii." - The proposed project is essentially a "clean industry" which can provide employment opportunities for Hawaii residents. Implementation of the proposed project will not affect the aesthetic, recreational and scientific values of the summit.

(2) Enhance the quality of life by:

(A) "Setting population limits so that the interaction between the natural and man-made environments and the population is mutually beneficial;" - Only five to seven persons will probably be present on the mountain at one time, operating in two shifts at the telescope site. The impacts of the additional population on the environment at the summit is expected to be minimal.

(B) "Creating opportunities for the residents of Hawaii to improve their quality of life through diverse economic activities which are stable and in balance with the physical and social environments;" - As previously stated, the proposed project will create employment opportunities in an industry which is stable and relatively pollution-free.

(C) "Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian; and" - While the proposed project does not include establishment of a community on the summit, to accomodate approximately 5 persons, Hale Pohaku mid-elevation facilities will have to be expanded. The mid-elevation facilities have been designed to: minimize the marring of the existing landscape; avoid changing sub-surface drainage patterns; be constructed of wood or stone, and stained in earth tones to harmonize with the surrounding area; minimize to the greatest extent possible the removal of existing vegetation; and to use vegetation of endemic species for landscaping.

(D) "Establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on nonrenewable resources." - Other than the use of petroleum-based electricity, the operation of the telescope will not require the use of non-renewable resources.

E. HALE POHAKU MID-ELEVATION FACILITIES MASTER PLAN

At the present time it is not expected that the construction and operation of the Caltech telescope on the summit of Mauna Kea will affect the Mid-Elevation Facilities Master Plan. If Caltech astronomers and crew use the facility they will be subject to the constraints and requirements outlined in the Plan.

F. OTHER RELATED PLANS, POLICIES AND CONTROLS FOR THE AFFECTED AREA

1.0 Hawaii State Plan

The Hawaii State Plan sets forth long range and comprehensive goals, objectives, and policies to guide the future development of the State of Hawaii. It further details priority directions which indicate areas of Statewide concern meriting immediate attention.

Caltech's proposed telescope fulfills one of the State Plan's stated objectives of "increasing and diversifying Hawaii's economic base." The telescope also fulfills the related policy of "Promoting Hawaii's geographic, environmental, and technological advantages to attract new economic activities into the State."

Astronomical development in general, and the Caltech telescope in particular, possesses the characteristics of the type of industry which the State Plan singles out as desirable for Hawaii. Part III, Priority Directions, Section 103, subsection (e) lists the characteristics of a desirable industry: (1) An industry that can take advantage of Hawaii's unique location and available manpower resources. Part III of this Environmental Impact Statement describes the qualities of Mauna Kea that make it the most desirable site in the world for location of a submillimeter telescope. Caltech has stated its willingness to hire from the local labor pool, and where necessary, provide training in technical skills.

Subsection (e) (2) states that new industry should be a clean industry that would have minimal effect on Hawaii's environment. Astronomy is a clean, non-polluting industry. It does not generate noxious waste products nor does it pollute the water and air. Astronomers have a vital interest in maintaining a clean environment; pollution has already had an effect on existing mainland observatories, and it is in astronomers' interest to vigorously protect the local environment.

Subsection (e) (3) gives priority to an industry which is willing to hire and train Hawaii's people to meet the industry's labor needs. As stated above, Caltech has agreed to hire from the local labor pool, wherever possible, and train these persons in the necessary skills.

Interactions with students and faculty at UH Manoa and UH Hilo will also serve to assist in the training of future scientists who may take advantage of the Caltech facility. Caltech has also agreed to be a steady employer for as long as they are located on the mountain.

2.0 State Higher Education Interim Guidelines

Until the legislature adopts the necessary functional plans pursuant to Chapter 226, HRS, the State Higher Education Plan delineates specific objectives, policies, and high priority actions with respect to higher education to be addressed in seeking to achieve the ideals expressed in the State Plan. Functional Plans are intended to act in a coordinated fashion with County General Plans and Development Plans.

The development of "the Mauna Kea Observatory into a pre-eminent international center for observational astronomy" is specifically identified in the Higher Education Plan as a high priority implementing action which will "maintain and strengthen the position of the University of Hawaii at Manoa as a leading national and international research center." [23] The development

of the observatory as an international center for astronomy is cited in the State Conservation Lands Plan as a complementary interest.

3.0 Hawaii County General Plan

The General Plan for the County of Hawaii contains general economic policies which pertain to Caltech's proposed telescope:

1. Strive for an economic climate which provides its residents an opportunity for choice of occupation;

2. Encourage the expansion of the research and development industry by working with and supporting the University and other agencies' programs developed to aid the County of Hawaii; and,

3. Strive for diversification of the economy by strengthening existing industries and attracting new endeavors.

Hawaii County has encouraged diversified agriculture, manufacturing, the visitor industry, and scientific research and development as suitable economic alternatives for broadening and diversifying its economic base from its earlier reliance on the sugar industry. Caltech's new observatory will create approximately six to eight permanent jobs. As an addition to the research and development industry, Caltech's proposed project will add to the critical mass necessary to support related jobs, such as computer technicians and mechanical engineers, and in doing so, will contribute to the potential of creating a new range of jobs for Hawaii's youth.

4.0 Northeast Hawaii Community Development Plan

The area covered by the Northeast Hawaii Community Development Plan (NHCDP) includes the districts of Hamakua, North Hilo, and portions of South Hilo from Honoli'i Stream northward. It is intended to provide implementation guidance over a fifteen year period.

Scientific research and development and, more specifically, the development of Mauna Kea, are discussed in several sections of the NHCDP. The Economic Element, Environmental Quality, Historic Sites, Natural Beauty, and Recreation sections all have recommendations pertaining to Mauna Kea's use for astronomy.

4.1 Economic Element

Scientific research and development is identified as one of the existing major sources of primary income for the Planning Area. Fifty-nine percent of the residents in the area believe that greater use should be made of the scientific resources located atop Mauna Kea.[24] Because an increase in primary sources of income is cited in the NHCDP as necessary to best serve the interests of the Planning Area residents, the following was one recommendation to help insure at least the medium level of employment projected:

"The County and community should support State and Federal development of the scientific and recreation resources of Mauna Kea and Mauna Loa, but should also insist that uses be consistent with an approved master plan that adequately protects the environmental qualities of the mountains."[25] The Mauna Kea Plan, adopted by the Board of Land and Natural Resource, February 1977, is the approved Master Plan for Mauna Kea.

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The NHCDP describes evidence of ancient religious activity which occurred at Mauna Kea's summit. Puu Poliahu and Lake Waiau are considered candidates for high value ranking as potential historic sites. An archaeological survey will be undertaken by Dr. Patrick McCoy of the Bishop Museum, as part of Caltech's EIS/CDUA process, to evaluate the historical/archaeological significance of the Caltech site.

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The profile of Mauna Kea's landform will not be affected by Caltech's proposed telescope because the telescope is to be sited in a depression between Puu Poliahu and the Summit Cinder Cone. Only those people visiting the summit will be able to see the observatory from various points within the summit. The telescope will not be visible from other areas on the island. Construction of the telescope will not alter the landform of any of the identified elements.

4.4 Transportation

Realignment of the access road within the summit region is recommended by the NHCDP to allow easier access to the upper elevations, provide new access to the area proposed for further telescope expansion, and allow the removal of the existing switch-back road which is the major visual surface scar within that region. This will not be undertaken as part of the Caltech project. Implementation of such a proposal may require an amendment to the Mauna Kea Plan.

5.0 Policies and Plans Incorporated in this EIS by Reference

Air quality	Clean Air Act, as amended (42 U.S.C. 1857h-7 et. seq.)	No effect expected
Endangered and threatened species	Endangered Species Act of 1973, as amended (16 U.S.C. 1451 et sea.)	No known effect
Fish and wildlife habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	No effect
Historic and cultural properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. Sec. 470 et seq.)	No effect
Water Quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	No effect

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY

SEE FRAME(S) IMMEDIATELY FOLLOWING

(C) "Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian; and" - While the proposed project does not include establishment of a community on the summit, to accomodate approximately 5 persons, Hale Pohaku mid-elevation facilities will have to be expanded. The mid-elevation facilities have been designed to: minimize the marring of the existing landscape; avoid changing sub-surface drainage patterns; be constructed of wood or stone, and stained in earth tones to harmonize with the surrounding area; minimize to the greatest extent possible the removal of existing vegetation; and to use vegetation of endemic species for landscaping.

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PART VI: ANTICIPATED ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

A. INTRODUCTION

Construction and operation of the California Institute of Technology's 10.4 meter submillimeter telescope within the Science Reserve at the summit of Mauna Kea will not only affect the primary users of the area and impact the immediate project site, but may also induce secondary impacts in other areas of Mauna Kea and the Island of Hawaii. These primary (direct) or secondary (indirect) impacts can be either positive or negative, short-term or long-term.

Direct impacts are those resulting from construction and operation of the telescope while indirect impacts are those which may occur in other areas of the mountain and the region as a result of developing the facility. Short-term impacts are generally construction related and limited to the duration of the construction period. Long-term impacts are those generated by the continued presence and use of the telescope and related facilities on Mauna Kea.

The discussion of anticipated environmental impacts which follows will assess the effects and potential impacts associated with the proposed project on specific users and areas of concern. It will consist of evaluations of the impacts of development on the following items:

(1) the physical characteristics, appearance, and existing infrastructure of the project area;

(2) the vegetation and biology of the area including rare and/or endangered flora and fauna and their related ecosystems;

(3) the archaeology, anthropology, natural history and scenic beauty of Mauna Kea;

(4) other users of the Science Reserve and Summit area;

(5) base camp, mid-elevation facilities, and Mauna Kea access road;

(6) University of Hawaii; and,

(7) the island of Hawaii economy and population growth.

The relationship of the proposed action to policies and plans for the area and the impacts of the action on these plans are presented in Part V of this Environmental Impact Statement.

The impact evaluation for this project is based on the following assumptions: (1) the environmental effects generated by this action are either specific to the site or additive to those generated by the existing

six facilities; (2) Caltech's action is mutually exclusive of any further astronomy development on the mountain; and (3) the construction of the Caltech telescope does not set the stage for an additional increment of telescopes. Being able to utilize existing infrastructure capacity, rather than being the first development on a particular site, was the key to locating this particular instrument on Mauna Kea.

The following sections will summarize the probable effects of various actions, together with their anticipated environmental consequences, using the above assumptions under each of the aforementioned classifications. Proposed mitigating measures that will be undertaken to minimize any significant negative impacts will also be included in the discussions.

B. THE PHYSICAL CHARACTERISTICS, APPEARANCE, AND EXISTING INFRASTRUCTURE OF THE PROJECT AREA

1.0 Construction Phase

a. Description of the action

Specific actions to be taken in the construction of the Caltech telescope which may disturb the localized environment and/or modify or change the physical characteristics and appearance of the area are:

(1) On-site presence of construction equipment, construction vehicles, construction materials, a temporary construction field office, and an auxiliary generator;

(2) Excavation and grading of a 0.75 acre site for concrete footings, foundation, 850 gallon septic tank, 1,000-1,500 gallon water tank, housing for a 25 KW generator and 1,000 gallons of fuel;

(3) Removal of 100 cubic yards of soil material and backfilling and balancing of the site with this material;

(4) Excavation of the existing utility trench (which runs from the UH 88-inch telescope to the generator pad) for the telephone conduit, construction of handholes at 400 foot intervals along this trench, excavation of approximately 1,300 linear feet of utility trench from the generator to the Caltech site for telephone and power lines, construction of handholes at 400 foot intervals along this trench, and filling trenches when utility line installation is complete;

(5) Pouring of 150 yards of concrete for footings and foundation pad and transferring 30 truck loads of dry concrete mix from Hilo to the summit;

(6) Assembling the dome and telescope on-site;

(7) Paving 6,000 square feet of parking area and truck access, paving a ten foot wide band around one-half the circumference of the building, and paving a short (30 foot by 14 foot) access driveway; and,

(8) Removal of equipment, temporary field office, and temporary generator from the site.

b. Impact assessment

Only direct impacts related to the above actions will be described in this section. Other impacts will be discussed under separate headings in this Chapter.

Short-term negative impacts on the physical characteristics and appearance of the area may occur as a result of the above actions. The significance of these effects is expected to be related to the small scale of the project.

The presence of construction equipment, construction materials and temporary structures will impact the visual quality of the area. This will be temporary since these items will be removed when the project is completed.

Excavation and grading will alter the landform of the site and generate dust. Fine dust commonly occurs in the interstices of the volcanic rocks on Mauna Kea. Heavy construction equipment operations at the site and increased traffic along access roads will lead to the temporary generation of small dust particles. In addition, dust will be generated by the abrasive action of construction equipment on rocks. Because the apparent composition of the soil at the site is more basalt than cinder, dust during construction will be minimal. Dust mitigation measures such as water truck spraying of equipment routes during construction are not likely to be necessary. (Dames & Moore, Appendix B) During high winds and storms, materials will be covered and construction will cease until the weather improves.

No precautions will be taken for drainage because precipitation at the summit is very light (less than 15 inches annually) and the ground is very porous. Rain and snow melt dissipates rapidly.

There will be increased truck traffic between Hilo and the summit during the construction period. Thirty truck loads of dry concrete will be brought from Hilo to the project site

because the 150 cubic yards of concrete required for construction is too small to require a batch processing plant. It is estimated that this activity will require 3 - 6 truckloads per day for a period of 5 - 10 days. It has not yet been determined whether sea containers containing the dissasembled telescope and dome will be delivered directly to the observatory site or whether the structures will be partially assembled at sea level and then delivered to the site. Therefore, the number of truck trips generated by these types of construction activities cannot be determined now. Most heavy construction equipment will be stored on the site for the duration of the construction period. Heavier than normal truck traffic will only continue for two to three weeks. All trips of heavy trucks up the mountain will be scheduled during off-peak hours so as not to interfere with normal traffic flow in Hilo or along the Saddle Road. No improvements to the road will be required in order to bring construction equipment and personnel to the proposed telescope site.

Direct and long-term impacts on the physical characteristics and appearance of the area can be anticipated as a result of excavation of trenches and laying of utility lines. In order to minimize these impacts Caltech intends to:

(1) Utilize the existing trench from the UH 88-inch telescope to the generator pad for its telephone lines so as not to scar the summit cinder cone; and,

(2) Excavate the utility trench from the generator pad to the telescope site alongside the existing unpaved access road in order to minimize scarring of undisturbed areas.

All excavated material will be used to fill the trenches once the cable is laid. Although "handholes" will be required along both trenches to allow access to the conduits, those on the summit cinder cone will be constructed adjacent to the existing boxes so that visual impact is minimized.

Paving of parking, turnaround and driveway areas will have positive long-term impacts to the project site. Paving will act to minimize dust at the site.

2.0 Operations Phase

a. Description of the Action

Actions to be taken upon completion of the telescope which

may affect the local environment and/or modify or change the physical characteristics, existing infrastructure, and appearance of the area are:

(1) The presence of a sixty-foot diameter telescope dome, paved parking area, and an average of three persons per shift for two shifts per day;

(2) Consumption of 1,500-2,000 gallons per month of water for heating, cooling and domestic consumption;

(3) Disposal of 1,100-1,500 gallons per month of liquid sewage;

(4) Additional consumption of less than 4 gallons per hour of diesel fuel by the 850 KW generator;

(5) Generation and disposal of solid waste; and

(6) Vehicle trips for personnel and service vehicles from Hilo and Hale Pohaku to the Observatory.

b. Impact Assessment

Only direct impacts related to the above actions will be described in this section. Secondary (indirect) impacts will be discussed under separate headings in this chapter.

Because the base of the telescope dome is considerably lower than the adjacent cinder cones (268 feet lower than the peak of Puu Poliahu and 433 lower than Puu Wekiu), visual impact of the facility on the surrounding area will be minimal. Paving the parking areas and driveway with bituminous macadam with a gravel surface will also act to minimize visual impact because as the color of this paving material is similar to the surrounding soil.

Utility trenching will result in visual impact within the Science Reserve. Covering the trenches with excavated material will serve to minimize this impact. No additional trenches will be required to service the Caltech site if a new power source replaces the generator. Use of the existing trench along the slope of Puu Wekiu will minimize scarring of the summit cinder done.

On the average, only three persons are expected to be present at the telescope site for each of two shifts per day. Based on the present experience at CFHT, water consumption will average 10 gallons per day per person (50-70 gallons per day

total). There is no municipal water system at the summit and the present practice is for water trucks to come from Hilo periodically and replenish the tanks which are located at each major observatory. Caltech's proposed 1,000-1,500 gallon water tank will require replenishment at two to four week intervals. This additional water demand can be accommodated in the normal delivery schedule of water to the summit, no additional truck trips will be necessary. The slight increase in demand should have no noticeable effect on the island of Hawaii water supply.

Disposal of 1,100-1,500 gallons per month of liquid sewage into a 850 gallon septic tank is not expected to impact the hydrology of the area or pollute Lake Waiau. Dames & Moore (Appendix B) evaluated the impact of the Caltech telescope facility on Lake Waiau and came to the following conclusions:

> "An important consideration for the proposed project is the impact on Lake Waiau of sewage disposal at the site. No impact has been identified for cesspools that are currently utilized for existing telescope facilities, located on the summit cone and on an adjacent cinder cone. The geologic and hydrologic evidence suggests negligible impact on Lake Waiau from cesspools and leaching fields at the proposed site.
>
> The ground slope toward Lake Waiau is very gentle, only about 7/10 of 1 percent. Therefore, the total effluent flow, estimated to be about 35-50 gallons per day, would tend to flow radially and rapidly disperse from the source. Moreover, unconfirmed information (Boesgaard, personal communication, 1982) indicates that evaporation losses from cesspool tanks may be extremely high. Residual effluent flow from the leaching field would be subject to rapid purification due to filtering within the underlying lava rock. Even assuming that residual effluent is perched above a permafrost layer at a depth of only two feet, the radially dispersed flow rate would be insignificant within a distance of a few hundred feet from the source.

> The combined factors of relatively low effluent flow, evaporation losses from the cesspool tank, storage within the underlying lava rock or permafrost, probable downward dispersion (in event of a deep permafrost layer), and estimated negligible flow rate combined with significant purification within a few hundred feet of the source - lead to the conclusion of no impact on Lake Waiau." (Dames & Moore)

The normal practice of a septic tank and leaching field system used by the existing telescopes is considered appropriate for this site. Specific design features will be based on results of a soils investigation at the site and will be subject to approval by the Department of Health.

The Caltech telescope will require only 15 kw of electric power. Because there is excess capacity in the existing 850 kw generator, the generator engine is operating at an inefficient level. The increased load on the generator necessary to meet Caltech's power needs will increase the fuel consumption of the generator by 4 gallons per hour. The higher level of operation of the generator will probably result in a higher level of engine efficiency. Because fuel consumption will increase by less than 5%, no significant increase in pollutants emitted by the generator is expected. The additional diesel fuel demand generated by the Caltech facility can be accommodated in the existing schedule of fuel deliveries to the summit.

The Caltech telescope will have a 25 kw standby generator to provide for its power needs in the event that the summit source fails. A diesel fuel tank of 1,000 gallon capacity will also be located on site. This will provide enough fuel to run the standby generator for two weeks. Once the tank is initially filled, it will not require refilling unless an emergency requiring the use of the standby generator occurs.

Solid waste generated by staff and visitors to the observatory will be collected on-site and taken to Hale Pohaku for eventual disposal at Hilo. Caltech has assured the University that every precaution will be taken to insure that the observatory site will remain free from visible signs of litter.

Since the tradewind inversion at the 7,000 ft. level of the mountain is strong during most of the year, pollutants generated below that level do not cause any particular problems at the summit of Mauna Kea. The air quality of the summit area is primarily affected by the amount of exhaust generated by internal combustion engines (automobiles, power generating plant) above the 7,000 ft. level. The additional traffic generated by the Caltech observatory (2-3 trips per day) will not significantly increase the amount of air pollution from this source.

The unpaved spur road to the project site is seldom used at the present time, except by skiers. Increased traffic on this road attributable to the construction and operation of the Caltech facility will increase the amount of dust particles in the air. The prevailing summit winds are expected to disperse these pollutants before their concentration exceeds ambient air quality standards. Caltech has no plans to pave this segment of the road because access to the site for construction and operations is feasible without additional improvements at this time. The small additional number of trips on the access road from Hale Pohaku to the summit by Caltech staff will not necessitate any improvements to that road.

C. THE VEGETATION AND FAUNA OF THE AREA

Consultants' reports concerning the vegetation and fauna in the vicinity of the project site and surrounding areas were prepared for this EIS. They are incorporated in Appendices C and D of this report. The reader is referred to these appendices for each consultant's assessment of the possible positive and negative impacts of the proposed action on their particular area of expertise. Portions of these reports will be excerpted in the following sections.

1.0 Description of the Action

(1) Disturbance of approximately 0.75 acres of a barren and undeveloped area;

(2) Excavation and filling of approximately 1,300 linear feet of previously undisturbed land for utility trenches;

(3) Increased traffic on the roads within the summit and the summit access road;

(4) Disturbance of permafrost if present at the site;

(5) Increased usage of the site by scientists, staff and visitors; and,

(6) Changes in micro-climate resulting from construction of the facilities in the area.

2.0 Impact Assessment and Mitigating Measures

2.1 Vegetation

The bryophyte and lichen flora atop Mauna Kea is poorly known. Although no site survey was conducted, photographs of the proposed site indicate that the area is a very likely site for all mosses and lichens known to be present on the mountain. The climatic conditions tend to be too severe for higher plants.

The building of the telescope facility and the paving of the parking areas and driveways will destroy a certain segment of the biotic community. This impact will be negative and long-term as the ecosystem on Mauna Kea is very fragile and will take many years to recover once it is disturbed. Another impact generated by the structure itself is that the leeward side of the building will probably act as a trap for windblown dust which may cover the rocks.

Lichens and bryophytes are particularly sensitive to air pollution. Mitigating measures may include insuring that vehicles using the area are well tuned.

Visitors and scientists may inadverently destroy the flora in the area by walking around the unpaved portions of the area. They may also inadvertently transport new exotic flora from lower elevations to the summit. These introduced species may adversely effect the native biota of the area. Caltech will abide by the terms of the General Lease No. S-4191 between UH and BLNR which states that "in order to prevent the introduction of undesirable plant species in the area, the lessee shall not plant any trees, shrubs, flowers or other plants in the leased area". It is also possible that provisions will be made to restrict foot traffic to certain specified areas of the summit if this measure would result in minimizing disturbance to native biota.

Long-range positive benefits may occur as a result of the telescope. The shading effect of the telescope may encourage growth of lichens and bryophytes, particularly on the western side of the building. In addition, increased activity in the area may act to prevent off-road vehicular use of the area. Many of the cinder cones are being destroyed by these vehicles and the disturbance of the substrate results in the death of both the bryophytes and lichens in the area. The presence of the Caltech telescope may be a deterrent to the use of the Puu Poliahu cinder cone in particular.

2.2 Avi-Fauna

The Hawaiian Dark-Rumped Petrel or 'Ua'u (Pterodroma Phaeopygia sandwichensis) is the only endangered endemic subspecies known to be present at high altitudes of Mauna Kea. The habitat of the rare and endangered Palila (Psittirostra bailleui) is at lower elevations on the mountain. At the present time a critical habitat has not been defined for the 'Ua'u, however, a "Recovery" team has been appointed to investigate actions which might restore the population of this endangered bird. [26]

No 'Ua'u burrows have been observed in the summit area, and none of the birds have been observed in the Science Reserve. No mitigating measures are anticipated to be necessary at this time. If, during construction, it appears that some of these species might be disturbed, the appropriate Fish and Wildlife officials will be notified so that appropriate measures can be taken to protect the bird.

2.3 Mammals

The Hawaiian Hoary Bat (Lasiurus cinereus semotus) inhabits the island of Hawaii. Although they have been observed at elevations as high as 13,200 feet they are most commonly observed at sea level to 4,000 feet. None have been observed in the vicinity of the project site. Should any of the species be inhabiting the project site, they would normally relocate to more suitable environs on the large expanses of adjacent undeveloped lands. No mitigating measures are considered to be necessary in relation to this endangered species.

2.4 Arthropods

If any arthropods inhabit the site the impact of construction and operation of the telescope will be long-range and negative. However, Dr. Howarth has stated

that it is possible that with appropriate mitigative measures the Caltech development will not critically impact the ecosystem. (Appendix D)

The evidence to date indicates that the animals present in the aeolian ecosystem are sensitive to disturbance of the surface, destruction of the permafrost layer beneath the surface, dust, petroleum products, and other toxic environmental pollutants. In addition, the telescope dome could change the pattern of snowdrifts, snow melt, and aeolian fallout in the area, and these changes may affect the animals.

Precautions will be taken to minimize the amount of area to be disturbed by this project. The cables for electrical power and telephone communication, for example, will be buried in the existing trench that runs down Puu Wekiu from the UH 88-inch telescope and alongside the access road from the generator to the Caltech site.

Additional mitigating measures that may be taken to minimize the potential adverse impact of the construction and operation of the Caltech telescope on the aeolian ecosystem in the area are:

(a) inspection of the telescope packing operations at the Caltech laboratories by a qualified plant and animal quarantine official in order to prevent the introduction of pests from the mainland;

(b) insuring that waste oil from machinery and telescope mountings will not drip on bare ground; and,

(c) strict control of solid waste disposal so that colonization by exotic scavengers such as ants and mice will be prevented.

D. THE ARCHAEOLOGY, ANTHROPOLOGY, AND SCENIC BEAUTY OF THE MOUNTAIN

1.0 Description of the Action

Construction and operation of a new telescope on the mountain could generate direct and indirect impacts within and outside of the Science Reserve. Preserving the integrity of Lake Waiau and protecting the adze quarry are concerns which must be addressed. Certain citizens are concerned with the visual impact of the telescope on the mountain as seen from other areas of the island of Hawaii such as Hilo, Waimea, and Volcanoes National Park.

2.0 Impacts and Mitigating Measures

Some potential impacts of the action and mitigating measures follow:

a. Lake Waiau is located in the Natural Area Reserve, approximately 4,000 feet south of the Caltech telescope site. The increase in dust from the construction area would be miniscule compared to wind-generated dust over extensive natural surface areas of the mountain.

   It is not anticipated that the presence of the Caltech telescope will generate increased visitor traffic to the summit area, therefore there should be no impact on the adze quarry or Lake Waiau attributable to these sources. No mitigating measures particularly related to the protection of Lake Waiau are anticipated to be required. The Department of Land & Natural Resources has adopted rules regulating activities within Natural Area Reserves. (Subtitle 9, Chapter 209 of Title 13). These regulations specify permitted and prohibited activities within NARS and provides for issuance of permits and penalties for orolations (Appendix F). (Other potential impacts on Lake Waiau were discussed in Section B-2-(b) of this Chapter).

b. There are no archaeological sites on the project site. Two previously unrecorded sites which were discovered in a concurrent survey (under a separate contract) are sufficiently distant (400-700 feet) from the proposed telescope that they will not be disturbed during construction of the facility. As a precautionary measure, construction personnel will be made aware of their proximity and Caltech will educate its personnel as to the importance of not disturbing these (and other) sites.

c. Scenic impact of the dome will be limited to areas within the Science Reserve and the Natural Area Reserve. The location of the telescope on a plateau between two cinder cones will preclude its being seen from other areas on the island of Hawaii.

E. OTHER USERS OF THE SCIENCE RESERVE AND THE SUMMIT AREA

1.0 Description of the Action

Construction and operation of the Caltech 10.4 meter telescope and the presence of additional personnel at the summit

of Mauna Kea can have both positive and negative effects on other users of the summit area. Some of these users are other astronomers; scientists from other disciplines; lay people with an interest in the various natural and biological features of the summit area of the mountain and other visitors; hunters; skiers and snow-play participants.

2.0 Impacts and Mitigating Measures

Some potential impacts and mitigating actions to be taken follow:

(a) Impacts on existing observatory operations at the summit are long-term and positive. The Caltech operations will complement other research on the mountain but will not duplicate it. Its operations will not interfere with the operations of the other telescopes, nor will its location cause any physical disturbances, such as wind deflection, that might disturb the "seeing" of the existing telescopes.

(b) The telescope will provide an important source of new information to astronomy while having minimal impact on the research possibilities for other scientific disciplines. (Only 0.75 acres will be developed out of a total remaining area of the Science Reserve of 13,000 acres.) The astronomers will not restrict access to the summit for other research as long as it does not interfere with astronomy operations. The "Research Development Plan for the Summit and Related Facilities" describes the procedures to be taken by scientists to obtain permission to conduct research on the mountain.

(c) At the present time, there is no plan to restrict daytime access to the summit area, therefore, the Caltech telescope will have no impact on visitors and lay persons with an interest in the natural and biological features of the summit area. The presence of the telescope is not expected to generate additional visitors to the mountain because the observatory will be for the express purpose of research, and because the project does not envision paving or improving the summit access road.

Visitors to the summit who plan to joy ride "off-the-road" may be discouraged by the presence of the observatory. A positive benefit of Caltech's proposed telescope operations to Mauna Kea visitors is that Caltech has agreed to participate in the funding

of a visitor information station at Hale Pohaku in a manner to be negotiated between Caltech and the University of Hawaii.

(d) The proposed project will not affect hunting on the mountain. The only game present in the area is in transit and hunting usually takes place at lower elevations.

(e) Skiers and snow-play participants may be affected by the presence of the Caltech observatory at times when snowfall is heavy. Skiers do not normally use the telescope site, because the base of Puu Poliahu is a flat, rough area, not suitable for skiing. When snow is heavy, however, such as in 1981-1982, skiers use all areas of the summit. Skiers will be permitted to continue to use the spur road from the main summit access road to the Caltech observatory site and on towards Honokaa as they have in the past.

F. BASE SUPPORT FACILITIES, MID-ELEVATION FACILITIES, AND THE SUMMIT ACCESS ROAD

1.0 Description of the Action

(a) Establishment of an engineering support office in Hilo with an engineering and clerical staff of approximately 5 persons to support management and operations of the observatory.

(b) Accommodations at Hale Pohaku mid-elevation facilities for approximately 5 persons.

(c) Increased passenger vehicle and truck traffic on the summit access road.

2.0 Potential Impacts and Mitigating Measures

(a) Establishment of base support facilities at Hilo is expected to be a long-term positive benefit to the County and to the University. Caltech plans to hire local personnel for clerical and technical positions.

(b) Caltech's requirement for five bedspaces at Hale Pohaku will have only minimal impact on the mid-level facility in the short-term; most impacts will be related to the inconvenience that may be experienced by Caltech personnel if they have to readjust their observing schedules. Because the new facility was

planned and designed to support the existing six telescopes on the summit, it has a capacity of 59 persons at 100% occupancy. These beds are allocated in the following manner:

(1) UH 88" - 10;

(2) CFHT - 15;

(3) UKIRT - 14;

(4) IRTF - 13; and

(5) Mauna Kea Support Services (MKSS) and Hale Pohaku Management-7.

To cover Caltech's housing needs, the Institute and the University of Hawaii have agreed that Caltech should receive first priority on such mid-level bedrooms as become available on a nightly basis after the needs of the institutions sponsoring the existing telescopes are met. The bed allocations for UH, IRTF, CFHT, and UKIRT were determined on the basis of optimal utilization of each telescope. Because each of the telescope groups wishes to insure maximum utilization of Hale Pohaku, it appears likely that the few rooms required by Caltech will often be available for them to rent. When rooms are not available, astronomers will be required to commute from the base support facility.

Caltech recognizes that a resolution of its needs at the mid-level can be obtained through construction of new accommodations, in the area designated for expansion in the Hale Pohaku Plan. If additional telescopes are constructed on Mauna Kea, Caltech will join with the next users to develop a new dormitory building to accommodate their needs.

About six to eight persons will be present on the site during the construction phase of the project. It would be preferable if space could be found for these persons at Hale Pohaku in order to acclimate them to the altitude and in order to conserve travel time. If not, they will have to commute from other areas of the island as individuals from other telescope construction crews have elected to do.

(c) Two to three vehicle trips per day from Hale Pohaku to the summit will be generated by the operation of the Caltech telescope. At present, approximately 38 vehicle trips per day are made on this section of road. The additional 2-3 trips will not impact the capacity of this road.

The steepness of the road and its lack of paving have led to problems with maintaining its gravel surface. An increasing volume of traffic will eventually cause a more rapid deterioration of the road surface. The small increase in traffic resulting from the construction and operation of the Caltech facility will not necessitate paving the Hale Pohaku to the summit portion of the Mauna Kea access road.

G. THE UNIVERSITY OF HAWAII

Impacts of the operation of the Caltech 10.4 meter telescope for millimeter and submillimeter astronomy on the University of Hawaii will be long-term and positive. The major benefit of the proposed telescope for UH Hilo will be the indirect effect of UH Hilo's proximity to a new research facility. Students will be able to tour the telescope during open house and get first hand exposure to modern research. Some students may find employment at the new facility and some employees may be part-time students at UHH. Interactions between Caltech scientists and the staff and students of the UHH will be welcome. The staff and students will be eligible to use the Caltech telescope under the terms of the anticipated agreement with the University of Hawaii.

The University of Hawaii Institute for Astronomy at the Manoa campus will benefit from the presence of Caltech observatory on Mauna Kea because they will be able to encourage the growth of submillimeter astronomy in Hawaii. Astronomy students and professionals wish to take up their studies or jobs as close as possible to the telescopes in order to maximize their observing time and minimize their travel time. Someone already in Hawaii has a great advantage in terms of time saved and ease of access. Also the observatory site, the Hilo base facility and the Institute at Manoa will all benefit by the steady passage of visiting astronomers from all over the world and particularly from Caltech.

H. THE ECONOMY OF THE ISLAND OF HAWAII AND POPULATION GROWTH

The telescope will generate direct and indirect employment opportunities both during the construction phase and after it becomes operational. It is estimated at the present time that the estimated construction costs of approximately $2,000,000 will generate approximately 18 to 24 direct construction jobs in Hawaii. (Six to eight jobs per construction phase). In addition, the

approximately $500,000 annual operating costs will result in five to six direct jobs to support operations and two to three indirect positions. Although the State Economic Model (SEM) would predict that, based on the above expenditures, the number of jobs created would be greater (48 construction jobs and 12 support positions) the actual number of jobs generated will be lower than model estimates because:

(a) All of the construction funds will not be expended in Hawaii:

(b) Much of the construction activity will involve assembling the prefabricated dome; and

(c) High technology industries do not generate direct jobs in the same ratios as other industries because of greater use of automation and remote operation and the highly specialized nature of the field.

Caltech estimates that there will be approximately $500,000 of expenditures per year in Hawaii. Hilo industrial and business facilities will be used. About 100 persons per year will travel to the Big Island from the mainland and foreign countries.

Building of Caltech's proposed telescope is not expected to have any significant effects on the growth or composition of the Island of Hawaii's population. Only three scientists may immigrate to the Big Island to live. Other scientists and personnel will only stay for short periods of time.

PART VII: PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

A. DIRECT SHORT-TERM IMPACTS

Construction related effects are primarily related to dust, noise and additional vehicle traffic on the summit access road. Dust mitigation measures, such as water truck spraying of equipment routes during construction are not expected to be undertaken because the dust anticipated as a result of construction is estimated to be an extremely small percentage of the total natural dust generation of the summit area. During high winds and storms, materials will be covered and construction will cease until the weather improves. All excavated materials will be used for balance and fill.

Noise related impacts will be minimized by having the contractor use equipment with proper noise muffling devices. The number of increased truck trips cannot be determined now. Most heavy construction equipment will be stored on the site for the duration of the construction period. Heavier than normal truck traffic will only continue for two or three weeks while concrete mix and construction materials are being delivered to the site.

B. DIRECT LONG-TERM IMPACTS

Excavation of trenches for utility conduits will impact the appearance of the area. Every effort will be made to minimize the scarring of undisturbed areas. The trenches will be filled and covered with the excavated material and the contractor will be directed to make every attempt to restore the original appearance of the area.

There are no officially designated rare or endangered species of flora or arthropod fauna at the summit of Mauna Kea. Any existing biotic communities within the construction area and along the utility trenches, however, will be destroyed. Disturbance will be confined to specific areas directly related to construction and operation of the telescope. The contractor will be directed to confine his activities to specified areas and Caltech will instruct its personnel and visiting astronomers to be careful not to disturb surrounding areas.

Operation of the facility will generate traffic on the unpaved access road. This will also generate dust. The minimal number of vehicles using the road for this purpose will serve to mitigate this potential impact.

PART VIII: THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

The proposed project will be a small but important addition to Hawaii's growing research and development industry, a clean industry which can continue to provide a broadened employment opportunity for Hawaii residents. The "productivity" of Mauna Kea's summit region, however, cannot be measured in purely traditional economic ways. Mauna Kea is a natural and scientific resource which belongs to all the people of Hawaii. It is used as a research area, an aesthetic resource, and a recreational area.

Any assessment of the comparative productivity of Mauna Kea's role as an astronomical observatory, as compared to its role as a natural laboratory for other scientists, as an aesthetic resource, or as a recreational resource, should include the understanding that astronomy and other activities are not mutually exclusive. If the telescope is built, Caltech's new instrument will make long term contributions to the advance of man's understanding of the Universe without subtracting significantly from the use of the summit for other compatible activities.

There are no alternative planned uses for the site in the short term. If Caltech does not use the site it will remain empty.

PART IX: AN INDICATION OF WHAT OTHER INTERESTS AND CONSIDERATIONS OF GOVERNMENT POLICIES ARE THOUGHT TO OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

Strict adherence to the policies and conditions set forth in the Mauna Kea Plan concerning development at the Summit acted to curtail adverse environmental impacts to the area. The Conservation District Use Permit which is required before the facilities are constructed will also insure that all of the most important environmental aspects have been considered in the design of the facility and that all restrictions placed on the permit as a condition of approval will be strictly adhered to.

PART X: IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

If the Caltech telescope is built, its construction will represent an irretrievable commitment of construction manpower, construction materials, energy, and capital investment. Land will be committed until at least the end of the century.

The irretrievable commitment of resources will be minimal because the telescope project is being planned so that most actions taken can be easily reversed. That is, the Caltech telescope will be constructed in such a manner that should the instrument no longer be required to perform the functions for which it is designed, it can be disassembled easily, crated and shipped back to California. Minimal grading and excavation, minimal foundation work, and the use of paving material that is easy to remove, will allow the site to be restored. If permafrost exists in the area affected by construction, the permafrost layer will be disturbed.

PART XI: LIST OF NECESSARY APPROVALS AND STATUS OF THESE APPROVALS

1. Conservation District Use Permit - Department of Land and Natural Resources - Filed June 10, 1982

2. State of Hawaii - Department of Health - Septic Tank Approval - No action to date

3. County of Hawaii - Building Department - Building Permit -

   a. Engineering

   b. Structural

   c. Mechanical

   d. Civil

   e. Sewers

   f. Land Use

   g. Fire

   h. Plumbing

   i. Electrical

   j. Grading

   No action to date

PART XII: AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED IN THE PREPARATION OF THE EIS

The following persons and firms were contacted for professional services and/or specialized advise on various aspects of this EIS:

T. G. Phillips, PhD Robert B. Leighton, PhD	California Institute of Technology
Patrick C. McCoy, PhD S.H. Sohmer, PhD P.J. Kores Clifford W. Smith, PhD Francis Howarth, PhD	Bishop Museum
Dames & Moore	
John Jefferies, PhD Ginger Plasch Hans Boesgaard	University of Hawaii Institute for Astronomy
Mr. Tom Krieger	Mauna Kea Support Services
Mr. Robert Lee Mr. Gene Renard Mr. Ron Walker	Department of Land and Natural Resources (DLNR)
Ed Laws, PhD Al Woodcock, PhD (Retired)	University of Hawaii Department of Oceanography
Power Sogo	University of Hawaii, Hilo Natural Sciences Division
Mr. Stuart Kearns	County of Hawaii Dept. of Research and Development
Mr. Ron Agnostanelli	Pacific Machinery
Mr. Dick Tillson	Ski Association
Mr. James Tanaka	Hawaii Department of Transportation
Mr. Charles Wong Mr. Ernest Iwasa Mr. Brian Blevens	Hawaiian Telephone Co.

The following agencies, organizations and firms received copies of the Notice of Preparation for the Environmental Impact Statement. Starred (*) agencies, organizations, and individuals responded to the Notice and double starred (**) respondents made substantive comments which are included in this section of the EIS.

Federal Agencies

U.S. Department of the Air Force
U.S. Department of the Army
** U.S. Army Engineer District
** Headquarters U.S. Army Support Command
U.S. Department of Energy
Office of Environment
U.S. Department of Health and Human Services
Public Health Service
U.S. Department of the Interior
** Office of the Secretary
Bureau of Land Management
U.S. Geological Survey
** Fish and Wildlife Service
Heritage Conservation and Recreation Service
National Park Service
* Office of Water Research and Technology
Water and Power Resources Service
U.S. Department of Agriculture
Forest Service
Soil Conservation Service
Agricultural Stabilization and Conservation Service
Animal and Plant Health Inspection Service
Economics, Statistics, and Cooperative Service
* U.S. Environmental Protection Agency
U.S. Department of Transportation
* Federal Highway Administration
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
U.S. Department of Defense
Army Corps of Engineers
U.S. Department of Housing and Urban Development
Office of Community Planning and Development

State Agencies

Office of Environmental Quality Control
* Department of Accounting and General Services
** Department of Planning & Economic Development
** Department of Transportation
* Hawaii Air Reserve National Guard
University of Hawaii at Manoa

* Water Resources Research Center
** Environmental Center
University of Hawaii at Hilo
** Natural Sciences Division
* Department of Health
* Department of Defense
** Department of Land and Natural Resources

County Agencies

Department of Parks and Recreation
* Department of Public Works
* Department of Water Supply
** Planning Department
* Police Department
** Fire Department
** Office of the Mayor
** Department of Research & Development
** County Council

Firms

Hawaiian Electric
** Hawaii Electric Light Company
** Hawaiian Telephone

Organizations

** Advisory Council on Historic Preservation
Conservation Council, Hawaii Chapter
** Hawaii Audubon Society, Island of Hawaii Representative
* Sierra Club
Hilo Chamber of Commerce
Animal Species Advisory Committee
Sportsmen of Hawaii
Hawaiian Trail and Mountain Club
Life of the Land
** Ski Association
** Hamakua District Development Council

Individuals

Mr. Lawrence Katahira
Fred Metcalf
Dr. T.J. Lee, UKIRT

* Dr. Rene Racine, CFHT
Mrs. Mary Matayoshi
Mrs. Eric Mullmann
Senator Neil Abercrombie
Senator Dante Carpenter
Senator Richard Henderson
Senator John Ushijima
Senator Ann Kobayashi
Representative Byron Baker
Representative Andrew Levine
Representative Richard Matsuura
Representative Herbert Segawa
Representative Yoshito Takamine
Representative Virginia Isbell
Representative Russell Sakamoto

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858

FACILITIES PLANNING
OFFICE
JAN 27 4 21 PM '82

PODED-PV

25 January 1982

Dr. Harold S. Masumoto
Vice President for Administration
University of Hawaii
2444 Dole Street, Room 202
Honolulu, HI 96822

Dear Dr. Masumoto:

Thank you for the opportunity to review the Notice of Preparation for the Environmental Impact Statement for the California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii, sent to us on 8 January 1982. Based on our review, we provide the following comments:

a. A Department of the Army permit is not required for this project.

b. The proposed site is not a designated flood plain or special flood hazard area, according to the preliminary Flood Insurance Study for the island of Hawaii prepared by the Federal Insurance Administration. The area is classified Zone C or area of minimal flooding.

Sincerely,

KISUK CHEUNG
Chief, Engineering Division

CF:
Group 70
ATTN: Ms. Marilynn Metz
924 Bethel Street
Honolulu, HI 96813

UNIVERSITY OF HAWAII

Vice-President for Administration

5 February 1982

Mr. Kisuk Cheung
Chief, Engineering Division
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, HI 96858

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Mr. Cheung:

Thank you for your response to the EIS Notice of Preparation for Caltech's proposed 10 Meter Telescope at Mauna Kea, Hawaii.

We appreciate the information provided us and hope you will review the EIS when it is published.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY SUPPORT COMMAND, HAWAII
FORT SHAFTER, HAWAII 96858

FACILITIES PLANNING OFFICE

FEB 12 4 35 PM '82

REPLY TO
ATTENTION OF:

APZV-EHV

9 FEB 1982

University of Hawaii
Vice President for Administration
ATTN: Mr. Walter Muraoka
2444 Dole Street
Honolulu, Hawaii 96822

Gentlemen:

The Environmental Impact Statement (EIS) Notice of Preparation for the 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii for California Institute of Technology has been reviewed It is anticipated that the proposed project will not result in adverse impacts on military training activities at Pohakuloa Training Area.

Thank you for the opportunity to comment on the EIS Notice of Preparation. When completed, we would appreciate receiving a copy of the draft EIS.

Sincerely,

Adolph A. Hight

ADOLPH A. HIGHT
COL, EN
Director of Engineering and Housing

UNIVERSITY OF HAWAII

Vice-President for Administration

February 26, 1982

Col. Adolph A. Hight
Director of Engineering & Housing
Dept. of the Army
Fort Shafter, HI 96858

Dear Col. Hight:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for commenting on the EIS Notice of Preparation for Caltech's 10-meter telescope at Mauna Kea.

We appreciate your interest in the project and will send you a copy of the EIS when it is completed.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

2444 Dole Street • Room 202 • Honolulu, Hawaii 96822
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UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556-8200

ER 82/148

February 26, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Attention: Walter Muraoka

Dear Mr. Muraoka:

This is in response to the request for the Department of the Interior's comments on the draft environmental impact statement for a 10 Meter, Submillimeter and Millimeter Wave Telescope, Mauna Kea, Hawaii.

Geological Comments

The statement acknowledges the potential for ground-water impacts from the use of a cesspool in this region. In rock that has permeability due to fractures or other discrete interconnected voids of appreciable size, especially where there is no adequate filtering by soils, pollutants can travel long distances. For safe use, the base of a cesspool should lie on at least 4 to 5 feet of suitable soil above bedrock or highly permeable materials (Salvato, J.A., 1972, Environmental engineering and sanitation: New York, N.Y., John Wiley and Sons, Inc., p. 267, 268, 297, 298). We suggest that the environmental statement should propose mitigation, such as construction of the base of the cesspool to provide proper filtration. For example, use of a sufficiently thick filter bed of suitable imported soil at the bottom of the cesspool excavation might be considered.

National Park Comments

Although the project description indicates that the 60-foot diameter dome will not be visible from the Hilo area, will it be visible from other sections of the island, particularly from Hawaii Volcanoes National Park? Vistas of the upper slopes and summit of Mauna Kea are very important to the proper interpretation of geologic and natural history of the Mauna Loa and Kilauea areas of the National Park. Although another telescope dome (two can be seen from the national park) will not directly inhibit interpretive efforts, a new dome should be designed, located, and textured to be as subtle as possible.

We are also concerned about how this project conforms to over-all planning for the Mauna Kea summit area. Reference is made in this document to a number of plans, mostly State or County, which presumably control development of summit projects, and which appear to have unranked and redundant objectives. It is pointed out (p. 33) that in the absence of an approved Master Plan, the California Institute of Technology (C.I.T.) will proceed with the application and permitting process, by applying independently to the Board of Land and Natural Resources, which controls development of Conservation District lands.

In our opinion, the extent of the C.I.T. proposal's conforming to limitations contained in the draft Research Development Plan should be made clear. We also believe this plan, if it is indeed to become a "master plan" for Mauna Kea summit development, should incorporate the concerns of the several other plans which attempt to control growth of summit developments. This would provide a standard by which to evaluate development proposals more rationally.

By current standards, it is possible for proposals, like the C.I.T. telescope developments, to claim a tolerable increment in environmental impact in the summit, when realistically the development is boosting the tolerance level of impact and setting the stage for another increment. Six telescopes at the summit have made it possible to accept a seventh, with its "insignificant" increases in road traffic, sewage disposal, solid waste disposal, fuel consumption, etc. A Master Plan is needed which recognizes limits to development and impact. We believe this is needed before the C.I.T. proposal is approved.

Thank you for the opportunity to review this document.

Sincerely,

Patricia Sanderson Port
Regional Environmental Officer

cc:
Director, OEPR (w/copy incoming)
Director, National Park Service
Director, Fish and Wildlife Service
Director, Geological Survey
Regional Directors
Superintendent, HAVO
State Officer, Hawaii

UNIVERSITY OF HAWAII

Vice-President for Administration

March 31, 1982

Ms. Patricia S. Port
Regional Environmental Officer
U.S. Department of the Interior
Pacific Southwest Region
P.O. Box 36098
San Francisco, CA 94102

REFERENCE: YOUR LETTER ER 82/148

Dear Ms. Port:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

The subject document which you have reviewed is not a draft EIS -- it is a "Notice of Preparation of EIS". Therefore, it does not purport to be a complete statement of the environmental impacts of the proposed project. The forthcoming draft EIS will expand on the various areas which you refer to and it will also contain consultants reports on geology, biology, botany and archaeology.

The telescope dome will not be visible from Hawaii Volcanoes National Park, Hilo, Waimea or anywhere except the road to the summit within the science reserve. As stated in the subject Notice of Preparation (p. 35), the proposed telescope will be located in a depression between Puu Poliahu and the summit cinder cone.

The forthcoming draft EIS will describe, in detail, the relationship of the proposed project to State and County Plans, the DLNR Mauna Kea Plan, and to the Research Development Plan for the Mauna Kea Science Reserve. It should be noted, however, that Caltech is not setting the stage for another increment. Although the Research Development Plan indicates a possible 13 total telescopes on the summit by the year 2,000, the presence or absence of Caltech will in no way affect the plans of other observatories.

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MS. PATRICIA S. PORT
U.S. Department of the Interior
30 March 1982

Another much larger telescope could possibly trigger the need for infrastructure improvements which would in turn require additional telescope facilities to amortize the cost, but Caltech's facility will not do this.

Very truly yours,

Harold S. Masumoto
Vice President for Administration

HM:MM:gt

cc: Adair Montgomery,
National Science Foundation

United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P.O. BOX 50167
HONOLULU, HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

JAN 25 1982

University of Hawaii
Vice President for Administration
Attn: Walter Muraoka
2444 Dole Street
Honolulu, Hawaii 96822

Dear Sir:

This replies to your January 8, 1982 request for comments relative to the Notice of Preparation of an Environmental Impact Statement on the proposed construction of a 10-meter telescope at Mauna Kea, Hawaii.

The proposed action will have little, if any, adverse impact on the fish and wildlife resources of our concern in the area. In addition, to the best of our knowledge there are no species of plants or animals listed or proposed to be listed as endangered or threatened at that site.

Thank you for this opportunity to comment on your proposal.

Sincerely yours,

Derral Herbst

Derral Herbst
Acting Project Leader
Office of Environmental Services

cc: Regional Director, FWS, Portland, OR

FACILITIES PLANNING OFFICE
JAN 27 11 35 AM '82

CONSERVE AMERICA'S ENERGY

UNIVERSITY OF HAWAII

Vice-President for Administration

March 5, 1982

Mr. Derral Herbst
Acting Project Leader
Office of Environmental Services
U.S. Department of Interior
Fish and Wildlife Service
300 Ala Moan Blvd., Suite 5302
Honolulu, HI 96813

Dear Mr. Herbst:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for responding to our request for comments on the subject Notice of Preparation. We appreciate your interest in the project.

It may be of interest to you that Caltech's consultant, Group 70, has retained both an entomologist and a botanist to study the project site and surrounding area at the summit. Although winter snows preclude a botanical field survey, the entomologist is planning to visit the site to obtain some winter samples in the area.

We would appreciate your comments on the EIS when it is available.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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GEORGE R. ARIYOSHI
Governor

DEPARTMENT OF PLANNING AND ECONOMIC DEVELOPMENT

HIDETO KONO
Director

FRANK SKRIVANEK
Deputy Director

Kamamalu Building, 250 South King St., Honolulu, Hawaii • Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

January 21, 1982

Ref. No. 4110

Mr. Harold S. Masumoto
Vice President for Administration
University of Hawaii
2444 Dole Street
Honolulu, Hawaii 96822

Attention: Mr. Walter Muraoka

Dear Mr. Masumoto:

Subject: Caltech Proposal for a 10-Meter Telescope, Mauna Kea, Hawaii - EIS Preparation Notice

In the forthcoming EIS, we suggest that Part VI, Section I, relating to Economic and Social Considerations (pages 41-42), be clarified and expanded with regard to the following.

1. Specifically, the types of jobs provided so far by the astronomy program filled by long-term residents. The Preparation Notice states that "a majority of the jobs provided so far by the astronomy program has been filled by long-term residents of the State." We feel it may be helpful to specify what types of jobs have been made available, and whether those employed are primarily residents of Hawaii County.

2. Whether the addition of $400,000 in salaries is a one-shot expenditure associated with the actual construction of the facility, or is a part of the expected long-term yearly expenditure of $0.5 million.

3. Whether there may be Hawaii contractors capable of handling the construction as prime contractors and whether mainland firms are utilized as prime contractors for the construction of the other facilities at Mauna Kea. Presumably, the construction of such a facility would require the services of a highly specialized and skilled prime contractor. The public would be interested in knowing whether there are any construction firms in Hawaii who may have the qualifications necessary to be considered as the prime contractor.

Relative to the above concerns, we note that The Hawaii State Plan specifies priority actions to encourage the development of industries which have the following characteristics.

From Part III - Priority Directions, Section 103

Subsection (e)(1) An industry that can take advantage of Hawaii's unique location and available manpower resources.

Subsection (e)(2) A clean industry that would have minimal effects on Hawaii's environment.

Subsection (e)(3) An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs.

Subsection (e)(4) An industry that would provide reasonable income and steady employment.

Thank you for inviting our participation in the preparation of the project's EIS.

Sincerely,

Hideto Kono

cc: Group 70
924 Bethel Street
Honolulu, Hawaii 96813
Attention: Ms. Marilynn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

5 February 1982

Mr. Hideto Kono, Director
Dept. of Planning and
Economic Development
P.O. Box 2359
Honolulu, HI 96804

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Mr. Kono:

Thank you for your letter of January 21, 1982 (Ref. No. 4110) commenting on the subject Notice of Preparation. Your suggestions relating to clarification and expansion of the social and economic considerations sections of the EIS are appreciated. At the present time, we are researching responses to your specific comments and will transmit them to you as soon as the information is available.

In reference to the priority actions of the Hawaii State Plan, we will elaborate on the relationship of this project to those objectives in the forthcoming EIS. We do, however, feel that astronomy is the type of industry envisioned when these directions were adopted.

Thank you for participating in the EIS process. We look forward to your comments on the EIS.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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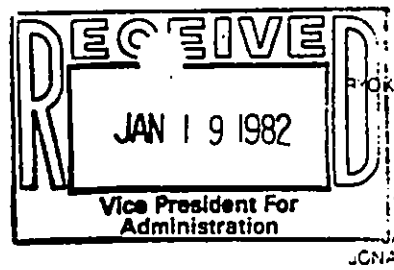
GEORGE R. ARIYOSHI
GOVERNOR



RYOKICHI HIGASHIONNA, PH.D.
DIRECTOR

DEPUTY DIRECTORS
WAYNE J. YAMASAKI
JAMES R. CAPRAS
JAMES B. McCORMICK
JONATHAN K. SHIMADA, PH.D.

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813

IN REPLY REFER TO

STP 8.7991

January 18, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

JAN 22 8 34 AM '82
FACILITIES PLANNING OFFICE

Attention: Walter Muraoka

Dear Sir:

California Institute of Technology -
Proposed 10-Meter Telescope for Millimeter
and Submillimeter Astronomy at Mauna Kea,
Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for the opportunity to participate in the preparation of the subject EIS document.

We call your attention to a potential problem that may have been overlooked. A commitment that mobilization for construction will be appropriately scheduled to reduce hazardous and congested travel conditions may be appropriate. This may be particularly important considering the steep grades and winding alignment of the roadways to be used in transporting materials to the construction site.

Very truly yours,

Ryokichi Higashionna

Ryokichi Higashionna
Director of Transportation

UNIVERSITY OF HAWAII

Vice-President for Administration

5 February 1982

Mr. Ryokichi Higashionna
Director of Transportation
State Dept. of Transportation
869 Punchbowl Street
Honolulu, HI 96813

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Mr. Higashionna:

Thank you for reviewing and commenting on the EIS Preparation Notice for the California Institute of Technology Proposed Telescope at Mauna Kea. We appreciate your interest in this project.

In answer to your comments concerning hazardous driving conditions on Mauna Kea, be assured that recommendations will be made to the contractors involved to schedule their trips to the mountain in off-peak hours. Concerns over traffic and road conditions will be addressed in more detail in the EIS.

We hope you will review the EIS for the project.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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FACILITIES PLANNING
OFFICE
MAR 2 10 10 AM '82

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

Office of the Director

March 1, 1982

PN:0016

MEMORANDUM

TO: Walter Muraoka
Office of Vice President for Administration

FROM: Doak C. Cox, Director

SUBJECT: Preparation Notice
A 10-Meter Telescope for Millimeter and Submillimeter Astronomy
Mauna Kea, Hamakua, Hawaii

In accordance with your request of January 8, 1982 and our telephone conversations of February 26, 1982, we have reviewed the above cited EIS Preparation Notice for the proposed California Technology telescope on Mauna Kea.

In looking over this document our major concern is one we have expresed in the past and that is the need for an overall environmental assessment of the various projects proposed for Mauna Kea.

It is our understanding that the University has now adopted the "proposed" Research Development Plan and that under this plan, all future potential telescope sites and any necessary support facilities have been identified. The need now is for an overall EIS to address the impacts of the entire Research Development Plan (RDP). It appears from the Preparation Notice that such an approach is the recommended approach of the plan. What is unclear is the rationale in this EIS Preparation Notice that, because this (CALTECH) "application is preceding the adoption of the RDP, it is proceeding with its own EIS and CDUA." It would seem appropriate to delay assessment of this specific project until the State/University prepares the EIS for the total complex. Furthermore, if the RD plan has been adopted it would appear that consideration of the separate EIS would be contrary to the terms of that plan and therefore subject to legal question. A few specific points of concern are noted as follows:

Page 25 - Pu'u Pohaku is mentioned on page 25 and shown on the map on page 26. No further reference is provided in the text. What is proposed at Pu'u Pohaku?

Page 26 - No scale is given on this map so one cannot determine distance from Lake Waiau to the project site. Location of Lake Waiau on Figure 2 (p. 8) would also be helpful.

Page 35 - The EIS should include some statement on location vs. archaeological sites. We do not necessarily expect any significant impact of this project on the Adz quarry (p. 25), however since the quarry is of major archaeological significance, its location relative to the telescope site should be shown on the map to assure reviewers that the project will not impact the site. It would be prudent to have a statement from a consulting archaeologist (perhaps Matthew Spriggs, or Bertell Davis of the U.H. Anthropology Department would be available regarding archaeology impacts).

Page 41 - There is an unresolved question as to potential impacts of cesspool seepage on Lake Waiau. What might well be settled on the basis of the general geologic structure without more details than are known now.

Two general comments are provided for your consideration.

The environmental evaluations of this site with respect to insect populations can not be undertaken in winter with snow cover. Assessment without snow cover can most likely be made between May and October.

The Dark-rumped Petrel, a protected species, has been observed on Mauna Kea at 11,000 feet. We do not know if it exists at higher elevations and in any case would not expect there to be any significant impact on it from the project. We mention it so that the EIS can address the chance that alternatives or additions to the project may encroach on the territory of the petrel.

If we can be of further assistance please do not hesitate to call us.

cc: Marilywn Metz, Group 70
Office of Environmental Quality Control
Jacquelin Miller

UNIVERSITY OF HAWAII

Vice-President for Administration

March 12, 1982

Dr. Doak C. Cox, Director
University of Hawaii - Manoa
Environmental Center
Crawford 317, 2550 Campus Road
Honolulu, HI 96822

Dear Dr. Cox:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for responding to our request for comments on the subject Notice of Preparation. We understand your concerns for the environmental quality of the summit area. In reference to your concerns about the Research Development Plant:

Although the University's Research Development Plan (RDP) for the Mauna Kea Science Reserve and Related Facilities was approved by the Board of Regents on 22 January 1982, it may be some time in the future before a complex development plan and EIS can be prepared. Because the process of acquiring the necessary approvals to construct a new telescope is very complex and lengthy, preliminary planning work must be initiated far ahead of projected dates for actual construction in order to work out any serious problems that might be encountered.

We agree with you that the ideal situation would be to hold back the Caltech EIS and incorporate it into a comprehensive EIS for the proposed development plan. Unfortunately, the ideal is not always achievable, particularly in economic times such as these when Federal funding is at a premium and delays in any part of the approval process could mean loss of funding forever. Caltech has an excellent opportunity to obtain funding for its project if certain requirements, including an acceptable EIS, can be completed during this fiscal year.

The National Science Foundation (NSF) requires that an EIS accompany the proposal throughout the approval process. Holding Caltech's EIS in abeyance until some indeterminate time in the future when a more complete EIS can be undertaken could, in effect, result in delaying the project for many years or cancelling it altogether. Caltech is currently constructing its

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project with temporary and limited funds from NSF. Any loss of continuity in the project will necessitate layoffs of the engineering staff leading to irreplaceable losses of trained personnel who are critical to the success of the project. It should be remembered that acceptance of the EIS in no way commits the County of Hawaii, the State of Hawaii or the University of Hawaii to approve the project, nor does it commit NSF to fund it. The Board of Land and Natural Resources and the University have agreed to process Caltech's EIS and CDUA prior to the overall assessment of the Summit RDP. We do not anticipate any legal problems resulting from this decision.

We do not perceive the proposed submillimeter telescope as being a phase or increment of a larger total undertaking. The research objectives of this action could be accomplished without any future telescopes being constructed on the mountain. In addition, construction and operation of the Caltech 10.4 meter telescope will not commit the University or the Board of Land and Natural Resources to any further development at the summit. The project will utilize the existing capacity of the infrastructure that is already in place. (For example, it will not be necessary to pave the road or develop a new power source in order to accommodate Caltech's requirements.) In other words, this telescope will not be the catalyst which will result in commitments to future development in order to offset heavy infrastructure investments.

In response to your specific comments:

p. 25 Pu'u Pohaku is the name of the separate satellite section of the Mauna Kea Ice Age Natural Area Reserve. Nothing is proposed for the area. It is shown because it is a part of the Natural Area Reserve.

p. 26 We are enclosing a map at 1:24,000 scale. Lake Waiau is approximately 280 feet below and 4,000 feet distant from the project site.

p. 35 Dr. Patrick McCoy has been retained to conduct an archaeological survey of the project area. Dr. McCoy is considered the premiere authority of the Adze Quarry and other areas on Mauna Kea.

p. 41 Dames & Moore, geological consultant, has been retained to assess the impact of cesspool seepage on Lake Waiau.

In answer to your general comments:

(1) Dr. Francis Howarth, entomologist with the Bishop Museum, is currently conducting field studies at the project site. He felt that winter samples were an important part of his on-going research of aeolian eco-systems at the summit.

(2) Some information on the Uau and what is known of its habitat will be discussed in the draft EIS. The possible relationship of project actions to the territory of the Uau will also be discussed.

We are looking forward to your comments on the forthcoming EIS.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

University of Hawaii at Hilo
COLLEGE OF ARTS AND SCIENCES
NATURAL SCIENCES DIVISION

January 18, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, HI 96822

Attention: Walter Muraoka

Dear Mr. Muraoka:

I have read the Notice of Preparation of the Caltech EIS and found it to be an interesting, well-written document. In my judgement the construction and operation of this telescope at the proposed site on Mauna Kea will produce many significant scientific results which are not now accessible to existing telescopes. The addition of millimeter and submillimeter wavelengths in a 10-meter dish will be a fine complement to the existing 6 telescopes on the summit of Mauna Kea and will further enhance its image as the premier astronomy research facility in the world. The Caltech telescope will have a beneficial effect on the University of Hawaii at Hilo and will help the economy of the Big Island at a time when help is sorely needed. I do not believe that any significant negative impact will ensue from its construction and operation.

Finally, I appreciate the opportunity to comment on this proposal.

Sincerely,

Power B. Sogo
Chairman, Natural [illegible]
Professor of Physics

PBS:lnw

cc: Group 70
924 Bethel Street
Honolulu, HI 96813
Attention: Marilynn Metz

1400 Kapiolani Street
HILO, HAWAII 96720 TEL: (808) 961-9383

UNIVERSITY OF HAWAII

Vice-President for Administration

21 January 1982

Dr. Power B. Sogo, Chairman
Natural Sciences Division & Professor of Physics
University of Hawaii-Hilo
1400 Kapiolani Street
Hilo, Hawaii 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Dr. Sogo:

Thank you for your prompt comments on the Environmental Impact Statement Preparation Notice for Caltech's proposed 10 Meter Telescope at Mauna Kea, Hawaii.

We appreciate your recognition of the positive impacts the Caltech project may have on scientific research, the University of Hawaii, and the Big Island economy.

We appreciate your interest in the project and hope that you will review the E.I.S. when it is published.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822

1/4/81 Xc To: Mac Jo Hamilton

GEORGE R. ARIYOSHI
GOVERNOR OF HAWAII

SUSUMU ONO, CHAIRMAN
BOARD OF LAND & NATURAL RESOURCES

EDGAR A. HAMASU
DEPUTY TO THE CHAIRMAN

DIVISIONS:
- AQUACULTURE DEVELOPMENT PROGRAM
- AQUATIC RESOURCES
- CONSERVATION AND RESOURCES ENFORCEMENT
- CONVEYANCES
- FORESTRY AND WILDLIFE
- LAND MANAGEMENT
- STATE PARKS
- WATER AND LAND DEVELOPMENT

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

December 23, 1981

Mr. Harold S. Masumoto
University of Hawaii
Room 202
2444 Dole Street
Honolulu, HI 96822

Dear Mr. Masumoto:

We have further comments to add to our December 16, 1981 response to the EIS preparation notice for Caltech's telescope on Mauna Kea:

1) The EIS should cover the NRAO telescope if the main purpose for the Caltech scope is interferometry in conjunction with the NRAO scope.

2) The EIS should describe the extent to which the mountain top can accommodate additional scopes. Our concern is that the carrying capacity of the top not be overloaded.

3) More cesspools for handling sewage will inevitably lead to contamination of water sources at Waiau and Pohakuloa Gulch. Consideration should be given to treatment and leading effluent away from water sources in the area.

4) The impact of new road construction should be addressed, particularly any access road via Lake Waiau.

5) The EIS should address how the facility will accommodate crowds including visitors and school groups.

Sincerely,

SUSUMU ONO, Chairman
Board of Land and Natural Resources

UNIVERSITY OF HAWAII

Vice-President for Administration

March 3, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Ono:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

This letter follows up our 8 January 1982 response to your inquiries of 23 December 1981 (attached). Answers to your specific comments follow:

1) Being able to utilize the Caltech telescope for interferometry in conjunction with a possible NRAO telescope is minimal in terms of justification for the Caltech telescope. At the present time, it does not appear that funding for the NRAO telescope will be available in the near future. In any event, an additional telescope is not necessary in order for Caltech to maximize the research capabilities of the propoosed 10-Meter Submillimeter telescope.

2) The construction and operation of the Caltech 10.4 meter telescope will not commit the University or the Board of Land and Natural Resources to any further development at the summit. The project will utilize the existing capacity of the infrastructure that is already in place. This telescope will not be the catalyst which will result in commitments to future development in order to offset heavy infrastructure investments. Your concerns about carrying capacity should be addressed in an EIS for the Research Development Plan which will be prepared sometime in the future.

3) Caltech has retained Dames & Moore to evaluate methods of sewage disposal on the mountain.

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4) At the present time, it does not appear that any road construction will be required in conjunction with the Caltech telescope. Any road modifications that are deemed necessary will be addressed in the EIS.

5) It is not expected that visitors and school groups will visit the facility in such great numbers as to require crowd control.

Very truly yours,

Harold S. Masumoto
Vice President for Administration

Attachment

COUNTY OF HAWAII

PLANNING DEPARTMENT

25 AUPUNI STREET • HILO, HAWAII 96720

FACILITIES PLANNING OFFICE
MAR 4 35 PM '82

HERBERT T. MATAYOSHI
Mayor

SIDNEY M. FUKE
Director

DUANE KANUHA
Deputy Director

February 10, 1982

Mr. Walter Muraoka
University of Hawaii
Office of Vice President
for Administration
2444 Dole Street
Honolulu, HI 96822

Dear Mr. Muraoka:

EIS - Preparation Notice
California Institute of Technology (CIT)
10-meter Telescope for Millimeter
and Submillimeter Astronomy
Mauna Kea, Hamakua, Hawaii

Thank you for the opportunity to review this EIS Preparation Notice. As you know, we in the County of Hawaii are concerned with the manner in which our environmentally sensitive National Landmark is developed. Ordinance 445, the Northeast Hawaii Community Development Plan, adopted on June 20, 1979, includes our official position on Mauna Kea's future.

This EIS Preparation Notice states that because Caltech's application is preceding the adoption of the Research Development Plan, it is proceeding with its own EIS and CDUA. We note that the Mauna Kea Plan approved by the Board of Land and Natural Resources requires that:

"Application for any proposed facility on Mauna Kea shall be accompanied by a comprehensive justification report, showing:

(1) Public benefit to the people of Hawaii, in terms of employment sources, educational pursuit, overall economic development, etc.

(2) Public necessity in terms of cooperative use of facilities and overall advancement of science and research;

(3) Evidence that Mauna Kea is the best site for such facility;

(4) Compatibility with other uses of Mauna Kea and within the terms of the lease between the University of Hawaii and the Board of Land and Natural Resources."

It does not appear that such a comprehensive justification report was to be included, according to this EIS Preparation Notice; thus, your forthcoming EIS should be written in such a manner that can also serve as this comprehensive justification report.

In this regard, we understand that your Board of Regents recently approved a Mauna Kea Research Development Plan. We are not certain whether that document contains the required comprehensive justification report. If it did not, then we question if the Caltech EIS could adequately cover the full scope of the DLNR requirement inasmuch as their 10-meter telescope site is such a small part of the entire Scientific Reserve Management Area.

We believe your EIS should include more site specific considerations in the following areas:

1. Quantified data on dryness, wind speed, earth quantities to be filled excavated, accessibility, sky coverage, etc.

2. The Preparation Notice cites Mauna Kea's attributes as "very dry," "very dark," "free from clouds and atmospheric pollutants," "excellent overall sky coverage," etc. These attributes must be quantified and monitored to assure non-degradation.

Quantifying the above will hopefully clarify other seemingly contradictory statements throughout the notice.

The EIS Preparation Notice presents general observations which are not common knowledge. These observations should be substantiated with data or estimates based upon past or parallel cases. For example statements such as the assumption that there are laterally impermeable dikes present on Mauna Kea's summit which constrains cesspool seepage into Lake Waiau; "a majority of the jobs provided so far by the astronomy program has been filled by long-term residents of the State"; dust is "not expected to occur in a large enough quantity to have any significant impact on the biology" of Lake Waiau; The University of Hawaii will be able to attract the highest quality faculty and students in this field, since they will be in the best possible location to take advantage of the new telescope"; etc. need much further explanation.

This EIS Preparation Notice implies a coupling of this Caltech Telescope with a planned NRAO telescope. If this Caltech telescope

is approved, is approval of the NRAO also implied or required? Is the proposed site for each based on their independency or ultimate coupling? These relationships must be discussed in greater detail in the EIS.

In addition, your EIS must specifically address the proposed action's relationship to land use plans, policies, and controls for the affected area. Our Northeast Hawaii Community Development is one such plan.

We hope these comments adequately reflect our concerns on the need for your EIS to provide greater detail and more data to substantiate some of your statements. We look forward to reviewing your draft document. Meanwhile, should you require our assistance, please do not hesitate to contact us at 961-8288.

Sincerely,

SIDNEY FUKE
Planning Director

RN/DT/DK:gs
Enc.

cc: Group 70 w/enc.
Environmental Quality Commission w/enc.
Department of Land and
Natural Resources w/enc.
Mayor Matayoshi w/enc.

UNIVERSITY OF HAWAII

Vice-President for Administration

March 24, 1982

Mr. Sidney Fuke, Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Fuke:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for your comments on the subject Notice of Preparation. Be assured that the University of Hawaii and Caltech will make every effort to address the concerns of Hawaii County in the draft Environmental Impact Statement.

The University of Hawaii has been designated proposing agency for this Environmental Impact Statement by virtue of their master-lease No. S-4191 for the Mauna Kea Science Reserve. Caltech has approached the University for permission to construct a telescope within this reserve. Agreements are being negotiated at the present time. Caltech does not have an interest in the land, such as an executed sub-lease. Therefore, the action which is the subject of this EIS is an agency action only because Caltech does not have standing, as yet, to be an applicant under current EIS regulations.

The Board of Land and Natural Resources will have to approve of Caltech's application during the Conservation District Use Application (CDUA) process. One criterion for acceptance will be whether or not the subject project conforms to the policies stated in the Mauna Kea Plan. The Research Development Plan for the Mauna Kea Science Reserve and related facilities, adopted January 22, 1981 by the Board of Regents, states that the University must take care to preserve the intent and objectives of the Mauna Kea Plan. Therefore, the Research Development Plan specifies a series of specific tests for justifying any new astronomical facility on the mountain. These tests are based on the broad considerations developed in the Mauna Kea Plan. Caltech's application will be subject to evaluation against these criteria.

The Environmental Impact Statement will not include a project justification specifically. The Statement is intended to be an objective evaluation of the positive and negative environmental

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impacts of the proposed project and proposed mitigating measures. These environmental concerns will also be addressed during the CDUA approval process. The National Science Foundation (NSF) funding process will address the scientific justification that you referenced as will the University's review. Feel free to write to Dr. John Jefferies, Director; Institute for Astronomy; 2680 Woodlawn Drive; Honolulu, HI; 96822 for more information concerning this justification. We enclose a copy of the Research Development Plan for your information.

In answer to your specific comments:

1) Certain data will be quantified in the EIS. A sketch of the site with elevations of the dome will be included. Items such as excavation, fill, accessibility, etc. will also be addressed.

2) The Caltech telescope is concerned primarily with the attributes of dryness and sky coverage. Darkness is not specifically critical to the location of a submillimeter telescope. "Free from clouds and atmospheric pollutants" are desirable attributes but not directly under the control of man to any degree. Please contact Dr. John Jefferies, Director, Institute for Astronomy, for further information concerning the site properties at Mauna Kea. He would be glad to furnish the planning department with any information that is available.

3) Information concerning the geology of the summit, its effects on effluent disposal, and the consequent impacts on Lake Waiau will be the subject of a report prepared by geological consultants to the project. In addition, they are evaluating the probability of dust caused by construction and operation of the telescope affecting the biology of Lake Waiau and environs.

4) The statement concerning jobs in the astronomy program being filled by long-term residents is quoted from a report prepared by Dr. John Jefferies, Director, Institute for Astronomy. Past experience shows that various kinds of job opportunities are created by the agencies responsible for operating the telescopes. For example: (1) electricians and machinists for maintenance and repair of the telescopes; (2) computer technicians, mechanical technicians, and systems programmers for the maintenance and repair of support equipment such as photographic equipment, computers, and communications equipment; (3) electronics engineers, mechanical engineers, and designers of instrument parts as

needed; and (4) support staff for administrative, clerical, and janitorial work. As vacancies in these jobs occur, advertisements are placed in local papers, thus encouraging local residents to apply for these positions.

5) The University of Hawaii will be allowed a certain portion of time on the new telescope. Because this instrument is the only one of its kind in the world, the University will be in an excellent position to attract students and faculty in this field since their association with the University of Hawaii will assure them of access to the telescope.

6) Being able to utilize the Caltech telescope for interferometry in conjunction with a possible NRAO telescope provides only a minimal justification for the telescope. At the present time, it does not appear that funding for the NRAO telescope will be available in the near future. In any event, an additional telescope is not necessary in order for Caltech to realize the research capabilities of the proposed 10-Meter Submillimeter telescope. The description in the Notice of Preparation was only mentioned to illustrate a theoretical capability of the instrument.

7) The EIS will address the relationship of Caltech's proposed action to the Hawaii State Plan, The Hawaii County General Plan, The State Functional Plan for Higher Education, The Mauna Kea Plan, The Research Development Plan, and the Northeast Hawaii Community Development Plan. In addition, it will look at State functional plans for Conservation Lands and the State Plan for High Technology. Other policies and plans will be discussed as they are appropriate.

You will receive the Caltech 10-Meter Submillimeter Telescope EIS through the normal channels. We are looking forward to your comments, and are confident that your input into the EIS process will help us to compile a complete and accurate document to fulfill the requirements of NEPA and Chapter 343 HRS.

Very truly yours,

Harold S. Masumoto
Vice President for Administration

Enclosure

HERBERT T. MATAYOSHI
MAYOR

HAWAII COUNTY FIRE DEPARTMENT
466 KINOOLE STREET, HILO, HAWAII 96720
PHONE: 935-2978

SHOZO NAGAO
FIRE CHIEF

FRANCIS E. SMITH
DEPUTY FIRE CHIEF

January 14, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Attention: Walter Muraoka

Dear Sir:

SUBJECT: CALIFORNIA INSTITUTE OF TECHNOLOGY - PROPOSED 10-METER TELESCOPE FOR MILLIMETER AND SUBMILLIMETER ASTRONOMY AT MAUNA KEA, HAMAKUA, HAWAII - E.I.S. PREPARATION NOTICE

Fire protection within the Mauna Kea Science Reserve at the summit of Mauna Kea, Island of Hawaii, is practically nil because of the distance and the fire apparatus capabilities.

Suggest developing their own fire brigade, with a fire truck standing by.

We will be willing to assist in training the men in fire and life safety.

Yours very truly,

SHOZO NAGAO
FIRE CHIEF

SN/mo

cc: Group 70
Attn: Marilynn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

20 January 1982

Fire Chief Shozo Nagao
Hawaii County Fire Department
466 Kinoole Street
Hilo, Hawaii 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Chief Nagao:

Thank you for reviewing the Environmental Impact Statement Preparation Notice for Caltech's proposed 10 Meter Telescope at Mauna Kea, Hawaii. Your suggestions for fire protection within the Mauna Kea Science Reserve will be considered in the preparation of the Environmental Impact Statement.

We appreciate your participation in the review process and hope that you will review the E.I.S. when it is published.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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Office of the Mayor

HERBERT T. MATAYOSHI
MAYOR

February 3, 1982

Mr. Harold Masumoto
Vice President for Administration
University of Hawaii at Manoa
2444 Dole Street
Honolulu, HI 96822

RE: California Institute of Technology
Proposed 10-Meter Telescope for Millimeter
and Sub-millimeter Astronomy at Mauna Kea,
Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for the copy of the Environmental Impact Statement, Notice of Preparation for the proposed sub-millimeter telescope at Mauna Kea.

We have forwarded a copy to the Planning Department for its review. They will be providing substantive comments for your consideration.

We would like, however, to note that while the proposed telescope is included within the University's Research Development Plan, if it is to ultimately serve as the State's Master Plan for the science reserve, an approval of this plan by the Board of Land and Natural Resources would also seem appropriate.

We would appreciate if a copy of the draft Environmental Impact Statement could be forwarded to the Planning Department when it is completed.

Sincerely,

HERBERT T. MATAYOSHI
MAYOR

VG:lrp

cc: Planning Department

UNIVERSITY OF HAWAII

Vice-President for Administration

February 25, 1982

The Honorable Herbert T. Matayoshi
Mayor, County of Hawaii
Hilo, Hawaii 96720

Dear Mayor Matayoshi:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

We have received substantive comments on the subject document from your Planning Department and we are currently preparing responses to them. We appreciate your interest and concern in this project. Be assured that the concerns of Hawaii County will be addressed in the Environmental Impact Statement.

The University's Research Development Plan for the Mauna Kea Science Reserve and Related Facilities is a policy statement of the University of Hawaii. It has been developed within established guidelines and relevant assumptions from several independent plans and studies made by the University, the Department of Land and Natural Resources, and other State and County agencies.

The University has a joint mission with other State constituencies to preserve and protect the unique attributes of the mountain. Accordingly, the University currently has plans to develop and seek approval of a single Conservation District Use Application (CDUA) for the Science Reserve. This CDUA will be subject to approval by the Board of Land and Natural Resources (BLNR). Thus, in effect, the Plan cannot be implemented without the approval of the BLNR.

If you are interested in any further information concerning the Research Development Plan for the Mauna Kea Science Reserve, please feel free to write to: Dr. John Jefferies; University of Hawaii; Institute for Astronomy; 2680 Woodlawn Drive; Honolulu, Hawaii; 96822. We will forward a copy of the Environmental Impact Statement to the Planning Department when it is completed.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto

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HERBERT T. MATAYOSHI, MAYOR
H. STUART KEARNS, JR.
Director

DEPARTMENT OF RESEARCH AND DEVELOPMENT
COUNTY OF HAWAII • 25 AUPUNI STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8366

FACILITIES PLANNING OFFICE
JAN 25 3 25 PM '82

January 21, 1982

University of Hawaii
Attention: Mr. Walter Muraoka
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for this opportunity to review the above subject.

We are generally in favor of the development of scientific resources on the Island of Hawaii where the socio-economic benefits accrue to the residents. It is our opinion that the proposed California Technology facility will meet this basic criteria.

We look forward to reviewing the completed E.I.S.

H. Stuart Kearns Jr.
H. STUART KEARNS, JR.
DIRECTOR

cc: Group 70
Attn: Ms. Marilynn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

5 February 1982

Mr. H. Stuart Kearns, Jr.
Director, Dept. of Research & Development
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Mr. Kearns:

Thank you for your comments on the Environmental Impact Statement Preparation Notice for Caltech's proposed 10 Meter Telescope at Mauna Kea, Hawaii.

In the EIS, we intend to expand upon the benefits of this project to the residents of the island of Hawaii. We would appreciate any information that your office might have compiled on the types of jobs which have been made available in the past by the Astronomy program to Hawaii County residents. We are also interested in the current labor force characteristics of the Big Island, in particular the available labor pool who would benefit from the creation of new "high-tech" jobs.

We appreciate your interest in the project and hope that you will review the E.I.S. when it is published.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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STEPHEN K. YAMASHIRO
Council Chairman

COUNTY COUNCIL
COUNTY OF HAWAII
HAWAII COUNTY BUILDING
HILO, HAWAII 96720

January 26, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822
Attn: Walter Muraoka

Thank you for the opportunity to review the EIS Preparation Notice for the proposed 10-meter telescope on Mauna Kea.

We fully support the development of the Mauna Kea Science Reserve in accordance with the existing Master Plan. That approach will encourage maximum utilization of the remaining research area with minimal environmental degradation.

Any Environmental Impact Statement should also evaluate the benefits conferred upon the University of Hawaii at Hilo. Future astronomical developments such as yours will also foster ties with University of Hawaii at Hilo, which will enhance the caliber and reputations of programs on the Hilo Campus. We look forward to the early implementation of your project.

We have no objections to the Preparation Notice. We would, however, appreciate a copy of the draft and final Environmental Impact Statements as they are completed.

Stephen K. Yamashiro
COUNCIL CHAIRMAN

cc: Group 70

UNIVERSITY OF HAWAII

Vice-President for Administration

5 February 1982

Mr. Stephen K. Yamashiro
Council Chairman
County Council
Hawaii County Building
Hilo, Hawaii 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Dear Mr. Yamashiro:

Thank you for your comments on the EIS Notice of Preparation for Caltech's proposed 10 Meter Telescope at Mauna Kea, Hawaii.

We appreciate the support of the Hawaii County Council in furthering astronomical development of the Mauna Kea Science Reserve. Be assured that this telescope project will enhance the reputation of Mauna Kea, and thus the Island of Hawaii, as being a superior site for ground-based astronomy. It will further the research development goals of the University, the County, and the State with minimal degradation to the environment.

As you have suggested, the Environmental Impact Statement will evaluate the benefits which may accrue to the University of Hawaii at Hilo as a result of this project. As you know, one reason Caltech is leaning towards Hilo as the site of its base camp is because of the University facilities located there.

We will send you copies of the EIS and Revised EIS when they are completed. We will look forward to receiving your comments on the EIS.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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ENV 2
H-W/R

HAWAII ELECTRIC LIGHT COMPANY, INC.
P. O. BOX 1027 HILO, HAWAII-96720

January 21, 1982

University of Hawaii
2444 Dole Street, Room 202
Honolulu, Hawaii 96822

Attention: Mr. Harold S. Masumoto
Vice President for Administration

Subject: EIS Preparation Notice
California Institute of Technology
Proposed 10-Meter Telescope

Gentlemen:

Thank you for your letter of January 18, 1982 allowing us the opportunity to comment on the EIS Preparation Notice for the proposed 10-meter telescope for Mauna Kea.

We have reviewed this EIS, and because the power requirements will be fed off of the diesel engines that are located at the top of Mauna Kea, our comments are very minimal. We would like to point out that the underground system that is presently installed at the top of the mountain which connects the generator to the various observatories, were installed by HELCO and is presently owned and maintained by our Company.

If any modifications to this underground distribution system is necessary because of the installation of this telescope, we request that we be given ample notice so that proper budget and preparations can be made.

As you are aware, HELCO has been approached by the University with the possibility of the installation of power lines to the summit. We understand, at this time, that no fundings has been made available; however, should fundings become available, we again request that we be given ample notice.

Again, thank you for the opportunity to comment on your notice.

Very truly yours,

Alva K. Nakamura, Manager
Engineering Department

AKN:bk

cc: Mrs. Jean Hatada
Mr. Edward Nakamoto

UNIVERSITY OF HAWAII

Vice-President for Administration

5 March 1982

Mr. Alva K. Nakamura, Manager
Engineering Department
Hawaii Electric Light Company, Inc.
P.O. Box 1027
Hilo, Hawaii 96720

Dear Mr. Nakamura:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for responding to our request for comments on the subject Notice of Preparation. We intend to describe the electrical requirements of the proposed telescope in greater detail in the Environmental Impact Statement.

At the present time, we do not believe that any modifications to the underground distribution system will be necessary, however, if we find that it is, we will give you ample notice so that proper budget and preparations can be made. As more information concerning these requirements becomes available, we will be in a better position to assess its impact on HELCO facilities in the area.

We appreciate your interest in this project.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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HAWAIIAN TELEPHONE
GTE

Russ K. Saito
Network Engineering Director

January 27, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Attn: Mr. Walter Muraoka

Dear Sir:

California Institute of Technology
Proposed 10-Meter Telescope for Millimeter
and Submillimeter Astronomy at Mauna Kea,
Hamakua, Hawaii - E.I.S. Preparation Notice

In response to Mr. Harold Masumoto's letter dated January 8, 1982, we have reviewed the enclosed Notice of Preparation of an Enviromental Impact Statement, particularly paragraph 13.3.

We have no technical problems with it. Our microwave system operates at a frequency of 2 GHz, or a wavelength of 15 centimeters. The wavelengths to be observed by the telescope are less than one millimeter and therefore no interference problems are anticipated.

In the interest of accuracy, the microwave system serving the summit of Mauna Kea is not part of our inter-island system, and the antenna described as about three feet in diameter is actually four feet in diameter.

Although it has no direct bearing on the EIS, we would appreciate as much advance notice as possible as to the communication requirements at the telescope site, so that we may insure that the necessary facilities are available when needed.

Sincerely,

R K Saito

cc: Group 70
924 Bethel Street
Honolulu, Hawaii 96813
Attn: Marilynn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

February 12, 1982

Mr. Russ K. Saito
Network Engineering Director
Hawaiian Telephone
P.O. Box 2200
Honolulu, HI 96814

Dear Mr. Saito:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for your comments on the EIS Notice of Preparation for Caltech's 10-meter telescope at Mauna Kea, Hawaii. We will incorporate the suggested corrections on the microwave system and antenna into the EIS.

We appreciate your interest in the project and hope you will review the EIS when it is published.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

Reply to:

Lake Plaza South, Suite 616
44 Union Boulevard
Lakewood, CO 80228

FACILITIES PLANNING
OFFICE

FEB 17 2 57 PM '82

February 5, 1982

Vice President of Administration
University of Hawaii
2444 Dole Street
Honolulu, HI 96822

Attn: Walter Muraoka

Dear Mr. Muraoka:

We received the National Science Foundation "scoping letter" on February 3, 1982. NSF requests the Advisory Council on Historic Preservation (Council) identify environmental issues which should be considered in the draft environmental statement (DES) for the proposed Ten-Meter Telescope at Mauna Kea, Hamakua, Hawaii.

As you know, the Council was created by Title II of the National Historic Preservation Act of 1966 Section 106 of the Act requires any Federal agency which funds, licenses or assists an undertaking affecting National Register listed or eligible properties to afford the Council an opportunity to comment on the undertaking prior to agency approval of the undertaking. Therefore, the Council would be interested in the effects, if any, which this undertaking may have on places and properties significant to Hawaiian history and culture.

The DES should include indentification of historically significant properties which exist in the vicinity of the proposed undertaking and a discussion of the effects, if any, which may occur on these properties as a result of the undertaking. The National Register and the Hawaii State Historic Preservation Officer (SHPO) are sources of information for the existence of significant and potentially significant historical properties. The DES should demonstrate that these two sources were consulted.

Should it become apparent, after consulting with the SHPO, that Section 106 compliance is applicable to this undertaking, we suggest the DES provide sufficient documentation to permit Council review. Please refer to 36 CFR Section 800.9 for information about coordinating NEPA and Section 106 requirements in order to achieve an expeditious review and comment by the Council. A copy of 36 CFR Part 800 is enclosed for your reference.

If you have questions or require additional information, please contact me or Robert Fink of my staff at (303) 234-4946.

Sincerely,

Louis S. Wall
Chief, Western Division
of Project Review

Enclosure

UNIVERSITY OF HAWAII

Vice-President for Administration

March 15, 1982

Mr. Louis S. Wall, Chief
Western Division of Project Review
Advisory Council On Historic Preservation
Lake Plaza South, Suite 616
44 Union Blvd.
Lakewood, CO 80228

Dear Mr. Wall:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for your comments on the subject Notice of Preparation. Caltech's consultant, Group 70, has retained Dr. Patrick McCoy of the Bishop Museum Anthropology Department in Honolulu to survey the proposed site and make recommendations concerning any significant archaeological sites that he might find there.

Dr. McCoy is recognized as an authority on the archaeology of the summit area of Mauna Kea. He has assured us that it is highly unlikely that anything historically significant will be found in the area. He will, however, make contact with the State Historic Preservation Offices. The site is not on the National Register. If Dr. McCoy determines that it is appropriate, consultation with the Council will be undertaken.

Thank you for you interest in the project. You will be receiving a copy of the draft EIS for review and comment.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

cc: Dr. Patrick McCoy

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For the Protection of Hawaii's Native Wildlife

FACILITIES PLANNING OFFICE
'82 FEB 20 AM 8:32

HAWAII AUDUBON SOCIETY

P. O. Box 5032
Honolulu, Hawaii 96814
P. O. Box 275
Volcano, HI 96785

February 4, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822 Attn. Walter Muraoka

Dear Mr. Masumoto:

Thank you for your letter of January 8 soliciting the Society's participation in the preparation of an Environmental Impact Statement (EIS) for the construction of a proposed 10-meter telescope on Mauna Kea by the California Institute of Technology.

By this letter the Society requests to be a consulted party on the environmental aspects of the proposed development.

The EIS Preparation Notice says on page 2 that ". . . biological studies may also be necessary." This is a serious understatement of the basic requirements for an EIS for a proposed project located in the conservation district or wilderness area under State and federal regulations. Biological studies are a necessity before new development.

Now that the existence of the high-altitude aeolian ecosystem on the summit of Mauna Kea is publicly known, there is a clear need for an extensive biological survey of the Science Reserve from the summit down to about 12,000 feet elevation -- covering annual seasonal changes -- in order to elucidate the extent of that aeolian ecosystem, its biological components, its interaction strategies, the effects of climatic changes on the biota, and the impact of mechanical disturbances on that high-stress environment.

Local newspapers have reported recently that the University of Hawaii has approved a Mauna Kea research development plan that envisions 13 identified telescopes on the summit by the year 2000. Now is the opportunity for the long-needed comprehensive EIS to cover <u>all</u> proposed development at the summit and downslope. The extensive biological survey that is essential for an adequate description of the environment would be part of the EIS for the whole development plan.

Instead of proceeding on a piecemeal basis, which is unsatisfactory for exposing and mitigating long-term environmental impacts, the Society recommends that the California Institute of Technology project be held in abeyance until the comprehensive EIS for all projected development at the summit and downslope has been completed. Hawaii EIS regulations require that "a group of proposed actions shall be treated as a single action when: (1) the component actions are phases or increments of a larger total undertaking . . ." (Sub-Part B 1:10 (c)).

We would appreciate your reply to these issues. Mahalo.

Sincerely yours,

encl. "Entomologists discover new life - on Mauna Kea desert", Ka 'Elele

UNIVERSITY OF HAWAII

Vice-President for Administration

5 March 1982

Mrs. Mae E. Mull
Hawaii Island Representative
Hawaii Audubon Society
P. O. Box 275
Volcano, HI 96785

Dear Mrs. Mull:

Thank you for reviewing and commenting on the Notice of Preparation of EIS for the proposed Caltech 10.4 meter telescope on Mauna Kea. It is the intention of the University that the concerns of all interested individuals and organizations be considered in the planning and development of facilities within the Mauna Kea Science Reserve.

The University of Hawaii has been designated proposing agency for this Environmental Impact Statement by virtue of their master-lease No. S-4191 for the Mauna Kea Science Reserve. Caltech has approached the University for permission to construct a telescope within this reserve. Agreements are being negotiated at the present time. Caltech does not have an interest in the land, such as an executed sub-lease. Therefore, the action which is the subject of this EIS is an agency action only because Caltech does not have standing, as yet, to be an applicant under current EIS regulations.

Responses to the issues raised in your letter of 4 February 1982 follow:

There was no intentional slight to the importance of biological studies in the statement that "... biological studies may also be necessary." The word "may" was used because at the time the Notice of Preparation was being prepared it appeared that a separate comprehensive biological survey was going to be completed at approximately the same time as the Caltech EIS was in process. This would have obviated the necessity of undertaking a separate study. Unfortunately, this study was the victim of funding cuts, thus, a biological study is necessary for this EIS.

Caltech's consultant, Group 70, asked Dr. Frank Howarth of the Bishop Museum to conduct a biological study of the proposed telescope site and environs, subject to the approval of Caltech. To our knowledge, he has already begun his field work.

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Although the University's Research Development Plan for the Mauna Kea Science Reserve and Related Facilities was approved by the Board of Regents on 22 January 1982, it may be sometime in the future before a complex development plan and EIS can be prepared. Because the process of acquiring the necessary approvals to construct a new telescope is very complex and lengthy, preliminary planning work must be initiated far ahead of projected dates for actual construction in order to work out any serious problems that might be encountered.

We agree with you that the ideal situation would be to hold back the Caltech EIS and incorporate it into a comprehensive EIS for the proposed development plan. Unfortunately, the ideal is not always achievable, particularly in economic times such as these when federal funding is at a premium and delays in any part of the approval process could mean loss of funding forever. Caltech has an excellent opportunity to obtain funding for its project if certain requirements, including an acceptable EIS, can be completed during this fiscal year.

The National Science Foundation (NSF) requires that an EIS accompany the proposal throughout the approval process. Holding Caltech's EIS in abeyance until some indeterminate time in the future when a more complete EIS can be undertaken could, in effect, result in delaying the project for many years or cancelling it altogether. Caltech is currently constructing its project with temporary and limited funds from NSF. Any loss of continuity in the project will necessitate layoffs of the engineering staff leading to irreplacable losses of trained personnel who are critical to the success of the project. It should be remembered that acceptance of the EIS in no way commits the County of Hawaii, the State of Hawaii or the University of Hawaii to approve the project nor does it commit NSF to fund it.

We do not perceive the proposed submillimeter telescope as being a phase or increment of a larger total undertaking. The research objectives of this action could be accomplished without any future telescopes being constructed on the mountain. In addition, construction and operation of the Caltech 10.4 meter telescope will not commit the University or the Board of Land and Natural Resources to any further development at the summit. The project will utilize the existing capacity of the infrastructure that is already in place. (For example, it will not be necessary to pave the road or develop a new power source in order to accommodate Caltech's requirements.) In other words, this telescope will not be the catalyst which will result in commitments to future development in order to offset heavy infrastructure investments.

Caltech is not dependent upon future development at the summit to maximize the research capability of its proposed telescope. Construction and operation of the Caltech telescope is a proposal that can be accepted or rejected on its own merits and does not require agreements with other proposed telescopes to support its objectives.

If you are interested in any further information concerning the Research Development Plan for the Mauna Kea Science Reserve, please feel free to write or call Dr. John Jefferies, Institute for Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

SKI ASSOCIATION OF HAWAII
P.O. Box 8327 / Honolulu, Hawaii 96815 Recorder Phone 949-7807

February 6,1982

University of Hawaii
Vicepresident for Administration
2444 Dole St.
Honolulu HI 96822

Attention: Mr. Walter Muraoka

Dear Sir;

This is to acknowledge receipt of your January 8,1982 letter submitting an EIS Notice of Preparation for the California Institute of Technolgy 10 meter telescope on the summit of Mauna Kea.

The proposed location as shown on the drawing in the Preparation Notice is acceptable to us as it does not interfere with skiing in Poi Bowl. We would ask that the EIS indicate that the skiiers will be permitted to continue to use the spur road from the main summit access road to the CalTech observatory site and on north towards Honokaa as we have in the past.

Please forward a copy of the draft and final EIS to us when they are available for public comment and review.

Sincerely
for Dick Tilson
President SAH

WDJ

UNIVERSITY OF HAWAII

Vice-President for Administration

February 19, 1982

Mr. Dick Tilson, President
Ski Association of Hawaii
P.O. Box 8327
Honolulu, HI 96815

Dear Mr. Tilson:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for commenting on the EIS Notice of Preparation for Caltech's 10-meter telescope at Mauna Kea. The EIS will state that skiers can continue to use the spur road from the main summit access road, as is their current practice.

We appreciate your interest in the project and we will contact you if there are any changes which could affect skiers. We will send you a copy of the EIS when it is available.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

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HAMAKUA DISTRICT DEVELOPMENT COUNCIL, Inc.
HONOKAA, HAWAII 96727

5 February 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822
Attn: Mr. Walter Muraoka

Dear Mr. Muraoka:

Thank you for this opportunity to comment on a project within the Hamakua District of the Big Island that has such great significance for the State of Hawaii and for the national and international community as well.

We have no specific comments on the 10-meter telescope project but would comment on other factors that will be effected by it. In sum, we favor the parts of the UH Mauna Kea Research Development Plan of which we have been informed in the local press.

In particular, we feel that the 8.5 miles of access road from Hale Pohaku to the summit should be paved and otherwise upgraded for the safety of users. Paving the road will help protect the Mauna Kea Ice Age Natural Area Reserve that is close to the road along about six miles of its eastern boundry. A paved road will eliminate the cause of much dust; dust that can pollute the air in the summit area and impinge upon the aeolian ecosystem in the summit area and in the Ice Age Natural Area Reserve. The roadways and parking areas should be the only areas accessable to vehicles. Vehicles should be kept from access to any other portions of the mountain above Hale Pohaku. ("Joyriding" in "off-road" vehicles should be outlawed.)

We favor the construction of a power line for commercial power from the Saddle Road to Hale Pohaku and then, by underground cable along the access road, to the summit. The advantages of such a power source being developed in the near future are manifold.

Please call on us at any time we can be of service to you.

Sincere Aloha,

Francis P. McGough
President

cc: Group 70, Marilynn Metz
Sidney Fuke, Hawaii County Planning Dept.
Yoshito Takamine, Rep. 3rd District

UNIVERSITY OF HAWAII

Vice-President for Administration

March 5, 1982

Mr. Francis P. McGough, President
District Development Council, Inc.
Hamakua, Hawaii 96727

Dear Mr. McGough:

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - E.I.S. Preparation Notice

Thank you for commenting on the EIS Notice of Preparation for Caltech's 10-meter telescope at Mauna Kea. We hope you will review the EIS when it is published.

We appreciate your interest in the University of Hawaii's Mauna Kea Research Development Plan. We have enclosed a copy of it for your organization's use.

Very truly yours,

Harold S. Masumoto

Harold S. Masumoto
Vice President for Administration

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
An Equal Opportunity Employer

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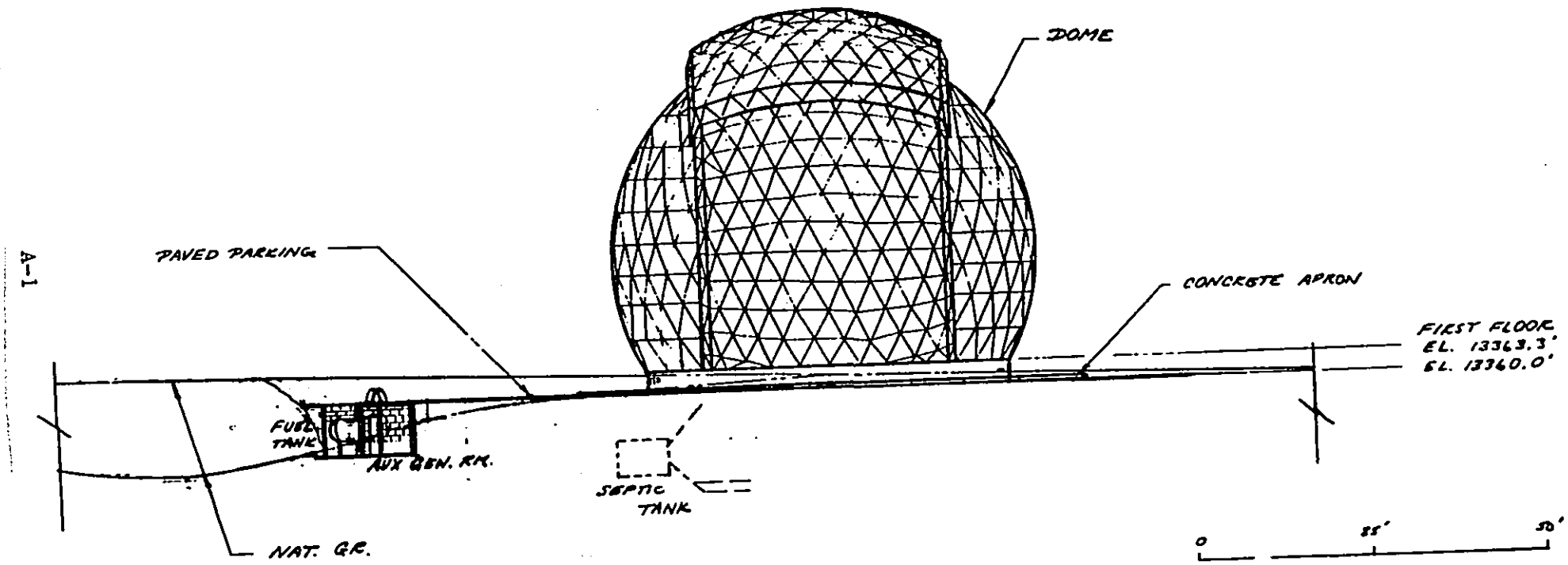
APPENDIX A

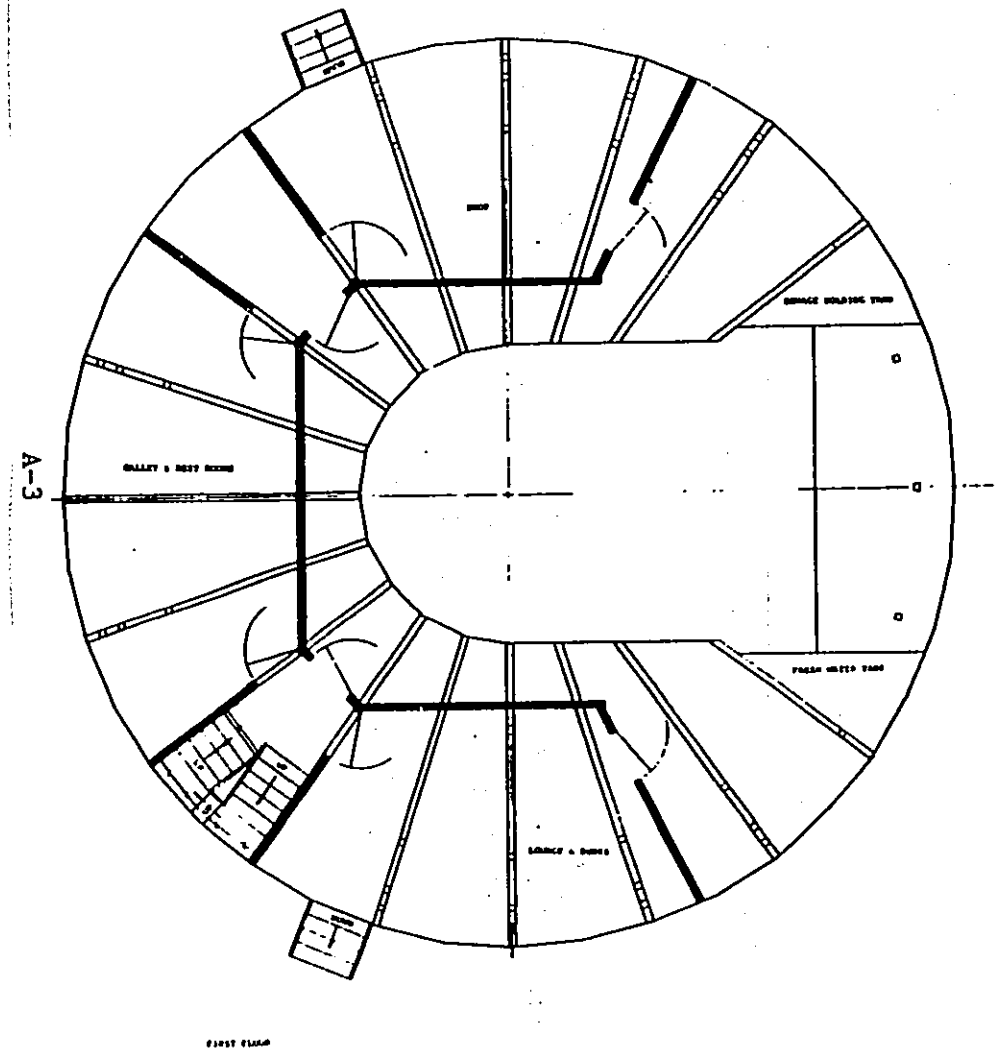
EXTERIOR ELEVATIONS

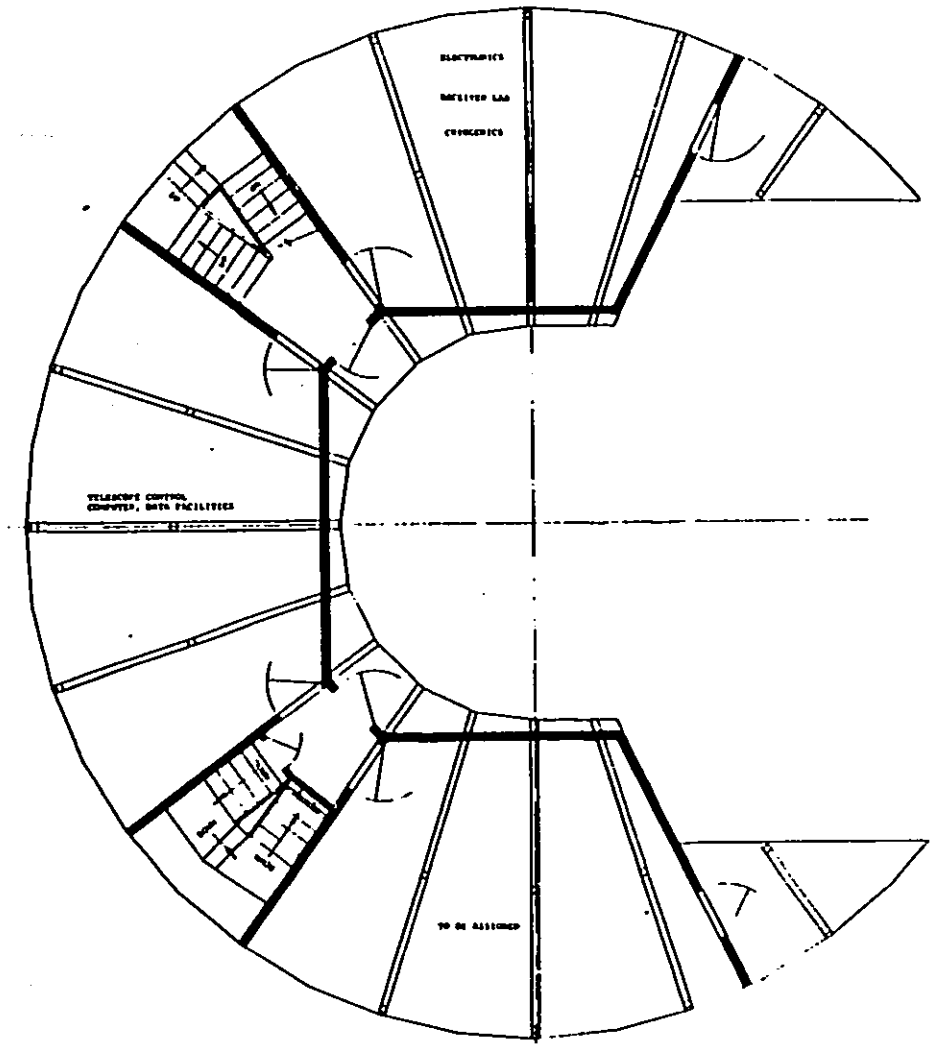
SCHEMATICS OF DOME INTERIORS

A-1



NORTHEAST ELEVATION





DOME SCHEMATIC

CORRECTION

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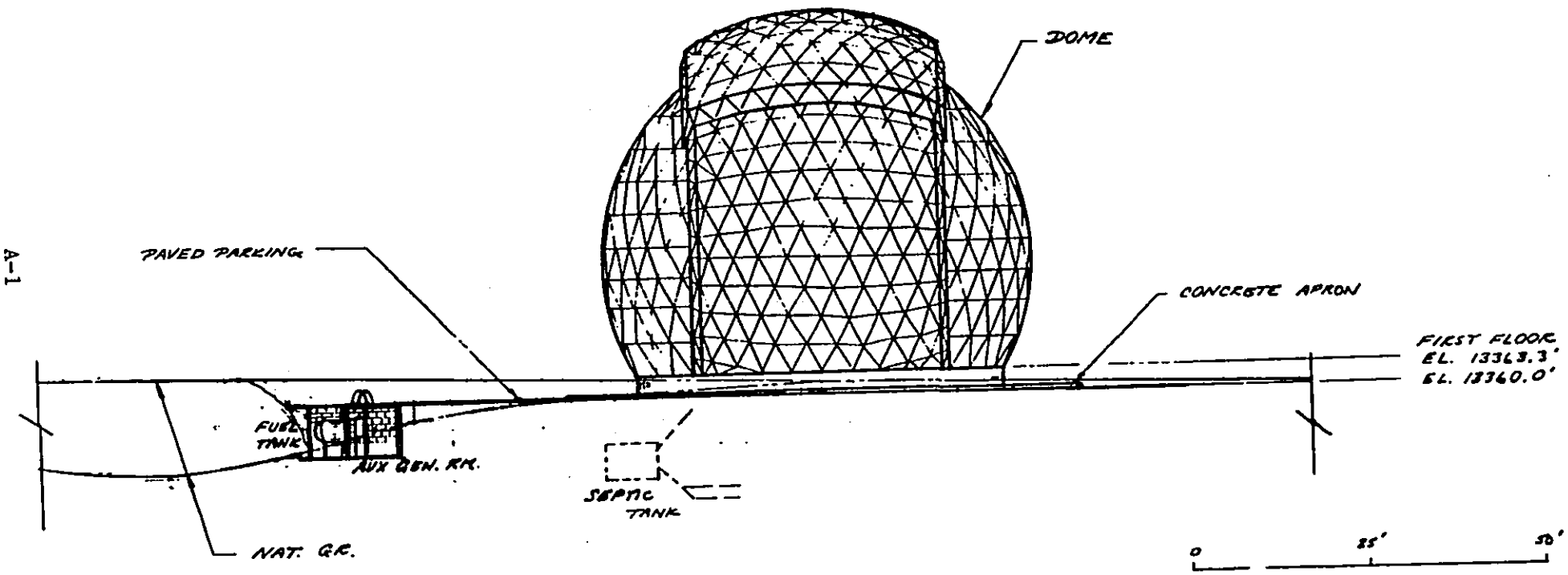

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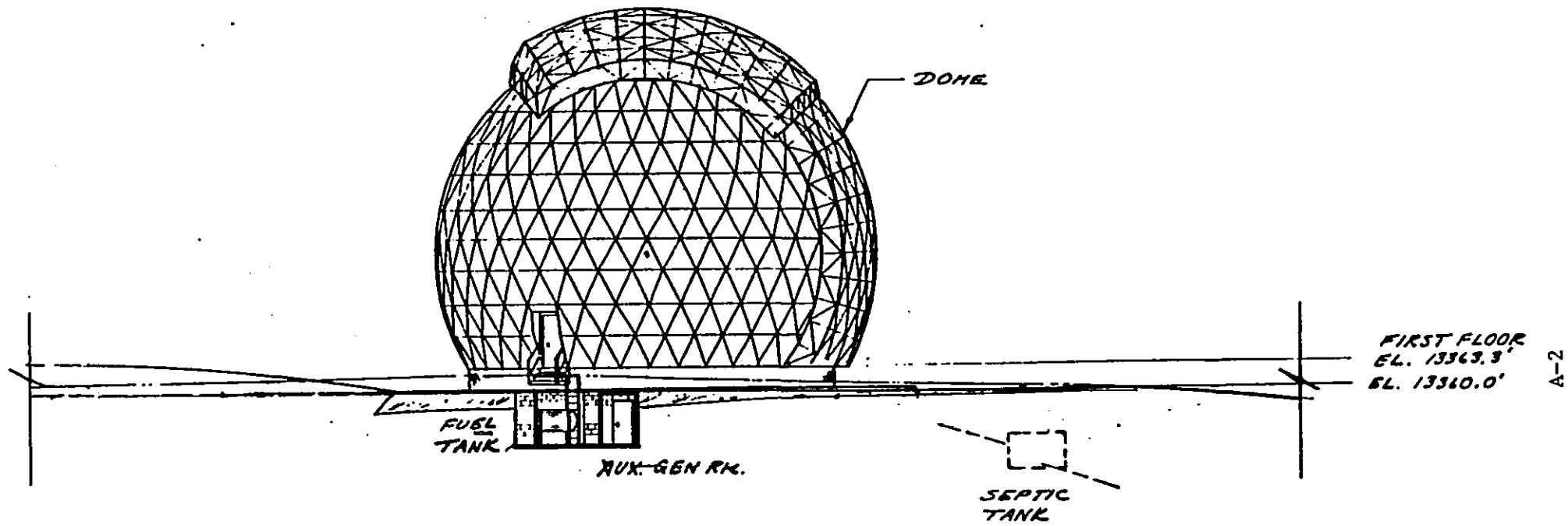
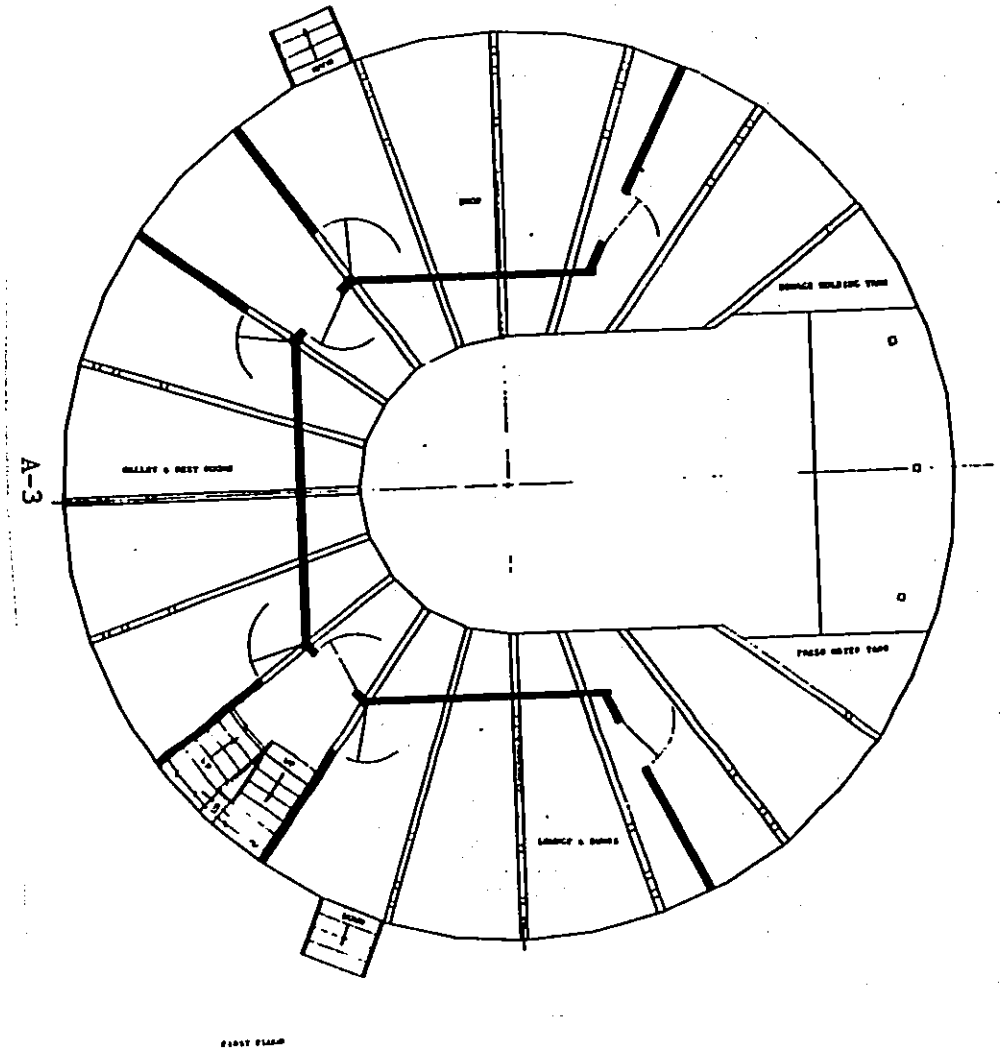
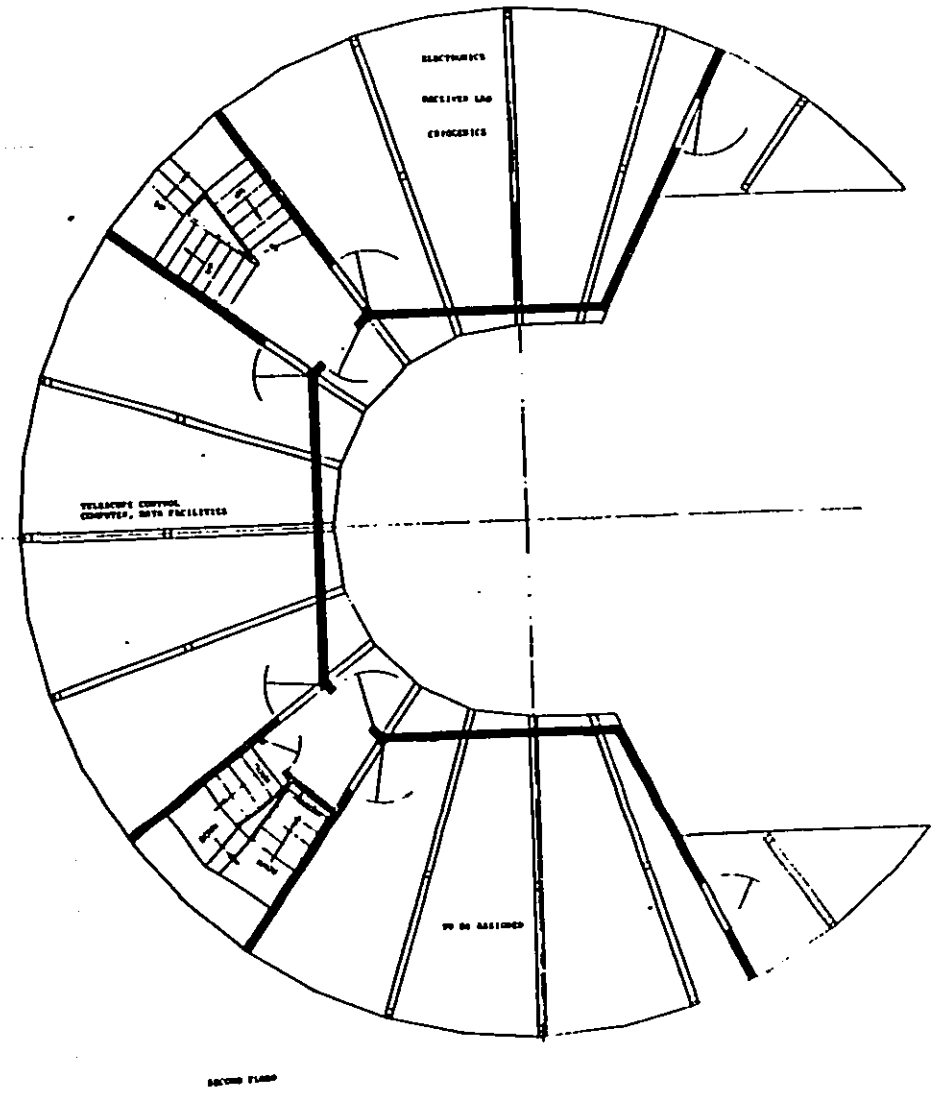


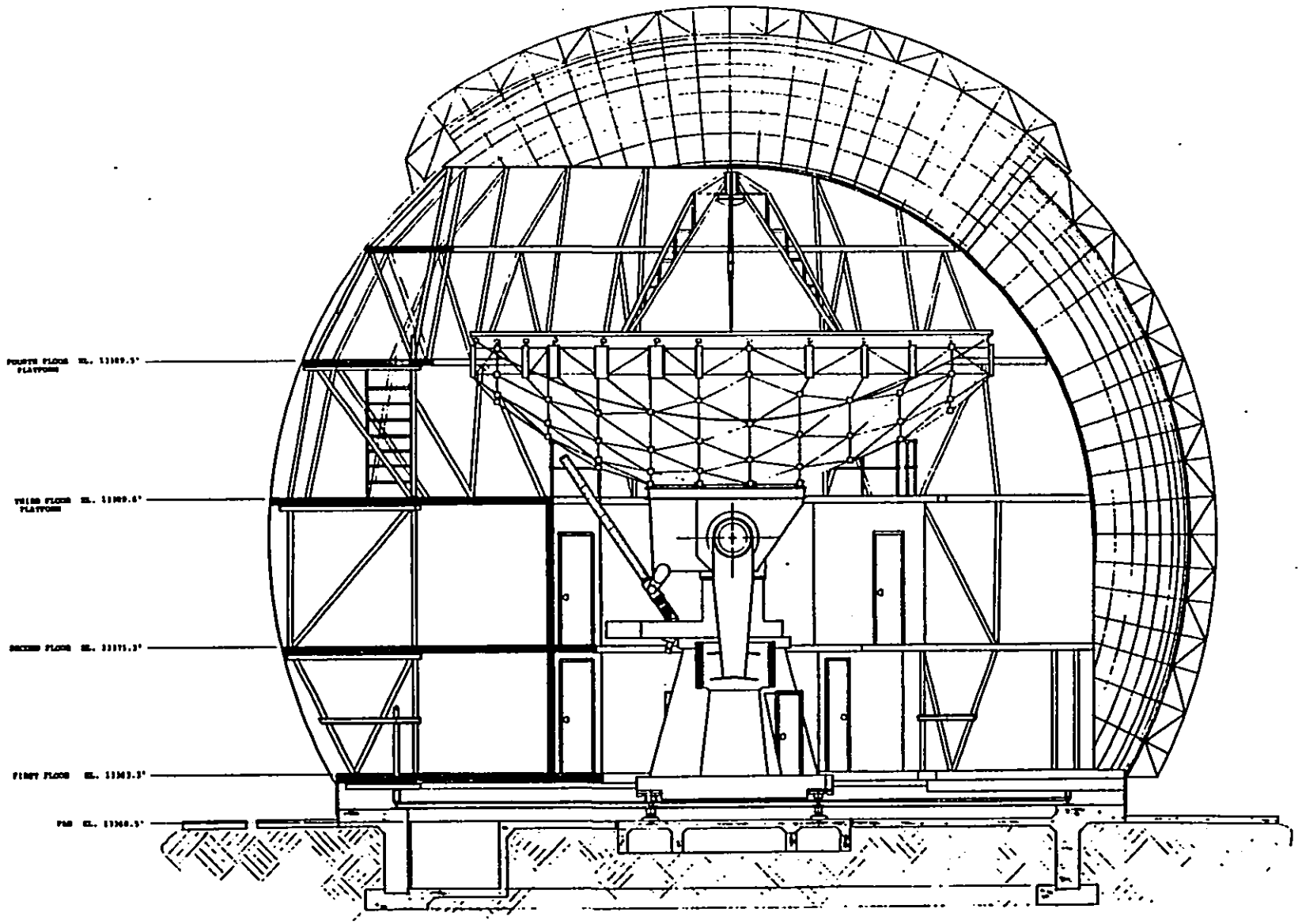
A-2

SOUTHEAST ELEVATION





DOME SCHEMATIC



A-4

SCHEMATIC OF DOME INTERIOR

APPENDIX B

DAMES & MOORE

GEOLOGIC & HYDROLOGIC FACTORS

APPENDIX

ENVIRONMENTAL IMPACT STATEMENT

CALTECH TELESCOPE SITE

MAUNA KEA SCIENCE RESERVE

GEOLOGY

Mauna Kea is the highest (13,800 feet) of the five volcanos which make up the Island of Hawaii. The summit of Mauna Kea is the highest point in the Pacific Basin and, along with Mauna Loa, it is one of the two most voluminous volcanoes in the world.

The rocks of Mauna Kea have evolved through the typical phases of Hawaiian volcanism to a relatively mature stage. The most recently erupted rocks possess higher alkali and silica contents than the basalts which comprise the main mass of the volcano. This so-called alkalic cap phase of volcanism typically marks the waning of eruptive activity. Mauna Kea has been dormant for at least 3,600 years (Porter, 1979) although occasional weak seismicity and the general evolutionary characteristics do not preclude future eruptions. The subaerial portion of Mauna Kea has been dated at least 315,000 + 50,000 years (Porter et al, 1977). Buried parts of the mountain are no doubt older.

The late stage alkalic rocks of the summit area, by virtue of their higher silica content, tend to be of higher viscosity and therefore more prone to explosive eruptions than those of the typical basalts which erupted during the major island building stage. Lava flows, which are less common than pyroclastic deposits such as cinder cones, consist generally of rubbley

aa lavas rather than the smoother more fluid pahoehoe lavas which are found at less mature volcanoes such as Mauna Loa. The occurrence of lava tubes in such aa flows is rare.

At least four periods of glaciation have accompanied eruptive activity at Mauna Kea, the last occurring about 20,000 years ago. Eight periods of eruptive activity have been identified (Porter 1977). Post glacial eruptive activity has apparently been confined to the south rift of the mountain below Elevation 10,000 feet. Thus, the deposits in the site area (Elevation 13,300 ft) erupted prior to, or during the last glacial episode. Some lavas have erupted through or adjacent to the glaciers and display features characteristic of subglacial eruptions.

The principal rock type of the summit area of Mauna Kea is hawaiite which commonly forms clinkery aa lava flows or cinder cones up to 600 feet high with ejecta fragments up to 10 feet in size. These hawaiites range from non-vesicular and dense to extremely vesicular and less dense. The surfaces of lava flows are frequently striated (which signify overriding glacier movement) and interstratified with glacial debris (characterized by loose rock fragments), which in turn are interlayered with cinder, ash and other volcanic pyroclastic materials.

Reconnaissance of Pohakuloa Gulch and Waikahalulu Gulch cut into the south side of the mountain displays overlapping lava flows with an aggregate thickness of more than 300 feet. Dike exposures occur infrequently in the walls of the gulches, angled obliquely to the gulch axes (West, personal

communication, 1982) and apparently not in a radial orientation to the summit. Macdonald (1945) has speculated that the orientation of cinder cones on Mauna Kea may imply both radial and ring structures within the volcano. Cinder cones radiate from the summit area to the south, to the northeast, and to the west. In addition cones oriented concentrically at about the 8,000-foot level may mark a ring structure which may represent the pre-existing and now infilled caldera.

The volcanic features on Mauna Kea do not show well developed fissure type eruptions (common to other Hawaiian volcanoes) which suggest the geometry of feeder dikes. Mauna Kea's summit vents may be fed by more pipelike conduits, though the alignment of cinder cones implies dike injection at some depth below the summit.

Based on available photographs and interviews with University of Hawaii researchers (Woodcock; Laws; West, personal communications, 1982), the proposed site is interpreted to be an aa lava flow which vented in the vicinity of the site (probably from one of the summit cones) and flowed primarily northwest with one lobe extending to the south. From the existing topography, the southern lobe of this flow appears to have moved about 2,000 feet downhill from the site -- about half the distance to Lake Waiau. However, the flow surface has been subject to subsequent glaciation and the original flow paths of the lava are obscured. This aa flow overlies a slightly older flow (possibly part of the same eruption period) which also

moved to the south and southwest — surrounding Lake Waiau and filling the area between Puu Waiau, Puu Poliahu and Puu Hau Kea and partially covered the north and west rim of Puu Waiau.

The stratigraphy and geology of the proposed site, pertinent to the hydrology consists of three geologic units (Porter, 1979b) as identified below:

1. Puu Waiau and Puu Poliahu are subglacial cones whose lower portion erupted below glacial ice and is characterized by hyaloclastictic tuff -- a relatively impermeable material. The upper portions of these cones are typical subaerial cinder and volcanic ejecta -- very permeable materials. These cones are dated 113,000 to 130,000 years.
2. Puu Wekiu; Puu Hau Kea; and Puu Hauoki are cinder cones which are primarily subaerial in character and dated around 55,000 years.
3. The lava flows which issued from these cones (Puu Wekiu, etc.), are aa lavas striated by glacial activity and strewn with various glacial debris. Subsequent transport by wind and water has in some areas partially covered the margins of these flows with cinder material from adjacent cones. The edges of these flows, where exposed, show evidence of contact with ice (pillow structures and vitric breccias). The north wall of Lake Waiau may be a rampart that formed at a lava-ice contact.

HYDROLOGY AND PERMAFROST

Groundwater per se has not been encountered in the summit area of Mauna Kea. However, permafrost has been found in the Summit Cone (Woodcock, 1974; Woodcock and Friedman, 1979) and negative thermal gradients at the UKIR telescope and at Lake Waiau imply permafrost at depth (Woodcock, personal communication, 1982). However, the extent of permafrost on the summit beyond these localities and its contribution to groundwater is not known.

The surfaces of the lava flows and cinder cones of Mauna Kea are extremely broken, strewn with rubble and therefore highly permeable. Surface drainage is essentially non-existent. The gulches of Pohakuloa and Waikahalulu apparently are eroded by water daylighting at the heads of the gulches (perhaps from a groundwater lens perched on a permafrost layer). The only other hydrologic feature in the site area is Lake Waiau, at 13,020 feet. This lake is 4,000 feet from the site and at an elevation 280 feet below the site. Lake Waiau is a water body on the order of 240 feet in diameter and 8 feet deep at overflow stage. Its persistence on the generally permeable slopes of Mauna Kea is anomalous and the subject of some debate. The origin of Lake Waiau is considered to be due to either: water ponding above a permafrost layer (Woodcock, 1980); or water perched above (relatively impermeable) hyaloclastitic tuff which occurs in the base portions of

Puu Waiau (Porter, 1979). The bottom and sides of the Waiau crater coincide with the contact between the subglacial tuff and later subaerial pyroclastic deposits.

Woodcock (1980) presents groundwater and surfacewater level data for Lake Waiau over 13 years. Groundwater levels from piezometers along the south and east margins of the lake indicate primary flow into the lake from the east (groundwater measurements along the north and west margins of the lake are not available). Presumably this water moves through the lake and out to the southwest feeding Pohakuloa Gulch.

The topography between the proposed site and Lake Waiau slopes first south and then southwest around Puu Waiau. Effluent flow may be confined to the lava flow below the site (into which the effluent will be injected) and/or perched on a continuous permafrost layer within this lava flow. In any event, effluent flow would be expected to flow more or less parallel to the surface slope. The impermeable hyaloclastitic tuff in the lower portion of Puu Waiau would likely route such effluent flow around the cone.

The biological water quality of Lake Waiau follows an annual cycle from which some inferences can be made regarding groundwater flow, as follows (E. Laws, personal communication, 1982):

1. In summer, the lake level drops and an upward head from groundwater beneath the lake sediments tends to circulate nutrients up into the water column. A phytoplankton bloom results.

2. In spring, melt water fills the lake, and curtails the bloom. During recent drought conditions (about six years ago), however, this bloom was extreme due to the low volume of melt waters which failed to check the biological activity during the spring thaw. It has taken 2 to 3 years for the lake to begin to re-establish its normal cycle. This indicates that natural variations of water flow and significant natural biological activity do occur within Lake Waiau.

SEWAGE DISPOSAL

An important consideration for the proposed project is the impact on Lake Waiau of sewage disposal at the site. No impact has been identified for cesspools that are currently utilized for existing telescope facilities, located on the summit cone and on an adjacent cinder cone. The geologic and hydrologic evidence suggests negligible impact on Lake Waiau from a cesspool and leaching field at the proposed site.

The ground slope toward Lake Waiau is very gentle, only about 7/10 of 1 percent. Therefore, the total effluent flow, estimated to be about 35-50 gallons per day, would tend to flow radially and rapidly disperse from the source. Moreover, unconfirmed information (Boesgaard, personal communication, 1982) indicates that evaporation losses from cesspool tanks may be extremely high. Residual effluent flow from the leaching field would be subject to

rapid purification due to filtering within the underlying lava rock. Even assuming that residual effluent is perched above a permafrost layer at a depth of only 2 feet, the radially dispersed flow rate would be insignificant within a distance of a few hundred feet from the source.

The combined factors of relatively low effluent flow, evaporation losses from the cesspool tank, storage within the underlying lava rock or permafrost, probable downward dispersion (in event of a deep permafrost layer), and estimated negligible flow rate combined with significant purification within a few hundred feet of the source - lead to the conclusion of no impact on Lake Waiau.

The normal practice of cesspool and leaching field construction adopted for other telescope sites is considered applicable to this site. Specific design features should be based on the results of a soils investigation at the site.

EARTHWORK AND DUST

The proposed earthwork for the site is minimal-limited to minor levelling, removal of lava fragments, and footing excavations up to 4 feet deep at the telescope site. Estimated total excavation is only about 100 cubic yards. The excavated lava rock will be utilized mostly for footing backfills.

Some fine dust, commonly occurring within the interstices of the volcanic rocks, will be released during excavation and backfilling. Construction equipment operations at the site and increased traffic along access roads will lead to the temporary generation of small dust particles. In addition some dust may be generated by the abrasive action of construction equipment on rock.

Lake Waiau is not downwind from the prevailing wind direction on the summit, and the amount of air-borne dust from a small construction area 4,000 feet away can be anticipated to be very small.

The removal of dust by surface water runoff is considered to be of little consequence due to the lack of surface drainage. Generally, dust mitigation measures, such as water truck spraying of equipment routes during construction, are not believed likely to be necessary.

- oOo -

The following attachment completes this Appendix.

Attachment 1 - Map of Area

REVISIONS _____ BY _____ DATE _____

BY _____ DATE 3-18-32 _____ FILE _____

CHECKED BY _____

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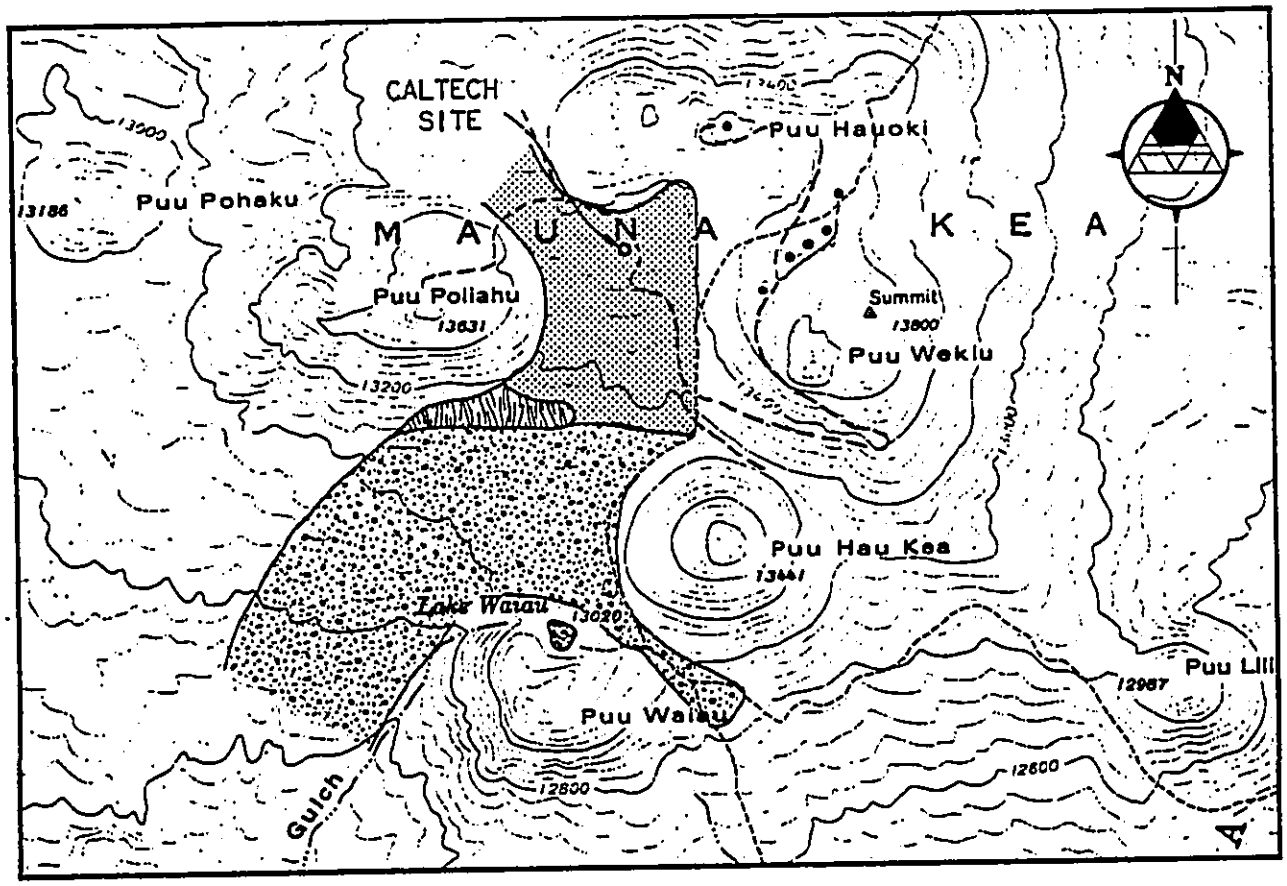

LEGEND:

- LAVA FLOWS
- YOUNGER
- OLDER
- • EXISTING TELESCOPES

MAP OF AREA

SCALE 1:24000

1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 KILOMETER

REFERENCE:
U.S.G.S. TOPOGRAPHIC MAP
MAUNA KEA, HAWAII, HAWAII
DATED 1956

DAMES & MOORE

ATTACHMENT 1

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APPENDIX C

BERNICE P. BISHOP MUSEUM

VEGETATION AT THE SUMMIT OF MAUNA KEA WITH SPECIAL REFERENCE TO THE PROPOSED CALTECH TELESCOPE SITE

AN ARCHIVAL REPORT ON THE VEGETATION AT THE SUMMIT OF MAUNA KEA WITH SPECIAL REFERENCE TO THE PROPOSED CALTECH TELESCOPE SITE

Presented by

Staff and Research Affiliates

Department of Botany

BERNICE P. BISHOP MUSEUM

Honolulu, Hawai'i

April 23, 1982

AN ARCHIVAL REPORT ON THE VEGETATION AT THE SUMMIT OF MAUNA KEA WITH SPECIAL REFERENCE TO THE PROPOSED CALTECH TELESCOPE SITE.

INTRODUCTION
(S. H. Sohmer)

The report herein presented is based entirely upon the knowledge of two specialists who have not had the opportunity to visit the site in question. These individuals could not have profitably visited the site under the climatic conditions prevailing at the time we were invited to join the study. We do wish to help in the matter, however, and to do so in such a faultless manner that the study to which we would be contributing would be beyond reproach.

The biotic community at the summit area of Mauna Kea is unique. Several members of the Bishop Museum have been particularly interested in the biological implications of this unique ecosystem. As far as plant life is concerned, the overwhelming forms of life are representatives of those groups of plants known as lichens and mosses (Bryophytes). Specialized members of these groups have adapted themselves to specific niches in the area and only the surface of what is known about them is being scratched. Dr. Clifford W. Smith, a specialist in Hawaiian lichens, addresses himself to the kinds of lichens and mosses that might be found at the site in question, and Mr. Paul Kores to the situation concerning higher plants. Both have also addressed themselves to the kinds of problems that may be caused by (1) the construction activities on the site, (2) the subsequent use of the site by scientists and visitors. Both also provide some insight into the kinds of things that may be done to mitigate these effects. Dr. Smith's suggestion of paving the road to mitigate the effect of the dust that will be raised by vehicles coming and going to the site is very well taken, as well as his concern for preventing the possibility of off-the-road traffic.

THE BRYOPHYTE AND LICHEN FLORA
(C. W. Smith)

The bryophyte and lichen flora atop Mauna Kea is poorly known. The only study that seriously considered these organisms as part of their program was the 1935 expedition sponsored by the Hawaiian Academy of Sciences led by Mr. E. Bryan, on which Dr. C. Hartt and Miss M. C. Neal were the botanists. Unfortunately their collections were sent to Berlin just before World War II and lost. Since then only Dr. O. Degener has systematically collected all the way to the summit. Dr. W. J. Hoe and myself spent a few hours at 12,000 feet a couple of years ago.

Proposed Caltech Telescope Site
An Archival Vegetation Report
April 23, 1982

The lichen and bryophyte flora is the principal component of the vegetation at the summit. It is very sparse except where it is shaded from the high winds and direct sunlight. The greatest abundance of species is found at the bases of and between the large boulders in the area. Some of the more porous rocks also house lichens in cavities. Six mosses have been reported from the general area:

Amphidium tortuosum
Andreaea acutifolia
Encalypta rhabdocarpa
Grimmia sp.
Pohlia cruda
Racomitrium lanuginosum

The lichen flora includes:

Baeomyces skottsbergii
Diploschistes lutescens
Lecanora polytropa
Lecidea skottsbergii
Rhizocarpon geographicum
Umbilicaria hawaiiensis
Ubilicaria magnussonii

This list is by no means exhaustive. There are a number of species that I would expect to be present but they would only be collected by someone who knew what they were looking for. Though less than half of the species listed above are endemic to Hawai'i, the two Umbilicariae are of particular concern. There were three endemic species in the islands. One, Umbilicaria pacifica, is now extinct in my experience. It has probably been overly disturbed by the activities of feral goats and man. The only other good habitat for the two remaining species would be Mauna Loa. However, the more recent nature of the substrate and the occasional production of sulphurous gases on the mountain make for a very unsatisfactory environment for these species. The upper elevations of Mauna Kea are the only remaining suitable habitat. No Umbilicariae are found on Haleakala any longer.

Photographs of the proposed site indicate that the area is a very likely site for all of the above species. Therefore the building of the structure will unavoidably destroy a certain segment of the biotic community. Normally this impact would be minimal. However, the ecosystem atop Mauna Kea is very fragile and once disturbed will take many years (possibly hundreds) to recover. The impact of the construction is not the only impact that must be considered. The shading effect of the telescope may encourage growth of lichens and bryophytes particularly on the western side of the building. However, the leeward side of the building will probably act as a trap for windblown dust which may cover the rocks. The activity of people visiting the facility and the scientists who may want to "stretch their legs" by walking around the area will have a devastating effect unless strictly controlled. Apart from disturbing the rocks, they will kick up dust which will either cover the plants or abrade them as it is blown by the wind.

The area down wind of the access road is going to be impacted by the dust that will be generated by motor vehicles going to and from the site. The most reasonable way to prevent this disturbance would be to pave the road. Motor vehicles which have access to the area should be properly tuned. Lichens and bryophytes are particularly sensitive to air pollution.

The most important safeguard is that the increased activity in the area will not result in an increase in off-road vehicular use of the area. Many of the cinder cones are being destroyed by these vehicles. The disturbance of the substrate results in the death of both the bryophytes and lichens in the area.

In conclusion, I wish to emphasize that I have not visited the site of the proposed construction. My remarks above are generalized statements of my evaluation of the bryophyte and lichen flora in the area from photographic evidence only and my knowledge of the literature. My concerns about the impact of the construction and subsequent activities in the area are derived from common problems associated with buildings in similar environments elsewhere.

HIGHER PLANTS
(P. J. Kores)

As pointed out by Dr. C. W. Smith, lichens and bryophytes are the principle components of the flora at the summit of Mauna Kea. At these altitudes the climatic conditions tend to be so severe under normal circumstances so as to exclude most higher plants. Currently only one native species (Agrostis sandwicensis Hbd.) has been reported above 13,200 feet and this is present only in extremely low density. Other native species occur in the 10,000 to 11,500 ft. range (e.g., Raillardia arborea Gray and R. struthioloides Gray) and may extend their altitudinal distribution by occupying areas with favorable microclimates, but their presence near the summit has never been documented. Whether this is indicative of the climatic conditions prevalent throughout the area or a lack of field work cannot be clarified without additional studies. Generally speaking, given the small size of the actual project site, the altitude at which it occurs and the low incidence of higher plants, I would conclude that this project will have little or no direct impact on any native pteridophytes (ferns) or phanerogams (seed-bearing plants) based on this archival study.

Secondly, I think it is necessary to point out that this project may have a number of secondary impacts on the aeolian ecosystems present on Mauna Kea. At these extreme altitudes one is dealng with very severe climatic conditions. Any factors which tend to moderate these conditions, such as the construction of structures which provide shade or shelter from the wind, increases in soil moisture and nutrient levels associated with sewage disposal or holding systems, localized

increases in temperature or relative humidity associated with heating and ventilation systems, could all encourage the establishment of weedy species of plants in and around the immediate vicinity of the site. In addition, the personnel utilizing the facility have the potential to serve as unknowing vectors in transporting propagules of higher plants from the low altitude facilities where they are housed to the summit where they work. If new introductions became established they might then adversely effect the native biota of the area. Attempts should be made to minimize these secondary impacts whereever possible and the immediate vicinity of the site should be monitored periodically for any new arrivals. Weeds are not a new problem on Mauna Kea (J. Rock mentioned the fact that the highest plant he observed on the mountain was a single specimen of Sonchus asper (L.) Hill growing at 12,000 ft.), but with increasing access and utilization of the summit region the possibility of aggrevating the problem exists.

SYNOPSES OF CURRICULUM VITAE

P. J. Kores. b. 1950. Research Affiliate, Bernice P. Bishop Museum. B.S., University of Wisconsin, 1972; M.S., University of Hawaii, 1979. POSITIONS: 1980-Present, Research Staff Member, Pacific Tropical Botanical Gardens, Kaua'i; 1978-1980, Curatorial Technician, Bernice P. Bishop Museum, Department of Botany; 1972-1978, Research Grant, Wau Ecology Institute, Wau, Papua New Guinea. SYSTEMATIC BOTANY, TAXONOMY OF FLOWERING PLANTS.

C. W. Smith. b. 1938. Associate Professor, Department of Botany, University of Hawaii (1970-Present). B.S., U.C.N.W., Wales; M.S. Manchester; PhD. Manchester. POSITIONS: 1978, Acting Assoc. Dean of Programs and Personnel, Graduate Division, Univ. of Hawaii. 1967-70, Assistant Prof., Univ. of Hawaii; 1966-67, Research Associate, Princeton Univ.; 1966, Visiting Asst. Prof. of Botany, Univ. of Hawaii; 1958-59, Fattorini and Son, Birmingham, U.K. SYSTEMATIC BOTANY, TAXONOMY OF LICHENS, DEVELOPMENTAL MORPHOLOGY, EMBRYOGENY OF HIGHER PLANTS.

S. H. Sohmer. b. 1941. Chairman, Department of Botany, Bernice P. Bishop Museum (1980-Present). B.S., City College of New York, 1963; M.S., Univ. of Tenn-Knoxville, 1966; Ph.D., Univ. of Hawaii, 1971. POSITIONS: 1979-80, Forest Botanist, Division of Botany, Office of Forests, Lae, Papua New Guinea (on leave from university position); 1977-1979, Staff Associate, Division of Environmental Biology, National Science Foundation, Washington, D. C. (on assignment from university position); 1967-1980, Professor of Biology and Director of Herbarium, University of Wisconsin, La Crosse, Wisconsin. SYSTEMATIC BOTANY, TAXONOMY OF HIGHER PLANTS.

APPENDIX D

BERNICE P. BISHOP MUSEUM

A PROVISIONAL ASSESSMENT OF THE ARTHROPOD FAUNA OF THE AREA TO BE IMPACTED BY THE PROPOSED UNIVERSITY OF HAWAII/CALIFORNIA INSTITUTE OF TECHNOLOGY 10-METER TELESCOPE NEAR THE SUMMIT OF MAUNA KEA, HAWAII

A PROVISIONAL ASSESSMENT OF THE ARTHROPOD FAUNA OF THE AREA TO BE IMPACTED BY THE PROPOSED UNIVERSITY OF HAWAII/CALIFORNIA INSTITUTE OF TECHNOLOGY 10-METER TELESCOPE NEAR THE SUMMIT OF MAUNA KEA, HAWAII

Presented by

Francis G. Howarth

Department of Entomology

BERNICE P. BISHOP MUSEUM

Honolulu, Hawaii

March 29, 1982

A provisional Assessment of the Arthropod fauna of the area to be impacted by the Proposed University of Hawaii/California Institute of Technology (CIT) 10-meter microwave Telescope near the summit of Mauna Kea, Hawaii. By Francis G. Howarth, B.P. Bishop Museum.

Introduction:

The summit area of Mauna Kea has long been assumed to be a biological desert. Yet similar environments on older continental mountains are often inhabited by obligate scavengers specialized to feed on the organic debris carried up the mountain by orographic winds. In addition to the animals, primarily arthropods, that exploit this aeolian habitat, plants that obtain their inorganic nutrients from windborne dust and debris are also included in the aeolian ecosystem. Such plants include certain algae, mosses, and lichens.

The recent discovery that an aeolian ecosystem exists on Mauna Kea is quite surprising given the relative youth of the mountain and its isolation from the older continental biomes. This newly discovered aeolian ecosystem presents a significant but little known biological resources that deserves further study. There may well be more species awaiting discovery. Furthermore, important comparisons in ecology, ethology, physiology, and morphology are possible between these aeolian animals and their lowland relatives and also between aeolian animals in Hawaii and those in other regions of the world. Therefore, an environmental assessment was initiated to survey the site of the proposed University of Hawaii/California Institute of Technology 10-meter telescope (CIT-site) in order to determine the impacts of this development on this ecosystem.

The Fauna:

The major component of the fauna of the aeolian ecosystem on the summit of Mauna Kea is composed of arthropods. Currently, about 12 species appear to be maintaining populations in this ecosystem. These include 3 spiders, 4 mites, 2 springtails, 1 bark louse, and 2 true bugs.

The most remarkable animal discovered so far is a highly evolved, long-legged black, nearly wingless true bug in the genus Nysius. There are numerous Nysius species unique to Hawaii, and all are believed to be seed predators. However, this obligate aeolian species feeds only on the moribund and dead arthropods chilled by the cold. The Wekiu bug was discovered in 1979, and is found most commonly at the summit of Puu Wekiu and on nearby ridges and has been collected only rarely nearby on the mountain. The other lygaeid but is Geocoris pallens, which is an exotic (introduced) insect predator and which was first reported from Mauna Kea by Usinger, 1936. It is often common near Lake Waiau but rare higher on the mountain.

The spiders have not yet been identified to species, but they belong to groups with numerous native species in other Hawaiian habitats. They are assumed to be native and may also be obligate to the aeolian ecosystem. Two species belong to the family Linyphiidae; one appears to be a species of Erigone. The other is unidentified. Both species build small sheet-like webs on the underside of large rocks near the summit. Their webs and egg cases are common and conspicuous under suitable rocks over a wide area of the summit, but the exact range and requirements of each species must await more data. The other spider is a large black wolf spider (Lycosa sp., family Lycosidae), which builds no web but lives under rocks and actively hunts prey. It is almost certainly a native species. Its range is not known, but is may also be restricted to the summit area of Mauna Kea.

The mites and springtails are small to tiny soil animals which live in and on the moist soil beneath and between large rocks. Six species have been found in the soil at the CIT site. They are not yet authoritatively identified so no conclusions can be drawn on their significance. One of the mites is an active predator and belongs to the family Anystidae. One of the springtails is a species of Entomobryia (Entomobryoides) and appears to be an introduced species. Some of these species could be associated with the algae, mosses, or lichens which grow near the summit. The small flightless bark louse prefers drier substrates than any of the other known aeolian species and feeds on decomposed arthropod remains on the ground. There are over 200 species of native bark lice in Hawaii, but this one remains unidentified and could be introduced by man.

Survey Methods:

A preliminary field survey of the site was made on 8-9 March 1982, and samples collected. A trapping program and other longer term studies were initiated. Since the site was still largely under snow cover, our sampling activities were somewhat limited. The major active season for the aeolian animals occurs as the snow melts, when both nutrients and moisture are being released by the melting snow. Therefore, we set out a number of pitfall traps and made other observations in preparation for this possibly brief activity period.

In order to assess the amount of nutrients available to the animals, we surveyed the surface of the snow for aeolian debris both at the site and neighboring areas, including an area known to be inhabited by the bug. Two test pits were also dug in the snow and four samples of snow each approximately 1 cubic foot in size were placed in plastic bags, subsequently melted, filtered, and the aeolian debris recorded. In order to census the arthropods living at the site five soil samples were taken from the loose cinders and soil near the rocky areas and analyzed for arthropods. In addition 16+ pitfall traps were placed in suitable areas on and near the site. The pitfall traps are small jars with preserving fluid and

buried in the ground so that foraging animals fall in. Additional pitfall traps and soil samples will be set out during the next few weeks in order to maximize our chance of making an accurate census. These will include a few traps and samples from other areas nearby in order to determine the biological uniqueness of the proposed site and determine the efficacy of our approach. These will be monitored through the spring season and the organisms identified. Additional censusing will be continued until we are confident in our assessment of what species are present.

Results and discussion:

Not all of the data are in, of course, but a provisional analysis is possible and necessary at this time. The surface of the snow was remarkably clean, with only a few insect fragments noted on the site. This was true of all areas checked during this 2 day period, including the ridge near Puu Wekiu where the bug is known to occur. This contrasts sharply with our observations in June 1980 when the few remaining snow patches near Puu Wekiu were gray with insects with densities approaching several hundred per square foot. Our four cubic foot snow samples also showed only a trace of organic material with densities of 2 - 5 insect fragments per sample. It appears that most of the insect debris on the snow arrives later in the season, however, more data are needed. I suspect that the flying insects are falling out in a widely scattered area nearer the lower snow line and become concentrated at the summit later in the season when there are few patches left. Possibly there are also fewer insects moving up the mountain in the cooler winter months, or this might be a unique winter with little aeolian debris. Energy inputs would appear to be an important parameter in understanding the range, extent, and diversity of the ecosystem. Data on annual patterns of snow fall and melt and accumulation of aeolian debris would partly fill this gap in our knowledge.

Most observations were made in the rocky outcrops on and near (mostly to the south and southwest) of the California Institute of Technology (CIT) site. Small patches of exposed soil occur between the rocks. Characteristically, the top 4-10 cm were composed of a loose, uncompacted layer of small cinders and aeolian debris. Drainage was rapid. This loose textured layer would shrink nearly 50% when compacted and appeared to be formed and maintained by ice wedging from the alternate freezing and thawing of the wet ground. Below this layer was a compact mud, or mud and sand layer, which was saturated with water and often frozen, although the top few cm were thawed during the warmer periods.

Although not specifically searched for or collected, a few plants were seen. Lichens were the most common plants and 2 different kinds were noted growing on the sides of rocks in protected places. One of these may be a Umbilicaria sp. (C.W. Smith, per. comm.). A few mosses were noted growing in the same habitat. Several desiccated flowering heads of grass stuck out through the snow and from cracks between rocks.

The rocky ridges visible in summertime photographs of the area and those exposed during our visit indicate the presence of suitable habitat for the Wekiu bug and other aeolian animals. We did not find the recently discovered Wekiu bug; however, the season and cool windy weather were not suitable for foraging by the bug, and these conditions made observations difficult. Two active aeolian animals were observed under rocks heated to 5-10° C. by the sun. These were a native Hawaiian lycosid wolf spider and an anystid mite; both are regular inhabitants of the aeolian zone on Mauna Kea.

The soil samples showed a rich supply of recently arrived aeolian nutrients (in the recent past). The proportions of the species represented were approximately the same for all samples, with Psylla uncatoides being the most abundant, (Gagne, 1973) followed in order by a fly (probably Hydrellia sp.), a chalcidoid wasp, and various species of lygaeid bugs. These four groups made up 2/3 of the material with the remaining species represented by only a few specimens each. The material was in varying stages of disintegration and probably represents several seasons of accumulation. Six species of arthropods were found living in the samples. Two were springtails, and the remaining were mites. These six have not yet been identified. These are all small species which correlates with the small soil pore size observed at the sites.

Potential Impacts:

The Mauna Kea aeolian ecosystem is still relatively unknown, especially since its existence was only recognized very recently and little research has been done to date. Some assessments can be made from the available data, but there is a risk of missing key parameters. The fundamental requirement is a thorough biological survey of the Science Reserve and Natural Area Reserve to determine the ranges of the specialized aeolian animals. Then we can assess the value and uniqueness of proposed development sites in terms of their role in maintaining populations of these remarkable animals. Additional new species may be discovered, and some may be as noteworthy for science as the Wekiu bug and the wolf spider.

The Wekiu bug is noteworthy because of its youth and because lowland relatives are extant. The Mauna Kea aeolian animals provide science with a unique opportunity for evolutionary study. Mauna Kea is the youngest and most isolated mountain on which a periglacial fauna has been found. The Wekiu bug (and other species) evolved on Mauna Kea probably at the margin of a montane glacier (periglacially) within the last 0.5 million years. The degree of morphological and physiological change from its ancestors is remarkable in so brief a time. Close relatives still survive on Hawaii Island and provide organisms for comparative research.

The evidence to date strongly indicates that the animals are extremely sensitive to distrubance of the surface. Although the reasons for the apparent limited range of the Wekiu bug are not well known, it is found in substrates where the cinders are of a

relatively large size, and not in neighboring areas where a large amount of mud or other particles partially fill the interstitial spaces. The bug is also known only from areas where there is a moisture layer (often frozen) within a few decimetres of the surface. This moist layer appears to be critical to the survival of the bug through drought periods in this relatively arid region. Crushing the cinders, removal of large boulders and disruption of the moisture layer by construction activities destroy the habitat for the bug. In addition, the loose friable nature of the ground surface in many areas is quite remarkable and allows many organisms to disperse and feed between refuges by moving in the more humid open spaces just below the ground surface. Compaction of this layer by construction or virtually any other surface activity (including footsteps) would kill many enclosed animals and close this dispersal route. If the increased use of the summit is not going to severely impact the ecosystem, then adequate controls must be developed which limit surface disturbance by offroad vehicles and other human activities. This impact transcends the boundaries of any single telescope on the summit. Although not specifically part of this telescope plan, should the road to the summit be paved, thereby allowing greater accessibility, this impact will increase exponentially. However, paving only the access road may mitigate some of the dust problem.

Dust from construction activities and the road also negatively impact the aeolian animals by filling the interstitial spaces in the substrate and may be an important impact downwind of the facilities. The four samples of snow collected from the CIT site were relatively clean but, significantly, did contain almost entirely aeolian debris of man-made origin. The most common substance was fibers of several types which were probably derived from clothing. Also present in descending order were paint chips, road dust, and insect fragments.

Shipping large prefabricated components to the site from continental source areas may allow foreign animal and plant species free passage as stowaways. Quarantine measures on such shipments are recommended. In additon to possible impacts on the natural environment of Mauna Kea, there is as great a threat that an economically important pest might become established. These quarantine measures can be prescribed from the degree of risk involved. The risks depend on source area, season, accessibility of components and packing materials to potential stowaways, length of time in travel, etc. For example, the worst case might be packing large components in the open in California foothills in autumn when insects are seeking winter hiding places. On the other hand packing the telescope components in an enclosed laboratory at CIT may not be as risky, and inspection of the packing operations by a plant and animal quarantine official may be adequate.

The telescope dome may change the pattern of snowfall (e.g. drifts), snow melt, and aeolian fallout in the area surrounding the facility and these changes may affect the animals.

Petroleum products and other toxic environmental pollutants will seriously impact the organisms. Waste oil from machinery and telescope mountings would last many years in the ground in the cold environment and would be expected to be detrimental to aeolian species. Nontoxic wastes in quantity such as around garbage cans might allow colonization by exotic scavengers such as ants, and mice which could compete with native species.

Burying the cables for electricity and telephone will destroy additional suitable aeolian habitat. The routing for this trench should follow closely the road alignment as this route is already impacted.

Construction of the CIT facility will lead to the direct permanent destruction of a small area of aeolian habitat. The significance of this impact on the total population of native biota is currently unknown, and additional data on the distribution of the various species on the mountain should be gathered to provide a measure of the uniqueness of the CIT site. Many of the potential impacts discussed above extend well beyond the boundaries of the proposed facility and for that reason should be of special concern. However, it is possible that with appropriate mitigative measures the CIT development will not critically impact the ecosystem.

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APPENDIX E

PATRICK McCOY

ARCHAEOLOGICAL SURVEY OF THE PROPOSED SITE OF THE CALTECH 10-METER TELESCOPE ON MAUNA KEA, HAWAII

Ms. 080682

ARCHAEOLOGICAL SURVEY OF THE PROPOSED SITE OF THE CALTECH 10-METER TELESCOPE ON MAUNA KEA, HAWAI'I

by

Patrick C. McCoy

Prepared for

Group 70 Inc.
Honolulu, Hawai'i

August 1982

Department of Anthropology
BERNICE P. BISHOP MUSEUM
Honolulu, Hawai'i

INTRODUCTION

An archaeological survey of the proposed site of the California Institute of Technology 10-meter telescope on Mauna Kea was carried out by the Department of Anthropology, Bernice P. Bishop Museum on July 17, 1982, under contract to Caltech's local consultant, Group 70 Inc. The subject area is located within a portion of the state-owned Mauna Kea Science Reserve (Fig. 1) that is leased to the Hawaii Institute for Astronomy. The planned observatory, support facilities, and parking lot cover an area of 32,400 square ft between the 13,346- and 13,364-ft elevations on the south side of an unpaved road (cf. fig. 3, Draft EIS; May 1982) that passes through the "saddle" between Pu'u Poliahu and Pu'u Hau Oki.

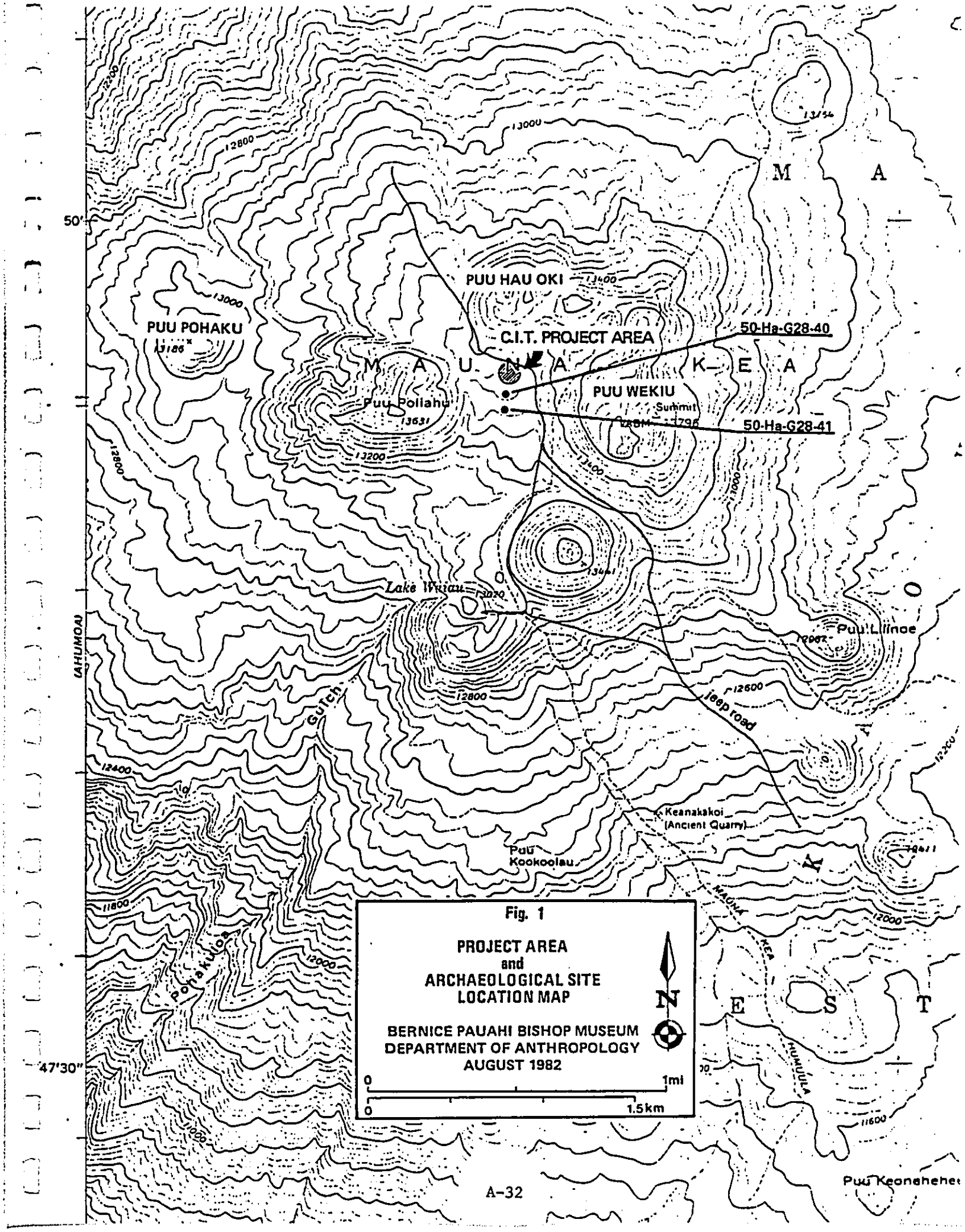
THE SURVEY AREA: GEOLOGIC AND VEGETATIVE CHARACTERISTICS

The surface geology of the project area is characterized by rubbly hawaiite a'a flows of late Pleistocene age, partially mantled by cinder, coarse ash, and spindle bombs from the similar age Pu'u Hau Oki and Pu'u Wekiu cinder cones (Porter 1979). The surfaces of the lava flows, commonly oxidized to a brownish hue, bear clearcut evidence of glaciation in the form of striations, polish and boulder erratics. The road adjoining the proposed telescope site skirts along the exposed margins of the flows on a hardened cinder rock surface that is now subject to some erosive action.

The vegetation of the alpine zone on Mauna Kea is predictably impoverished, although current studies on the lichen and bryophyte flora (Hoe and Smith, in preparation) seem to indicate a greater degree of species diversity than previously expected. Small, widely dispersed clumps of grass also exist in the general area.

ARCHAEOLOGICAL AND ETHNOGRAPHIC BACKGROUND

No previous archaeological surveys had been undertaken in the immediate environs of the proposed telescope site, although several locales near the northern terminus of the aforementioned dirt road had been examined in 1981 for the placement of small data-collecting stations by Kitt Peak Observatory


PUU HAU OKI
13400
PUU POHAKU
13186
C.I.T. PROJECT AREA
50-Ha-G28-40
50-Ha-G28-41
PUU WEKIU
Summit
13796
Puu Poliahu
13631
13200
12800
13000
12600
12400
11800
12000
Lake Waiau
13020
Puu Lilinoe
12967
Gulch
jeep road
Keanakakoi
(Ancient Quarry)
Puu
Kookoolau
MAUNA KEA
HUMUULA
Puu Keonehehe
50'
47'30"
MAUNA KEA
MAUNA LOA
Fig. 1
PROJECT AREA
and
ARCHAEOLOGICAL SITE
LOCATION MAP
BERNICE PAUAHI BISHOP MUSEUM
DEPARTMENT OF ANTHROPOLOGY
AUGUST 1982
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(McCoy, letter, June 9, 1981). In 1975 the area bordering Lake Waiau was surveyed in the course of research investigation of the Mauna Kea Adze Quarry, a National Historic Landmark (McCoy 1976, 1977; McCoy & Gould 1977). A shrine (site Ha-G28-36*) of inferred pre-contact (A.D. 1778) age was found above the lake on an a'a flow that covers the north flank of Pu'u Waiau (McCoy 1977b, 1981). Given the relative proximity of the shrine to the center of the adze quarry and the undoubted use of the lake as a source of fresh water for the adze makers, this site was included within the boundaries of the National Historic Landmark. It is now also included in the Mauna Kea Ice Age Natural Area Reserve.

Ethnographic information on Hawaiian land use (e.g., resource exploitation patterns, and religion) of the Mauna Kea summit region is presently being compiled and evaluated in terms of culture-historical significance as part of the RCUH contract. For the present, it can be noted that the Hawaiians were intimately familiar with the barren, stony alpine desert environment on the upper flanks of Mauna Kea. This is evident in the existence of Hawaiian trails to the summit, place names, and legends relating to the snow goddess, Poliahu, and burials on a number of cinder cones.

SURVEY METHODOLOGY

The survey, delayed by unseasonally deep snow in the project area, was begun on July 16, but was abruptly terminated due to unfavorable weather--rain, periodic snow flurries, and a dense, wet fog. The survey crew (Aki Sinoto, Ragnar Schousboe, Judy McCoy, and the writer) completed the work in the morning on the following day. Survey coverage was constrained to a degree by the presence of small patches of snow, but given the type and locational setting of archaeological sites in this general area, this is not considered to have had an effect on the survey results. A more serious constraint was the absence of fixed project area boundaries. An area far in excess of the project boundaries was surveyed as part of a concurrent contract with the Research Corporation of the University of Hawaii (RCUH) for the preparation of a separate EIS. This document will be available later this year and should be consulted for a more detailed description of the general area,

*Bishop Museum site designation.

archaeological sites, and related culture-historical values of the Mauna Kea summit region. All field records, maps, and photographs emanating from these two projects are on file in the Department of Anthropology, Bernice P. Bishop Museum.

RESULTS AND SIGNIFICANCE EVALUATION

No archaeological sites were found in the 32,400-square-ft project area. Two shrines, designated sites 50-Ha-G28-40 and -41 were recorded, however, in the reconnaissance survey of the immediately surrounding environs. The locations of the two sites were established on the basis of altimeter readings (40-ft interval accuracy) and compass bearings. Site 50-Ha-G28-40, located on the high point of a flow at roughly the 13,330-ft elevation, is circa 135 meters to the south-southwest of the planned observatory. The main structure is a pavement of cobble-sized stones, 1.60 by 1.50 meters and ca. 25 cm high; along its edges are three upright stones and two others are in a fallen, horizontal position. On the east side, 4.40 meters distant, is a single, isolated upright. Site 50-Ha-G28-41 is located on the downslope margin of a flow at approximately the 13,290-ft elevation, some 80 meters to the south of the first. It consists of two upright stones, 1.40 meters apart, with small pavements at the base of each.

The major significance of these structures is in their isolated geographical setting, inferred ritualistic function, and possible relationship to the adze quarry industry. A more detailed description of these sites and assessment of their culture-historical significance will be presented in the report for RCUH.

IMPACT ASSESSMENT AND RECOMMENDATIONS

The proximity of the proposed Caltech telescope to archaeological sites 50-Ha-G28-40 and -41 constitutes a potential adverse effect on these cultural resources. The small size and fragility of the shrines, particularly the settings of the upright stones, means that these structures are potentially susceptible to both direct and indirect impacts, i.e., during and after implementation of the proposed undertaking. Though

lacking excavation potential, the two structures have locational (environmental setting) and functional (religious) interpretive values that should be preserved.

In terms of the perceived culture-historical importance of the archaeological remains, and possibility that they will be subjected to direct and/or indirect adverse impacts, it is recommended that:

(1) Mitigative measures be undertaken to record in considerably more detail the form, size, and construction of the two shrines than was possible during the reconnaissance survey for RCUH.

(2) A cultural resources management plan for the preservation and interpretation of archaeological sites in the Mauna Kea Science Reserve be prepared by the State Historic Preservation Office or a qualified consultant.

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APPENDIX F

RULES REGULATING ACTIVITIES WITHIN NATURAL AREA RESERVES

TITLE 13

DEPARTMENT OF LAND AND NATURAL RESOURCES

SUBTITLE 9 NATURAL AREA RESERVES SYSTEM

CHAPTER 209

RULES REGULATING ACTIVITIES WITHIN NATURAL AREA RESERVES

Historical Note: Chapter 209 of Title 13, Administrative Rules, is based substantially upon Regulation 10 of the Administration of the Department of Land and Natural Resources entitled "Regulating and Prohibiting Activities within Natural Area Reserves Including Provisions for Excepted-Use Activities by Permit and Penalties for Violation of the Regulation". [Eff. 5/20/79; R JUN 29 1981]

Sec. 13-209-1 Purpose and applicability. (a) The purpose of these rules is to regulate activity within natural area reserves established pursuant to section 195-4, Hawaii Revised Statutes.

(b) These rules shall apply to all persons entering the boundaries of a natural area reserve. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-5)

Sec. 13-209-2 Definitions. As used in these rules, unless context requires otherwise:

"Board" means the board of land and natural resources.

"Commission" means the natural area reserves system commission.

"Department" means the department of land and natural resources.

"Game mammals and birds" means those animals that have been designated as such by sections 191-8 and 191-19, Hawaii Revised Statutes, and by administrative rules of the department.

"Natural area reserve" means those State lands that have been designated as part of the Hawaii natural area reserves system by the department pursuant to section 195-4, Hawaii Revised Statutes. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-5)

Sec. 13-209-3 Permitted activities. Hiking, nature study, and bedroll camping without a tent or other temporary structure are permitted. Hunting is a permitted activity pursuant to hunting

rules of the department. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-5)

Sec. 13-209-4 Prohibited activities. The following activities are prohibited within a natural area reserve:

(1) To remove, injure, or kill any form of plant or animal life, except game mammals and birds hunted according to department rules;
(2) To introduce any form of plant or animal life, except dogs when permitted by hunting rules of the department;
(3) To remove, damage, or disturb any geological or paleontological feature or substance;
(4) To remove, damage, or disturb any historic or prehistoric remains;
(5) To remove, damage, or disturb any notice, marker, or structure;
(6) To engage in any construction or improvement;
(7) To engage in any camping activity that involves the erecting of a tent or other temporary structure;
(8) To start or maintain a fire;
(9) To litter, or to deposit refuse or any other substance;
(10) To operate any motorized or unmotorized land vehicle or air conveyance of any shape or form in any area, including roads or trails, not designated for its use;
(11) To operate any motorized water vehicle of any shape or form in freshwater environments, including bogs, ponds, and streams, or marine waters, except as otherwise provided in the boating rules of the department of transportation, State of Hawaii;
(12) To enter into, place any vessel or material in or on, or otherwise disturb a lake or pond. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-5)

Sec. 13-209-5 Special-use permits. (a) The board or its authorized representative, with the approval of the commission, may issue permits to conduct activities otherwise prohibited by section 13-209-4 for research, education, management, or for any other purpose consistent with chapter 195, Hawaii Revised Statutes.

(b) The board or the commission may require a permit application to include an assessment of the potential environmental effect the special-use may have on the area concerned.

(c) The provisions of this section shall not exempt the applicant from complying with any other applicable rule or statute. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-5)

Sec. 13-209-6 Penalty. Any person violating any of the provisions of these rules shall be penalized as provided in section 195-8, Hawaii Revised Statutes. [Eff. JUN 29 1981] (Auth: HRS Sec. 195-5) (Imp: HRS Sec. 195-8)

APPENDIX G

RADIO INTERFERENCE

June 7, 1982 Kona

Office of Environmental Quality Control
550 Halekauwila Street Room 301
Honolulu, Hawaii 96813

Re: EIS, Caltech's Telescope atop Mauna Kea

Nowhere in this EIS is there any mention of the impact on other users of the electromagnetic spectrum. Thus, unanswered goes the question of,

> "Will the telescope have an adverse effect on other users of the electromagnetic spectrum, other users of radio frequencies?"

Not that the telescope will interfere with them -- it is a passive receiver -- but that harmonics generated by other users will interfere with telescope operations enough that Caltech will request these users be restricted in their operations or even be shutdown?

The problem is made clearer by the radiotelescope in West Virginia (Green Bank?) which, when completed, absorbed enough outside interference that they went to the Federal Communications Administration and asked these other users be highly restricted - and they were! Amateur radio operators for one. Amateur radio operators within a hundred mile radius, I believe it was, were forced into a "quiet zone" though they had met all FCC rules, regulations and safeguards against radio frequency interference and spurious emissions as the state-of-the-art permits.

Is that problem going to happen here? Though your wavelengths are shorter then West Virginia's, are harmonics from:

...microwave stations, commercial and amateur repeaters,
...aeronautical, land mobile and marine transmitters,
...amateur radio operations plus the widely used CB and marine VHF transceivers

going to give you a problem? If so, let's get it out in the open right away, before the fact. A "quiet zone" of 100 miles dumped on amateur radio operators in Hawaii will be a disaster, hitting about 90% of ham operators.

It is interesting that the one Federal agency most involved with this problem of infringement on users of the radio spectrum, the Federal Communications Commission, was never contacted, never sent an EIS Preparation Notice and probably not even the EIS itself. This might be done before the problem gets out of hand.

So, Caltech astrophysicists, please do some advance thinking on this one. Are our transmissions, even up in the gigahertz range, meeting FCC's "good engineering practices" to limit harmonics and spurious emissions, going to foul up your incoming signals?

Or will we be living in peace with each other?

Clark Richardson
Amateur Radio Operator

74-5040 Onipaa Street
Kailua-Kona, HI 96740
329-2083

c.c. Muraoka, Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

16 July 1982

Mr. Clark Richardson
74-5040 Onipaa Street
Kailua-Kona, HI 96740

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Richardson:

Thank you for reviewing the Draft EIS for Caltech's 10-Meter Telescope project. The FCC was sent a copy of the draft EIS for their review.

To reassure your concerns regarding the possibility of radio interference from the operation of the proposed telescope, we have attached a copy of a letter from Dr. T.G. Phillips, Director-designate for the Submillimeter Observatory, concerning the matter. Dr. Phillips will attempt to contact you by phone when he is in Kailua-Kona July 21st and 22nd, 1982, to answer any further questions that you might have on the subject.

We appreciate your thoughtful comments.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

Enclosure

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA 91125

GEORGE W. DOWNS
LABORATORY OF PHYSICS - 405-47

GROUP 70
TELEPHONE 213-356-6811
TELEX 675425

July 6, 1982

Marilynn Metz
Group 70
924 Bethel St.
Honolulu, HI 96813

Dear Marilynn:

Re: Letters from Mr. Richardson and OEQC on Radio Interference

This matter is quite complex and I thank Mr. Richardson and OEQC for bringing it up. I have looked into it to the degree that is sufficient to give an initial reply. However, I will wish to contact Dr. Vernon Pankonin at the National Science Foundation to discuss the long term situation, so that there may be a follow-up letter soon.

First let me deal with the practical situation at Mauna Kea, as it now stands. Several sets of observations have been carried out using the infrared telescope (IRTF) on Mauna Kea. That telescope is situated close to the anticipated position for the Caltech Submillimeter telescope and is, if anything, more exposed to interference of an electromagnetic nature. The detection equipment used in the tests was of the type to be fitted to the submillimeter telescope. No serious interference was detected. Therefore I conclude that the present situation is satisfactory for submillimeter telescope operations, including the effects of the microwave telephone link and the mobile radio phones currently operating on the mountain top.

The wavelength range of our detectors will be about 2mm (150 gigahertz, or kilo Megahertz) to about 300 μm (1,000 gigahertz), so there is little probability that any harmonically generated radiation from radio transmitters in the kilohertz or megahertz ranges could cause a direct interference problem (since the radiated power drops off rapidly with the harmonic number). However, at some other observatories TV transmitters have been placed within a few hundred yards of telescopes in which case it is found that the large electric fields cause currents to flow in the structures of the telescopes inducing interference in the detection equipment in a somewhat indirect manner. These effects could occur for the infrared telescopes as well as for the submillimeter. On page 36 of the draft EIS is a sketch of the Mauna Kea management area showing the Science Reserve as about 2 miles in radius. Provided there were no high power TV or radio station transmitters in the Science Reserve, it would seem that normal radio interference will not be an issue.

A further problem for submillimeter telescopes is radar interference. Some radar transmitters have concentrated power patterns and when directly pointing at the telescope could cause interference. No problems of this kind

were found in the tests at IRTF. In fact, the IRTF is quite exposed on the mountain peak and would be susceptible to any radar beamed in that direction, whereas the site for the submillimeter telescope has been chosen to minimize exposure to direct radar illumination, lying well below the summit on the sheltered plateau between the summit peaks. Interference from radar would be improbable, provided radar transmitters are not located within the Science Reserve.

The situation for radio and submillimeter observatories is now discussed in general. Radio Observatories are sometimes surrounded by "coordination zones," within which applications for frequency assignments in bands assigned to radioastronomy (or other services) should be coordinated. The regulations are contained in the "Manual of Regulations and Procedures for Federal Frequency Management." The coordination is made with respect to a specified agency for the individual case (e.g. Committee on Radio Frequencies, National Academy of Sciences; Radio Spectrum Manager, National Science Foundation, etc...). In the case of the Mauna Kea, Caltech Submillimeter telescope the relevant frequencies would be in the range of about 150-1,000 gigahertz, and would not affect conventional radio operators (Bodies such as the International Astronomical Union are currently considering the question of the frequencies bands for which protection should be requested within the 275-1,000 gigahertz range). Since the public use of those frequencies is currently uncommon, it probably would be sufficient to rely on the Science Reserve rather than designating a coordination zone. Incidentally, coordination zones already exist in the Hawaii area for ground stations in Honolulu, Kawai, etc... for a variety of radio frequencies; 1,670-1,710; 2025-2035; 2200-2300; 7300-7750; 8025-8400 Megahertz; etc.... Also there is a blanket requirement (which includes Hawaii) for coordination in the 1660-1670 megahertz range for Radiosondes.

The specific case,raised by Mr. Richardson, of the National Radio Astronomy Observatory (NRAO) at Green Bank, West Virginia, is now discussed. This is a unique situation in which NRAO and the Navy Research Station at Sugar Grove share the "National Radio Quiet Zone." This zone regulates all transmitters at all frequencies and covers roughly a 100 mile x 100 mile area. There is no need or desire for any such protection in the case of Mauna Kea. If protection were needed, it could be provided by a Big Island coordination zone affecting only 150-1,000 gigahertz operations, and as stated above, this is probably already achieved by the presence of the Science Reserve.

To summarize: There has been no interference detected in tests performed at IRTF: The short wavelengths (high frequencies in the 150-1000 gigahertz range) used by the submillimeter telescope make interference by any but the closest and most powerful radio transmitters negligible: The sheltered nature of the site makes interference by radar transmitters unlikely: The protection afforded by the Science Reserve would seem to make a "coordination zone" unnecessary: There is no need for a second "National Quiet Zone" of the kind in use at Green Bank, West Virginia.

Sincerely,

T. G. Phillips
Professor of Physics
Director-designate,
Caltech Submillimeter Observatory

TGP/kc
cc: G. Neugebauer, R. B. Leighton,

July 26, 1982

University of Hawaii: Louis Lopez
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Re: EIS-Mauna Kea Science Reserve
Master Plan & My Letters

Mister [illegible] and Mister Lopez,

An inquiry was made as to any adverse effects on other users of the electromagnetic spectrum by the millimeter wavelength telescopes planned for atop Mauna Kea.

The reply has come from Dr. T.G. Phillips, director-designate of the Caltech Observatory concluding that "there is little probablity that any harmonically generated radiation from radio transmitters in the kilohertz or megahertz ranges could cause a direct interference problem" and that "there is no need for a second 'National Quiet Zone' of the kind at Green Bank, West Virginia".

From this we understand that amateur radio operation in the State of Hawaii, and the Big Island in particular, will give no problem of interference to any of the planned millimeter and submillimeter wavelength telescopes in the Science Reserve.

Therefore, unless we hear otherwise from the Dr. Vernon Pankonin of the National Science Foundation, mentioned in Dr. Phillip's letter, we no longer have concern for construction of Caltech's and other telescopes for this segment of the electromagnetic spectrum.

Clark Richardson

Clark Richardson, WH6AJC

Ray Beik

Ray Beik, NH6K, President
Hawaii-West Amateur Radio Society

74-5040 Onipaa Street
Kailua-Kona, Hawaii 96740
Phone 808 329-2083

c.c. Big Island Amateur Radio Club/Hilo
Dr. T.G. Phillips
Group 70

APPENDIX H

COMMENTS AND RESPONSES ON THE

DRAFT ENVIRONMENTAL IMPACT STATEMENT

The following agencies, organizations and firms reviewed and commented on the Environmental Impact Statement during the review period. Starred (*) agencies, organizations, and individuals sent substantive written comments which are included in this section of the EIS. These respondents were sent written responses to their comments. All substantive comments that were received, and all responses are reproduced on the following pages of this appendix.

Federal Agencies

U.S. Department of the Air Force
U.S. Department of the Army
U.S. Army Engineer District
Headquarters U.S. Army Support Command
U.S. Department of the Navy
U.S. Department of the Interior
* Office of the Secretary
* U.S. Geological Survey
* Fish and Wildlife Service
U.S. Department of Agriculture
Forest Service
* Soil Conservation Service
* U.S. Environmental Protection Agency

State Agencies

* Office of Environmental Quality Control
* Department of Accounting and General Services
Department of Agriculture
* Department of Planning & Economic Development
Division of Energy
Department of Transportation
University of Hawaii at Manoa
Water Resources Research Center
Environmental Center
University of Hawaii at Hilo
* Natural Sciences Division
Department of Health
Department of Defense
Department of Land and Natural Resources
Department of Education

County Agencies

Department of Public Works
Department of Water Supply
Police Department
* Fire Department
** County Council

Firms

* Hawaiian Electric

Organizations

* Hawaii Audubon Society, Island of Hawaii Representative
* Hawaii Island Chamber of Commerce
* Mauna Kea Ski Patrol Hawaii
  Ski Association
* Hamakua District Development Council

Individuals

  Mr. David K. Hein, Brock & Associates
* Dr. Edward Laws, U.H. Department of Oceanography
* Dr. T.J. Lee, UKIRT
* Dr. Rene Racine, CFHT
* Mr. Clark Richardson (see Appendix F)
* Mr. Henry A. Ross

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556-8200

In Reply Refer To:
ER 82/1039

July 13, 1982

Mr. Adair F. Montgomery, Chairman
Committee on Environmental Matters
National Science Foundation
Office of the Assistant Director for
Astronomical, Earth and Ocean Sciences
Washington, D. C. 20550

Dear Mr. Montgomery:

The Department of the Interior has reviewed the draft environmental statement for 10-Meter, Submillimeter and Millimeter Wave Telescope Project, Mauna Kea, Hawaii. We offer the following comments.

GENERAL COMMENTS

The document is well written and the concerns of the Department of the Interior as expressed in previous correspondence have all been addressed in the draft environmental statement.

We encourage the proposing agency to conduct a thorough biological survey of the Science Reserve and general project area to determine the distribution of specialized animals within the aeolian ecosystems. Mitigation measures to protect these resources should be developed and implemented based upon a complete understanding of their range, life requirements, and ecological significance.

We appreciate this opportunity to comment.

Sincerely,

Patricia Sanderson Port
Regional Environmental Officer

cc: University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Attention: Walter Muraoka

UNIVERSITY OF HAWAII

Vice-President for Administration

23 July 1982

Ms. Patricia S. Port
Regional Environmental Officer
United States Department of the Interior
Office of the Secretary
Pacific Southwest Region
450 Golden Gate Avenue, Box 36098
San Francisco, CA 94102

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Ms. Port:

Thank you for comments on the subject EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii. We appreciate your positive assessment of the document.

In answer to your comments concerning a biological survey of the Science Reserve, please be informed that an EIS is currently being prepared for the University's Research and Development Plan (NOP issued July 8, 1982). Biological studies are being conducted in conjunction with the physical planning process which is being undertaken concurrently with the EIS.

Because of your interest in the proposed activities on Mauna Kea and in the possible impact that these activities may have on the environment, we are soliciting your participation in the preparation of this EIS. Enclosed is a copy of the EIS Preparation Notice for the subject project which was filed with the Environmental Quality Commission on 30 June 1982. Deadline for comments is 8 August 1982.

Please send your comments to:

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, HI 96822
Attention: Louis Lopez

2444 Dole Street • Room 202 • Honolulu, Hawaii 96822

Ms. Patricia S. Port
Regional Environmental Officer
United States Department of the Interior
23 July 1982

Page Two

with a copy to:

Group 70
924 Bethel Street
Honolulu, HI 96813
Attention: Marilynn Metz

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

June 8, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Sir:

The U.S. Geological Survey, Water Resources Division, would like to extend their appreciation in allowing us to comment on the California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy's environmental impact statement.

One of the reviewers from our Office suggested that it would have been useful if water quality data were reported for Lake Waiau for future comparisons.

Sincerely,

Benjamin L. Jones
District Chief

Enclosures

cc: University of Hawaii, Attn: Walter Muraoka, Honolulu, HI
Group 70, Attn: Marily Metz, Honolulu, HI

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Mr. Benjamin L. Jones
District Chief
U.S. Department of the Interior, Geological Survey
Water Resources Division
P.O. Box 50166
Honolulu, HI 96850

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Jones:

Thank you for reviewing the Draft EIS for the subject project. In answer to your specific comment on water quality:

The most recent water quality data for Lake Waiau are summarized in a dissertation by Jane E. Massey which was submitted to the graduate division of the University of Hawaii in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Botanical Sciences, May 1978. This dissertation is being incorporated by reference in the revised EIS.

Thank you for your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

Enclosure

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
300 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU HAWAII 96850

IN REPLY REFER TO:
ES
Room 6307

JUN 10 1982

Office of Environmental Quality Control
Office of the Governor
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Re: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy, Mauna Kea, Hamakua, Hawaii

Gentlemen:

We have reviewed the subject Environmental Impact Statement (EIS) and offer the following comments.

We encourage the proposing agency to conduct a thorough biological survey of the Science Reserve and general project area to determine the distribution of specialized animals within the aeolian ecosystems. Mitigation measures to protect these resources should be developed and implemented based upon a complete understanding of their range, life requirements, and ecological significance.

We appreciate this opportunity to comment.

Sincerely yours,

Derral Herbst

Derral Herbst
Acting Project Leader
Office of Environmental Services

cc: NMFS - WPPO
HDF&G
EPA, San Francisco
University of Hawaii, Vice President for Administration
Group 70

CONSERVE AMERICA'S ENERGY

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Mr. Derral Herbst
United States Department of the Interior
Fish and Wildlife Service
300 Ala Moana Boulevard
Honolulu, Hawaii 96850

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Herbst:

Thank you for reviewing the Draft EIS for the subject project. In respose to your specific comment:

Comment: "We encourage the proposing agency to conduct a thorough biological survey of the Science Reserve and general project area to determine the distribution of specialized animals within the aeolian ecosystems. Mitigation measures to protect these resources should be developed and implemented based upon a complete understanding of their range, life requirements, and ecological significance."

Response: The University of Hawaii has retained a biological consultant to continue his research on the anthropods in the area.

Thank you for your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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United States Department of Agriculture
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii
96850

June 17, 1982

Mrs. Jacqueline A. Parnell
Director, Office of Environmental
Quality Control
550 Halekauwila St., Room 301
Honolulu, HI 96813

Dear Mrs. Parnell:

Subject: EIS - California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, HI

We have reviewed the above-mentioned draft as you requested.

The soils in the proposed construction area are identified as Cinder land and Very stony land in the published "Soil Survey of Island of Hawaii, State of Hawaii."

Cinder land is classified as a miscellaneous land type consisting of bedded cinders, pumice, and ash. Very stony land has a slight erosion hazard.

There will be dust problems during construction, but the prevailing trade winds should take the dust away from the existing facilities, except during periods of "Kona" winds. The proposing parties may wish to consider dust control measures during this period.

Thank you for the opportunity to review this document.

Sincerely,

Herbert J. Tyler, acting
FRANCIS C. H. LUM
State Conservationist

cc:
University of Hawaii
Vice President for Administration
Attn: Walter Muraoka
2444 Dole Street
Honolulu, HI 96822

Group 70
Attn: Marilynn Metz
924 Bethel Street
Honolulu, HI 96813

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Mr. Francis C.H. Lum
State Conservationist
United States Department of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, HI 96850

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. Lum:

Thank you for your comments on the Draft EIS for Caltech's 10-Meter Telescope at Mauna Kea, Hawaii. We offer the following response to your specific comments:

Comment: "There will be dust problems during construction, but the prevailing trade winds should take the dust away from the existing facilities, except during periods of 'Kona' winds. The proposing parties may wish to consider dust control measures during this period."

Response: Please note that additional information received subsequent to the publication of the draft EIS indicates that the direction of the predominant winds are from the east-southeast direction. Despite this new finding, the end result remains the same, i.e., dust is blown away from existing facilities during prevailing wind conditions.

As stated in the DEIS, during high winds and storms, materials will be covered and construction will cease until the weather improves.

We appreciate your interest in this project.

Very truly yours,

Harold Masumoto
Vice President for Administration

HM:MM:cf

2444 Dole Street • Room 202 • Honolulu, Hawaii 96822
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
215 Fremont Street
San Francisco, Ca. 94105

FACILITIES PLANNING
JUL 21 2 59 AM '82

JUL 13 1982

Mr. Walter Muraoka
University of Hawaii
2444 Dole Street
Honolulu, HI 96822

Dear Mr. Muraoka:

The Environmental Protection Agency (EPA) has received and reviewed the Draft Environmental Impact Statement (DEIS) titled TEN METER ASTRONOMY TELESCOPE AT MAUNA KEA, HAWAII.

EPA's comments on the DEIS have been classified as Category LO-1. Definitions of the categories are provided by the enclosure. The classification and the date of the EPA's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and the adequacy of the environmental statement.

EPA appreciates the opportunity to comment on this DEIS and requests three copies of the Final Environmental Impact Statement when available.

If you have any questions regarding our review, please contact Loretta Kahn Barsamian, Chief, EIS Review Section, at (415) 974-8188 or FTS 454-8188.

Sincerely yours,

John Wise

John Wise, Acting Director
Office of Policy, Technical,
and Resources Management

Enclosure (1)

EIS CATEGORY CODES

Environmental Impact of the Action

LO—Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER—Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU—Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1—Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2—Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3—Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

UNIVERSITY OF HAWAII

Vice-President for Administration

23 July 1982

Mr. John Wise, Acting Director
Office of Policy, Technical,
and Resources Management
United States Environmental Protection Agency
Region IX
215 Fremont Street
San Francisco, Ca. 94105

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. Wise:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

We appreciate the information provided on the classification of the EIS and its eventual publication in the Federal Register.

As requested, three copies of the Revised EIS will be sent to you.

We appreciate your interest in the project.

Very truly yours,

Harold D. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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GEORGE R. ARIYOSHI
GOVERNOR

Jacqueline Parnell
DIRECTOR
TELEPHONE NO.
548-6915

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
550 HALEKAUWILA ST.
ROOM 301
HONOLULU, HAWAII 96813

June 21, 1982

MEMORANDUM

TO: Mr. Harold Masumoto, Vice President for Administration
University of Hawaii
Attention: Mr. Walter Muraoka

FROM: Jacqueline Parnell, Director
Office of Environmental Quality Control

SUBJECT: Environmental Impact Statement for a 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii for California Institute of Technology

We have reviewed the subject statement and offer the following comments for your consideration:

PAGE 15

The EIS states that approximately 5 to 7 persons will probably be working at the summit which will require dormitory space. We note, however, on your amendment to the Hale Pohaku EIS dated August 1980 that any increase in summit telescope will probably be due to an increased emphasis on remote control operations of scientific instrumentation at the observatories. Consequently, the number of personnel necessary to be on-site will be reduced. The EIS further indicates that if remote control of the telescope is not feasible and if on-site staffing is required, "each request will have to be fully assessed as to its environmental and support service requirements." Since Hale Pohaku was designed specifically for the existing six telescopes which are heavily used, it seems that there may be a problem with housing the additional members. Therefore, a discussion is needed to clarify whether the University of Hawaii will be planning to request an expansion for the Hale Pohaku dormitory due to the acceptance of the development plan for the Board of Regents which indicates that the University anticipates about thirteen telescopes atop Mauna Kea.

PAGE 23

We question the graph on page 23. How was the weighted average derived? What criteria was used in determining the weighted average?

PAGE 44

Dr. Frank Howarth's full report in the Appendix indicates that the site was under snow cover which limited sampling activities. More importantly, the major active season for aeolian animals occurs as the snow melts. Presently, the snow is melting and to this date, this Office is not aware of any further studies being conducted despite the recommendation from Dr. Howarth who states:

> Construction of the CIT facility will lead to the direct permanent destruction of a small area of aeolian habitat. The significance of this impact on the total population of native biota is currently unknown, and additional data on distribution of the various species on the mountain should be gathered to provide a measure of the uniqueness of the CIT sites.

Therefore, we recommend that more studies be conducted before an important resource and scientific value of the species may be significantly affected by the proposed action.

NATURAL AREA RESERVE SYSTEM

In the section regarding the National Natural Landmark designation, the EIS should also point out that further down the slopes of Mauna Kea, the lava flow is also designated as a natural area reserve.

PAGE 61

We question the survey which indicates that 59 percent of the residents believe that greater use should be made of the scientific resources located atop Mauna Kea. How was the sampling conducted? Who conducted the survey? What methodology was used for the survey? What kinds of people were interviewed? How many persons in the sample size? Where was the sample conducted?

PAGE 68

The EIS indicates that the Caltech project will require about one trip per every two-four weeks to fill the water tanks. However, page 51 indicates that approximately three trips per

week is necessary to fill the tanks at the summit. If one uses the Caltech water tank as a basis for measurement, then it would seem that there would be less trips generated for all the water tanks at the summit rather than the three trips per week as indicated. A discussion should be given to clarify the point.

PAGE 72

We question why a site survey was not conducted for bryophyte and lichen. We recommend a survey since the EIS indicates that the "bryophyte and lichen flora atop Mauna Kea is poorly known," even though the photographs of the proposed site indicate the area is very likely to have mosses and lichens. A discussion is warranted.

PAGE 73

The statement, "No 'Ua'u burrows have been observed in the summit area, and none of the birds have been observed in the Science Reserve," should be documented. Who conducted the survey? When was the survey conducted?

BASE FACILITY IN HILO

The EIS refers to a base facility in Hilo. The EIS should discuss the base facility because it is part of the proposed action. According to EIS Regulation 1:22 the entire project should be considered and treated as one action. Therefore, a discussion on the Hilo base facility is warranted.

STATE ENVIRONMENTAL POLICY ACT

The EIS should discuss the relationship and the effect of the proposed action and the State Environmental Policy Act, Chapter 344, Hawaii Revised Statutes.

SECONDARY AND INDIRECT IMPACTS, PAGE 82

The EIS should discuss the possible secondary impact associated with the telescope. For example, in the preparation notice it was indicated that the telescope can be used for interferometry in conjunction with a radio telescope. Although we are aware of the lack of funding for the NRAO telescope, it is conceivable that another radio telescope may be compatible with the existing system which can be used jointly. Therefore, the EIS should not dismiss the use of a radio telescope so lightly. While the funding may be cut, the possibility of another radio telescope not funded by the same source may become feasible. Therefore, the EIS should discuss the possible effects of a radio telescope along with other secondary or indirect effects of the proposed action.

PAGE 85

While the EIS lists the various permits needed, the list should include the status of each permit according to the EIS regulation 1:42 o.

UNRESOLVED ISSUES

We note that the issue of telescopes has generated considerable opposition among the residents of the Big Island. These issues should be described and responded to in this section as required by the EIS Regulations.

COMPLEX DEVELOPMENT PLAN

The EIS text should explain why the complex development plan is not completed and why Caltech is proceeding without a plan.

IMPACT OF TELESCOPE ON RADIO COMMUNICATIONS

The EIS should discuss whether the proposed action will interfere with other electromagnetic waves and whether other electronic equipment will affect the operations of the telescope. The discussion should focus on the wavelength the proposed telescope would be affected by. For example, would CB's, VHF, and other transmitters, microwave stations have an effect on the system? Furthermore, would our civil defense system affect the operations of the telescope? If such electromagnetic waves interfere with the proposed action, what mitigating measures would be proposed or recommended? How would the recommendations affect the radio communications?

RESPONSES TO ENVIRONMENTAL CENTER DURING THE PREPARATION NOTICE

We find your response dated March 12, 1982 to the Environmental Center misleading. In reference to federal funding by the National Science Foundation, it is not necessary that the state EIS portion must be done before the federal EIS. If federal funds are a problem and a time limit exists, it may be feasible to pursue a NEPA EIS first, then comply with the Chapter 343, Hawaii Revised Statutes. If this process was followed then a more complete EIS can be prepared for the state.

We also question your statement, "The Board of Land and Natural Resources and the University have agreed to process Caltech's EIS and CDUA prior to the overall assessment of the Summit RDP." First of all the Board of Land and Natural Resources does not process the EIS nor does the University. It is the Environmental Quality Commission who processes the EIS and it is the Office of Environmental [illegible] control who recommends the acceptance of

the EIS to the Governor. Secondly, as Doak Cox pointed out it does seem unreasonable that the proposed action will be processed prior to the overall assessment of the Summit RDP. The response seems to be inconsistent with the intent of an EIS to be a planning tool. While the response notes that the availability of federal funding is the main reason for moving ahead with the proposed action, it is not clear that the alternative of just proceeding with the federal part is a viable option.

CONFLICT OF POINT OF VIEW

On one hand the EIS is stating that Caltech will not commit more telescopes, while on the other hand, the University's plans for the summit area proposes 13 telescopes. In the overall scheme where the University is serving as an agent for Caltech, it seems that it is the responsibility of the University to clarify the misconception. If Caltech is stating that they propose no further telescopes then the statement would be valid. However, since the University is the proposing agency, it seems unreasonable for the UH to state that the Caltech telescope will not lead to other telescopes when in fact, the University has already adopted such a plan. Therefore, it must be realized that if the University is serving as an agent for Caltech, then whatever is stated in the EIS is a reflection upon the University including the Mauna Kea summit.

We trust that these comments will be helpful to you in preparing the revised EIS. An attached sheet lists the commenting parties. If you should have any questions regarding this matter, please do not hesitate to contact us.

Attachments

UNIVERSITY OF HAWAII

Vice-President for Administration

26 July 1982

Ms. Jacqueline Parnell, Director
Office of Environmental Quality Control
State of Hawaii
550 Halekauwila Street, Room 301
Honolulu, HI 96813

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Ms. Parnell:

Thank you for reviewing the EIS for the subject project. We offer the following responses to your comments:

Comment:

"Page 15 - the EIS states that approximately 5 to 7 persons will probably be working at the summit which will require dormitory space. We note, however, on your amendment to the Hale Pohaku EIS dated August 1980 that any increase in summit telescope will probably be due to an increased emphasis on remote control operations of scientific instrumentation at the observatories. Consequently, the number of personnel necessary to be on-site will be reduced. The EIS further indicates that if remote control of the telescope is not feasible and if on-site staffing is required, 'each request will have to be fully assessed as to its environmental and support service requirements.' Since Hale Pohaku was designed specifically for the existing six telescopes which are heavily used, it seems that there may be a problem with housing the additional members. Therefore, a discussion is needed to clarify whether the University of Hawaii will be planning to request an expansion for the Hale Pohaku dormitory due to the acceptance of the development plan for the Board of Regents which indicates that the University anticipates about thirteen telescopes atop Mauna Kea."

Response:

Caltech's on-site personnel compliment of 5-7 persons (including visiting astronomers) in 2 shifts is considerably fewer than the 6-10 per shift present at each of the existing telescopes. Part of this reduction is attributable to the increased emphasis on remote control operations.

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A discussion of the mid-level bedspace needs of Caltech personnel is found on pages 77 and 78 of the draft EIS. Caltech's requirements will not in and of themselves generate a need for expansion of the mid-level. Such expansion that may be generated by further telescopes, as described in the Research Development Plan, will be discussed in detail in the Mauna Kea Science Reserve Master Plan which is currently being prepared.

Comment:

"Page 23 - We question the graph on page 23. How was the weighted average derived? What criteria was used in determining the weighted average?"

Response:

The graph, prepared by Dr. T.G. Phillips, is a weighted version of the one on page 22 which was developed from data collected by J.A. Westphal in his 1972 Infrared Sky Noise Survey. (Reference 2, page 146 of draft EIS). The weights are described on page 21 (paragraph 1) of the draft EIS in the following manner: "Figure 6 weights the drier days more heavily because they are more valuable. Weights of 4 for less than on precipitable millimeter, 2 for less than 2, 1 for less than 3, 1/2 for less than 4, and 0 for the remaining values were used".

Comment:

"Page 44 - Dr. Frank Howarth's full report in the Appendix indicates that the site was under snow cover which limited sampling activities. More importantly, the major active season for aeolian animals occurs as the snow melts. Presently, the snow is melting and to this date, this Office is not aware of any further studies being conducted despite the recommendation from Dr. Howarth who states:

> Construction of the CIT facility will lead to the direct permanent destruction of a small area of aeolian habitat. The significance of this impact on the total population of native biota is currently unknown, and additional data on distribution of the various species on the mountain should be gathered to provide a measure of the uniqueness of the CIT sites.

Therefore, we recommend that more studies be conducted before an important resource and scientific value of the species may be significantly affected by the proposed action".

Response:

Further studies of the Science Reserve are currently being conducted by Dr. Howarth as part of a larger project. He is not, however, planning to specifically restudy the Caltech site. When Dr. Howarth contracted with Caltech to undertake his study he was aware of the climatic conditions he would be confronted with. He saw it as an opportunity to obtain winter samples for his research. The limitations of the study and a description of the adverse impacts were fully disclosed in the EIS.

Comment:

"Natural Area Reserve System - In the section regarding the National Natural Landmark designation, the EIS should also point out that further down the slopes of Mauna Kea, the lava flow is also designated as a natural area reserve".

Response:

Mr. Robert Lee, executive secretary of the Natural Area Reserve System, has approved of the NARS description as presented in the draft EIS.

Comment:

"Page 61 - We question the survey which indicates that 59 percent of the residents believe that greater use should be made of the scientific resources located atop Mauna Kea. How was the sampling conducted? Who conducted the survey? What methodology was used for the survey? What kinds of people were interviewed? How many persons in the sample size? Where was the sample conducted?"

Response:

As stated on page 61, the survey findings were reported in the Northeast Hawaii Community Development Plan which was adopted by the County of Hawaii as Ordinance 445 on 20 June 1979. The ordinance became effective on 26 June 1979. The Development Plan, as adopted, is intended to serve as a guide for all public and private actions within the region. The Development Plan report describes the survey methodology.

Comment:

"Page 68 - The EIS indicates that the Caltech project will require about one trip per every two-four weeks to fill the water tanks. However, page 51 indicates that approximately three trips per week is necessary to fill the tanks at the summit. If one uses the Caltech water tank as a basis for measurement, then it would seem that there would be less trips generated for all the water tanks at the summit rather than the three trips per week as indicated. A discussion should be given to clarify the point."

Response:

The Mauna Kea Support Services (MKSS) owns one 5,000 gallon water tanker. Therefore, about three trips a week are needed in order to keep all of the tanks on the summit filled. This tanker will only have to stop at Caltech once every 2-4 weeks, based on water useage.

Comment:

"Page 72 - We question why a site survey was not conducted for bryophyte and lichen. We recommend a survey since the EIS indicates that the bryophyte and lichen flora atop Mauna Kea is poorly known, even though the photographs of the proposed site indicate the area is very likely to have mosses and lichens. A discussion is warranted."

Response:

In PART IV, DESCRIPTION OF THE ENVIRONMENT, on page 42, a reference is made to Appendix C of the DEIS, "Vegetation at the Summit of Mauna Kea with Special Reference to the Proposed Caltech Telescope Site." It is stated in the opening paragraph of this Appendix that a site survey could not be conducted as the site was covered with snow.

As the EIS discloses, some mosses and lichens will probably be destroyed by construction. The botanical report, however, also states that "the shading effect of the telescope may encourage growth of lichens and bryophytes particularly on the western side of the building."

Flora are being studied in other areas of the Science Reserve in conjunction with another study.

Comment:

"Page 73 - The statement, 'No 'Ua'u burrows have been observed in the summit area, and none of the birds have been observed in the Science Reserve, should be documented. Who conducted the survey? When was the survey conducted?"

Response:

No on-site surveys were conducted. The statement was meant to convey the fact that there have been no published sightings in the area to the best of our knowledge. We have been in contact with the Fish & Wildlife Service on this matter.

Comment:

"Base Facility in Hilo - The EIS refers to a base facility in Hilo. The EIS should discuss the base facility because it is part of the proposed action. According to EIS Regulation 1:22 the entire project should be considered and treated as one action. Therefore, a discussion on the Hilo base facility is warranted."

Response:

No firm committments have been made for a base support facility location, except that it would probably be in Hilo. It is anticipated at this time that one office will be rented for this purpose. As stated in the EIS, page 77, approximately 5 engineering and clerical personnel will be hired to staff this office.

Comment:

"State Environmental Policy Act - The EIS should discuss the relationship and the effect of the proposed action and the State Environmental Policy Act, Chapter 344, Hawaii Revised Statutes."

Response:

As suggested, a discussion of the relationship of the proposed project to the State Environmental Policy Act will be incorporated into the text of the Revised EIS. It will read as follows:

D. CHAPTER 344 HRS - STATE ENVIRONMENTAL POLICY ACT

Chapter 344 HRS, Section 3 establishes a State policy which encourages productive but non-damaging use of the environment. The relationship of the proposed action to the state environmental policy act, follows:

(1) "Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augumenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii." - The proposed project is a "clean industry" which can provide employment opportunities for Hawaii residents. Implementation of the proposed project will not affect the aesthetic, recreational and scientific values of the summit.

(2) "Enhance the quality of life by:

(A) "Setting population limits so that the interaction between the natural and man-made environments and the population is mutually beneficial;" - Not applicable. The proposed project will not generate a significant population increase.

(B) "Creating opportunities for the residents of Hawaii to improve their quality of life through diverse economic activities which are stable and in balance with the physical and social environments;" - Implementation of the proposed project will not create any significant effects on the physical or social environments. While only three scientists may immigrate to the island of Hawaii, Caltech estimates that approximately $500,000 will be spent on the island.

(C) "Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian" - Not applicable. The proposed action does not involve the establishment of a community.

(D) "Establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on nonrenewable resources." - Other than the use of petroleum-based electricity, the operation of the telescope will not require the use of non-renewable resources. In addition, Caltech scientists will comply with the terms of the General Lease No. S-4191 between UH and BLNR which states that "in order to prevent the introduction of undesirable plant species in the area, the lessee shall not plant any trees, shrubs, flowers or other plants in the leased area."

Comment:

"Secondary and Indirect Impacts, Page 82 - The EIS should discuss the possible secondary impact associated with the telescope. For example, in the preparation notice it was indicated that the telescope can be used for interferometry in conjunction with a radio telescope. Although we are aware of the lack of funding for the NRAO telescope, it is conceivable that another radio telescope may be compatible with the existing system which can be used jointly. Therefore, the EIS should not dismiss the use of a radio telescope so lightly. While the funding may be cut, the possibility of another radio telescope not funded by the same source may become feasible. Therefore, the EIS should discuss the possible effects of a radio telescope along with other secondary or indirect effects of the proposed action."

Response:

As stated in our letter of 3 March 1982, in response to a comment on interferometry by DLNR, "Being able to utilize the Caltech telescope for interferometry in conjunction with a possible NRAO telescope is minimal in terms of justification for the Caltech telescope. In any event, an additional telescope is not necessary in order for Caltech to maximize the research capabilities of the proposed 10-meter submillimeter telescope". To put the issue in perspective, although the Caltech telescope could be used for interferometry with the existing UKIRT or IRTF telescopes, this function is secondary to the main purposes of these telescopes. This will also be the case with Caltech when it is operational.

Comment:

"Page 85 - While the EIS lists the various permits needed, the list should include the status of each permit according to the EIS regulation 1:42 o."

Response:

To this date, none of the permits listed on page 85 have been obtained. A CDUA was filed with DLNR on 10 June 1982, subsequent to the May 20th filing of the EIS.

Comment:

"Unresolved Issues - We note that the issue of telescopes has generated considerable opposition among the residents of the Big Island. These issues should be described and responded to in this section as required by the EIS Regulations."

Response:

The alleged "considerable opposition" to telescopes among residents of the Big Island has not materialized in the letters received during both public review periods. Caltech NOP's and DEIS's were sent to Hawaii District representatives to the State Legislature, county agencies, and Big Island organizations and individuals. For example, the County of Hawaii Council and Department of Research and Development, Hamakua District Development Council, and the Hawaii Island Chamber of Commerce were in favor of the project. In addition, in recent months Mayor Matoyoshi has publicly supported the development of telescopes on Mauna Kea. No project can be expected to generate 100% consensus.

Comment:

"Complex Development Plan - The EIS text should explain why the complex development plan is not completed and why Caltech is proceeding without a plan."

Response:

The Complex Development Plan (CDP) was initiated 1 May 1982. Caltech was quite far along in its plans before the UH Research Development Plan, which provided for a Complex Development Plan, was approved by the Board of Regents. Consequently, it requested (and was granted) permission from the University and the Board of Land and Natural Resources to proceed with its CDUA ahead of the plan.

Comment:

"Impact of Telescope on Radio Communications - The EIS should discuss whether the proposed action will interfere with other electromagnetic waves and whether other electronic equipment will affect the operations of the telescope. The discussion should focus on the wavelength the proposed telescope would be affected by. For example, would CB's, VHF, and other transmitters, microwave stations have an effect on the system? Furthermore, would our civil defense system affect the operations of the telescope? If such electromagnetic waves interfere with the proposed action, what mitigating measures would be proposed or recommended? How would the recommendations affect the radio communications?"

Response:

A discussion of radio interference will be incorporated as an appendix to the Revised EIS. It will discuss all of the issues which you have ennumerated in your comment. For your information, the major mitigating measure is the size of the existing Science Reserve which serves as a quiet zone. If additional protection is needed, it could be provided by a Big Island coordination zone affecting only 150-1,000 gigahertz operations. Dr. T.G. Phillips, Director-designate of the Caltech Submillimeter Observatory, summarizes the issue as follows:

"To summarize: There has been no interference detected in tests performed at IRTF: The short wavelengths (high frequencies in the 150-1,000 gigahertz range) used by the submillimeter telescope make interference by any but the closest and most powerful radio transmitters negligible: The sheltered nature of the site makes interference by radar transmitters unlikely: The protection afforded by the Science Reserve would seem to make a coordination zone unnecessary: There is no need for a second National Quiet Zone of the kind in use at Green Bank, West Virginia."

Comment:

"Responses to Environmental Center During the Preparation Notice - We find your response dated 12 March 1982 to the Environmental Center misleading. In reference to federal funding by the National Science Foundation, it is not necessary that the state EIS portion must be done before the federal EIS. If federal funds are a problem and a time limit exists, it may be feasible to pursue a NEPA EIS first, then comply with the Chapter 343, Hawaii Revised Statutes. If this process was followed then a more complete EIS can be prepared for the state.

We also question your statement, 'The Board of Land and Natural Resources and the University have agreed to process Caltech's EIS and CDUA prior to the overall assessment of the Summit RDP.' First of all, the Board of Land and Natural Resources does not process the EIS nor does the University. It is the Environmental Quality Commission who processes the EIS and it is the Office of Environmental Quality Control who recommends the acceptance of the EIS to the Governor. Secondly, as Doak Cox pointed out it does seem unreasonable that the proposed action will be processed prior to the overall assessment of the Summit RDP. The response seems to be inconsistent with the intent of an EIS to be a planning tool. While the response notes that the availability of federal funding is the main reason for moving ahead with the proposed action, it is not clear that the alternative of just proceeding with the federal part is a viable option."

Response:

We stand by our response dated 12 March 1982 to the Environmental Center. We have prepared one EIS to comply with both Chapter 343, HRS and NEPA requirements; this is in accordance with Section 343-5 (f), HRS which states:

> "Whenever an action is subject to both the National Environmental Policy Act of 1969 (Public Law 91-190) and the requirements of this chapter, agencies shall cooperate with federal agencies to the fullest extent possible to reduce duplication between federal and state requirements. Such cooperation shall to the fullest extent possible include joint environmental impact statements with concurrent public review and processing at both levels of government. Where federal law has environmental impact statement requirements in addition to but not in conflict with this chapter, agencies shall cooperate in fulfilling these requirements so that one document shall comply with all applicable laws."

Federal regulations contain similar provisons for cooperative efforts between State and Federal Agencies in meeting EIS requirements.

In this instance, the EIS is intended as a planning or decision making tool. A Federally approved EIS is a necessary, but not sufficient, condition to allow the decision to be made to fund construction and installation of this telescope. Making a decision while disregarding the status of required State approval, however, would be counter-productive to realistic planning.

In regard to the letter to the Environmental Center, the statement in question should read: "The Board of Land and natural Resources and the University have agreed to process Caltech's CDUA prior to the overall assessment of the Summit RDP."

Comment:

"Conflict of Point of View - On one hand the EIS is stating that Caltech will not commit more telescopes, while on the other hand, the University's plans for the summit area proposes 13 telescopes. In the overall scheme where the University is serving as an agent for Caltech, it seems that it is the responsibility of the University to clarify the misconception. If Caltech is stating that they propose no further telescopes then the statement would be valid. However, since the University is the proposing agency, it seems unreasonable for the UH to state that the Caltech telescope has already adopted such a plan. Therefore, it must be realized that if the University is serving as an agent for Caltech, then whatever is stated in the EIS is a reflection upon the University including the Mauna Kea summit.

Response:

Caltech had originally intended to file its EIS as an applicant. Discussions among members of my staff, and the staff of EQC and OEQC resulted in submitting as an agency action based on the following reasons:

The University of Hawaii was designated proposing agency for this Environmental Impact Statement by virtue of their master-lease No. S-4191 for the Mauna Kea Science Reserve. Caltech had approached the University for permission to construct a telescope within this reserve but did not have an interest in the land, such as an executed sub-lease. Therefore, the action which is the subject of this EIS is an agency action only because Caltech does not have standing, as yet, to be an applicant under current EIS regulations.

We stand by our position stated in the draft EIS pages 58 and 59 that Caltech's action is a single action which will not commit more telescopes to the mountain.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President of Administration

HM:MM:cf

GEORGE R. ARIYOSHI
Governor

HIDETO KONO
Director

FRANK SKRIVANEK
Deputy Director

DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

Kamamalu Building 250 South King Street, Honolulu, Hawaii • Mailing Address: P.O. Box 2359 Honolulu, Hawaii 96804

June 25, 1982

Ref. No. 6145

COPY

Ms. Jacqueline Parnell, Director
Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Ms. Parnell:

Subject: Draft Environmental Impact Statement for California Institute of Technology 10-Meter Telescope, Mauna Kea, Hawaii

We have reviewed the subject draft EIS and found that our concerns pertinent to the EIS Preparation Notice have been adequately addressed.

As you know, the State Higher Education Functional Plan, as well as the other eleven functional plans, were not approved by Concurrent Resolution of the 1982 Legislature. In the interim, Governor George R. Ariyoshi, by Administrative Directive No. 82-3, dated May 3, 1982, instructed State agencies to use as guidelines the documents established as the twelve State Plans which include the State Higher Education Plan (the term, "functional," has been deleted). May we, therefore, suggest that the discussion on the proposed Mauna Kea Observatory's relationship with the State Higher Education Plan be revised accordingly.

Thank you for the opportunity to comment on this matter.

Sincerely,

Frank Skrivanek

for Hideto Kono

cc: University of Hawaii
Vice-President for Administration

Group 70

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Mr. Hideto Kono, Director
Department of Planning and
Economic Development
P. O. Box 2359
Honolulu, HI 96804

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. Kono:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

As you have suggested, the EIS will be revised to incorporate the present status of the State Higher Education Plan.

We appreciate your interest in the project.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

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University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

Office of the Director

June 22, 1982

RE:0355

Ms. Jacqueline Parnell, Director
Office of Environmental Quality Control
550 Halekauwila Street
Honolulu, Hawaii 96813

Dear Ms. Parnell:

Draft Environmental Impact Statement
California Institute of Technology 10-Meter Telescope
Mauna Kea, Hamakua, Hawaii

The Environmental Center has reviewed the DEIS for the above cited project with the assistance of Reginald Young, Engineering Department; Sheila Conant, General Science; and Jacquelin Miller, Environmental Center.

The Environmental Center provided comments at the preparation stage of this DEIS and at that time cited three major and two minor points for inclusion in the draft document. These points have now been addressed in the DEIS. However, our major concern, that of the need for an overall EIS to address the impacts of the entire Research and Development Plan for Mauna Kea, remains one of the more serious concerns expressed by our reviewers. We can appreciate the time and funding constraints with regard to the CIT telescope project. However, this seems to be the continued justification for each such construction activity on the mountain. What effort has been initiated toward the development of an overall EIS? If none, why not? If so, what is the status of the effort and what is the scope and completion date for the product?

We are pleased to learn of Dr. McCoys retention to evaluate the archeological significance of the area and we look forward to a report of his findings in the revised document.

The study by Dames and Moore of the impacts of cesspool seepage on Lake Waiau, seems to adequately address our previously expressed concern.

The assessment of the arthropod fauna prepared by Francis G. Howarth confirms the uniqueness and fragility of the arthropod ecosystem on the mountain. The potential impacts of the development on this virtually unknown environment (in the arthropod-biology sense), could be extremely significant and have serious irreversible negative impacts. Prompt, i.e., immediate, initiation of thorough biological surveys of the Science Reserve and Natural Area Reserve should be a major and urgent requirement prior to construction. Dr. Howarth's concluding statement bears repeating, "Construction of the CIT facility

will lead to the direct permanent destruction of a small area of aeolian habitat. The significance of this impact on the total population of native biota is currently unknown and additional data on the distribution of the various species on the mountain should be gathered to provide a measure of the uniqueness of the CIT site."

The following questions and comments have been developed during our review and we suggest that appropriate responses will augment the revised document.

We see no mention of consultation with members of the Natural Area Reserve System Commission. Have they been contacted and if not, why?

We strongly suggest that the work of Dr. Jane Massey on Lake Waiau (Ph.D. dissertation, University of Hawaii) be incorporated by reference in the document.

Page 12. The transport of 30 truckloads of concrete to the site may cause severe impacts to the road, air quality (dust emissions) and adjacent plant communities. The signficance of these impacts should be addressed in the revised EIS.

Page 35. The Ice Age Natural Area Reserve is cited as a portion of the Science Reserve. Where is the Ice Age Natural Area Reserve relative to the Science Reserve and the CIT telescope site? Could this be added to Figure 9 or the location and legend on Figure 11 clarified?

Page 43 and 75. The Hawaiian Dark-Rumped Petrel or 'Ua'u is mentioned as an endangered species recently rediscovered on Mauna Kea. When were the surveys for this bird conducted and by whom? One would only expect to find them at night hence the time of the survey is critical to a valid determination of "presence or absence in the project area. How was the "no effect" determination made on page 62 with regard to endangered or threaten species?

Page 72. Restriction of foot traffic in the vicinity of the telescope site is extremely important and appropriate provision and enforcement procedures to assure compliance with the restriciton should be adopted.

Page 74. The need for inspection of telescope packing operations to prevent the introduction of pests etc. should be extended to inspection of construction equipment and operations in general. Greater awareness of the need to protect non-endangered biota (as well as endangered species) should be encouraged.

Appendix C. Botanical impacts were assessed by a literature search only, by C.W. Smith. Because of the dearth of data and near 50 year interval since it was collected, it would seem essential to have a field survey, particularly when the proposed construction may have such severe impacts on the little known bryophyte and lichen populations. The discussion by P.J. Kores on higher plants correctly emphasizes the need for periodic monitoring of the site to minimize secondary impacts associated with plant introductions. Has provision for such botanical monitoring been included in the construction and operational plans for the telescope?

We find the comments expressed by the Department of Land and Natural Resources to be particularly succinct and appropriate.

We appreciate the opportunity to comment on this document and look forward to your response.

Yours truly,

Doak C. Cox
Director

cc: UH, Vice President for Administration
Group 70
Reginald Young
Sheila Conant
Jacquelin Miller

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Dr. Doak C. Cox, Director
Environmental Center
University of Hawaii
2550 Campus Road
Crawford #317
Honolulu, HI 96822

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Dr. Cox:

Thank you for reviewing the subject draft EIS. In response to your concerns regarding the need for an overall EIS to address the impacts of the entire Research Development Plan for Mauna Kea, you are now aware that such a document is currently being prepared in conjunction with the development of a physical plan for the Science Reserve and related facilities to the year 2000. A copy of the Notice of Preparation of this EIS was sent to you on July 8, 1982.

In response to your specific comments:

Comment: "We see no mention of consultation with members of the Natural Area Reserve System Commission. Have they been contacted and if not, why?"

Response: Mr. Robert Lee, executive director of the Natural Area Reserve System Commission, was consulted in the preparation of the EIS. His name is listed on page 86 of the draft EIS, PART XII: AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED IN THE PREPARATION OF THE EIS.

Comment: "We strongly suggest that the work of Dr. Jane Massey on Lake Waiau (Ph.D. dissertation, University of Hawaii) be incorporated by reference in the document."

Response: Dr. Massey's dissertation has been referenced in the revised EIS.

Comment: "Page 12. The transport of 30 truckloads of concrete to the site may cause severe impacts to the road, air quality (dust emissions) and adjacent plant communities. The significance of these impacts should be addressed in the revised EIS."

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Response: It is estimated that the 30 mixer-loads of dry concrete will be transported to the summit in 3 to 6 truckloads per day, for a period of 5 to 10 days. Therefore, the impact of the cement mixer trucks on the road, air quality and plant community is expected to be temporary.

Comment: "Page 35. The Ice Age Natural Area Reserve is cited as a portion of the Science Reserve. Where is the Ice Age Natural Area Reserve relative to the Science Reserve and the CIT telescope site? Could this be added to Figure 9 or the location and legend on Figure 11 clarified?"

Response: As requested, the legend to Figure 11 will be revised to read "Ice Age Natural Area Reserve."

Comment "Page 43 and 75. The Hawaiian Dark-Rumped Petrel or 'Ua'u is mentioned as an endangered species recently rediscovered on Mauna Kea. When were the surveys for this bird conducted and by whom? One would only expect to find them at night hence the time of the survey is critical to a valid determination ot presence or absence in the project area. How was the 'no effect' determination made on page 62 with regard to endangered or threaten species?"

Response: Information on the U'au was obtained from the draft Recovery Plan. No surveys of the summit were conducted and our research did not turn up any reported sightings within the Science Reserve. The "no effect" determination was made based on two statements received during the consultation process. The first, from the U.S. Fish and Wildlife Service, stated:

"The proposed action will have little, if any, adverse impact on the fish and wildlife resources of our concern in the area. In addition, to the best of our knowledge there are no species of plants or animals listed or proposed to be listed as endangered or threatened at the site."

The other, from the Environmental Center, said:

"The Dark-rumped Petrel, a protected species, has been observed on Mauna Kea at 11,000 feet. We do not know if it exists at higher elevations and in any case would not expect there to be any significant impact on it from the project."

We will change the determination on page 62 to read "no known" effect.

Comment: "Page 72. Restriction of foot traffic in the vicinity of the telescope site is extremely important and appropriate provision and enforcement procedures to assure compliance with the restriction should be adopted."

Response: As stated in the EIS, Caltech will abide by the terms of the General Lease No. S-4191 between UH and BLNR, which states that "In order to prevent the introduction of undesirable plant species in the area, the lessee shall not plant any trees, shrubs, flowers or other plants in the leased area except those approved for such by the Chairman (of BLNR)." Caltech personnel will also be educated as to the importance of restricting foot traffic around the telescope site.

Comment: "Page 74. The need for inspection of telescope packing operations to prevent the introduction of pests etc. should be extended to inspection of construction equipment and operations in general. Greater awareness of the need to protect non-endangered biota (as well as endangered species) should be encouraged."

Response: Caltech is prepared to comply with all federal, state and county regulations regarding inspections necessary to prevent the introduction of pests to the area.

Comment: "Appendix C. Botanical impacts were assessed by a literature search only, by C.W. Smith. Because of the dearth of data and near 50 year interval since it was collected, it would seem essential to have a field survey, particularly when the proposed construction may have such severe impacts on the little known bryophyte and lichen populations. The discussion by P.J. Kores on higher plants correctly emphasizes the need for periodic monitoring of the site to minimize secondary impacts associated with plant introductions. Has provision for such botanical monitoring been included in the construction and operational plans for the telescope?"

Response: As stated on page 2 of Appendix C, inclement weather precluded a site visit. As of this writing, the site is still covered with snow. It should be noted that Dr. Smith also states that although construction will unavoidedly destroy certain segement of the biotic community, " the shading effect of the telescope may encourage growth of lichens and bryophytes particularly on the western side of the building." Dr, Smith has been retained by the University of Hawaii to conduct field research on the summit when the weather permits.

As yet, no provision for botanical monitoring has been included in the construction and operational plans for the telescope. Such monitoring schould be part of an overall management plan for the Science Reserve.

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

University of Hawaii at Hilo

COLLEGE OF ARTS AND SCIENCES
NATURAL SCIENCES DIVISION

June 15, 1982

Office of Environmental Quality Control
550 Halekauwila St., Room 301
Honolulu, HI 96813

Subject: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy Environmental Impact Statement Draft

Thank you for this opportunity to review the above subject.

I am in favor of clean scientific enterprises of the above nature for the Island of Hawaii. The construction and subsequent operation of the submillimeter wave radio telescope will surely be of economic benefit to our island and the intellectual scientific gains will be of benefit to all. I believe the proposed project meets the criteria of the Mauna Kea Plan and I urge timely approval so that NSF construction funding may not be jeopardized.

Sincerely,

Power B. Sogo
Professor of Physics

PBS:lnw:dli

cc: University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, HI 96822

Attn: Walter Muraoka

Group 70
924 Bethel Street
Honolulu, HI 96813

Attn: Marilyn Metz

A-82
1400 Kapiolani Street
HILO, HAWAII 96720 TEL (808) 961-9383

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Dr. Power B. Sogo, Chairman
Natural Sciences Division
College of Arts and Sciences
University of Hawaii at Hilo
1400 Kapiolani Street
Hilo, HI 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Dr. Sogo:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

We appreciate your support and concur with your opinion of economic and scientific benefits of the proposed telescope project.

We appreciate your interest in the project.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

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HERBERT T. MATAYOSHI
MAYOR

HAWAII COUNTY FIRE DEPARTMENT
466 KINOOLE STREET, HILO, HAWAII 96720
PHONE 935-2978

SHOZO NAGAO
FIRE CHIEF

FRANCIS E. SMITH
DEPUTY FIRE CHIEF

May 28, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

We are in receipt of your request of May 24, 1982, regarding the EIS for the California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy.

A copy of our comments which was submitted to the University of Hawaii in January is enclosed.

Yours very truly,

Shozo Nagao

SHOZO NAGAO
FIRE CHIEF

SN/mo

Enclosures (2)

cc: U of H
Group 70

January 14, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822

Attention: Walter Muraoka

Dear Sir:

SUBJECT: CALIFORNIA INSTITUTE OF TECHNOLOGY -
PROPOSED 10-METER TELESCOPE FOR MILLIMETER
AND SUBMILLIMETER ASTRONOMY AT MAUNA KEA,
HAMAKUA, HAWAII - E.I.S. PREPARATION NOTICE

Fire protection within the Mauna Kea Science Reserve at the summit of Mauna Kea, Island of Hawaii, is practically nil because of the distance and the fire apparatus capabilities.

Suggest developing their own fire brigade, with a fire truck standing by.

We will be willing to assist in training the men in fire and life safety.

Yours very truly,

SHOZO NAGAO
FIRE CHIEF

SN/mo

cc: Group 70
Attn: Marilynn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Mr. Shozo Nagao, Chief
Hawaii County Fire Department
466 Kinoole Street
Hilo, Hawaii 96720

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Nagao:

Thank you for commenting on the Draft EIS for the subject project. Answers to your specific comments of 14 January 1982 follow. We are sorry that they were not sufficiently addressed in the EIS.

Comment: "Fire protection within the Mauna Kea Science Reserve at the summit of Mauna Kea, Island of Hawaii, is practically nil because of the distance and the fire apparatus capabilities."

Response: The individual telescopes are responsible for fire protection within their respective facilities. Each building is equipped with fire extinguishers.

Comment: "Suggest developing their own fire brigade, with a fire truck standing by."

Response: Thank you for your suggestion. It will be considered during the planning process for the Mauna Kea Science Reserve. As you are aware, the summit is a water-short area and, therefore, fire fighting techniques requiring water have not been considered in the past.

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Mr. Shozo Nagao, Chief
Hawaii County Fire Department
19 July 1982

Page Two

Comment: "We will be willing to assist in training the men in fire and life safety."

Response: Thank you for offer. We may contact you in the future concerning such training programs.

We appreciate your thoughtful comments.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

Enclosure

HAWAIIAN ELECTRIC COMPANY, INC.

Box 2750 / Honolulu, Hawaii / 96840

FACILITIES PLANNING OFFICE
JUN 16 3 59 PM '82
ENV 2-1
NV/G

June 14, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Dear Sir:

Subject: Environmental Impact Statement for a 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii for California Institute of Technology

We have reviewed the above subject Environmental Impact Statement and offer the following comments:

Trenching: Page 67 states that "All excavated material will be used to fill the trenches once the cable is laid." To protect the PVC conduits from damage, select backfill material may be desirable (see HECO Standard 30-1010) instead of the excavated material which may contain rocks several inches in diameter.

Transformer: It is assumed that the power supplied to the new telescope from the 850 kw generator will be at 12 kv. Will there be a transformer at the telescope site? If so, will the transformer be on a concrete pad outside the telescope facility or incorporated as part of the telescope facility?

Standby Generator: What measures/facilities will be installed at the telescope site to prevent or contain any diesel fuel spillage for the 1,000 gallon fuel tank?

Thank you for the opportunity to comment on this Draft Environmental Impact statement.

Sincerely,

Richard L. O'Connell
Manager, Environmental Department

JMP,Jr.:cal

cc: University of Hawaii
Attention: Walter Muraoka

Group 70
Attention: Marilyn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Mr. Richard L. O'Connell
Manager, Environmental Department
Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, HI 96840

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. O'Connell:

Thank you for comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii. Answers to your specific comments are as follows:

Comment: "Trenching: Page 67 states that 'All excavated material will be used to fill the trenches once the cable is laid.' To protect the PVC conduits from damage, select backfill material may be desirable (see HECO Standard 30-1010) instead of the excavated material which may contain rocks several inches in diameter."

Response: The statement about back filling of cable trenches is intended to show that no foreign material will be introduced. Appropriate screening of the material will be done in the same manner as for the existing trenches.

Comment: "Transformer: It is assumed that the power supplied to the new telescope from the 850 kw generator will be at 12 kv. Will there be a transformer at the telescope site? If so, will the transformer be on a concrete pad outside the telescope facility or incorporated as part of the telescope facility?"

Response: The 12 kv transformer will be located on a concrete pad at the service entrance, exterior to the structure.

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Mr. Richard L. O'Connell
Manager, Environmental Department
Hawaiian Electric Company, Inc.
12 July 1982

Page Two

Comment: "Standby Generator: What measures/facilities will be installed at the telescope site to prevent or contain any diesel fuel spillage for the 1,000 gallon fuel tank?"

Response: The diesel fuel tank will be buried, therefore, no specific measures to contain diesel fuel spillage are planned. If it is determined later that the tank will be installed above ground, a lip or similar type construction will be installed to contain any fuel spills.

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

For the Protection of Hawaii's Native Wildlife

HAWAII AUDUBON SOCIETY

P.O BOX 22832
HONOLULU, HAWAII 96822

P. O. Box 275
Volcano, HI 96785

June 21, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Re: Draft EIS for California Institute of Technology (CIT) 10-meter Telescope for Millimeter and Submillimeter Astronomy, Mauna Kea, Hawaii

The biological resources of the summit region and of the proposed construction area within the summit are not adequately treated in the draft statement. Biological surveys conducted by specialists in the field were too short, too limited in scope or not conducted on site at all. The immense value to science of the newly found aeolian ecosystem at the Mauna Kea summit is not recognized and its existence there is scarcely acknowledged in the body of the text. The entomology specialist in high stress environments spent only two days in March at the construction site -- under heavy snow -- for an exceedingly brief and incomplete survey of the arthropod fauna.

There was no field survey <u>at all</u> of the vegetation at the summit with reference to the CIT site -- only an archival report. Society members who visit the summit from time to time frequently observe lichens on the undersides of rocks and boulders, apparently of several kinds. Ample field studies over an annual cycle by botanists and entomologists are clearly needed to adequately describe the unreported environmental setting and the potential impacts of construction projects on the fragile ecosystem.

The biological composition of nearby Lake Waiau is not adequately addressed and assumptions are easily made that the negative impacts of dust from road traffic and construction "would be miniscule" (p.74). No reference is made to the intensive study of the biology of Lake Waiau first conducted in 1976 by Jane Massey, a doctoral candidate in the Department of Botany, University of Hawaii at Manoa. Her Ph.D. thesis focused on establishing baseline data on the highest-altitude permanent lake in the Pacific basin -- at 13,200 feet elevation -- before significant pollution and degradation of its waters accrued from continuing summit construction and greatly increased human use.

Since three observatories have been constructed since the Massey study, it would be timely to replicate her research to determine the present biology of the lake and to see whether any changes are attributable to pollution.

Again the Society emphasizes that the time is ripe for the comprehensive EIS on the University's Research and Development Plan for Mauna Kea which encompasses construction projects at the summit and downslope into the 1990s. The framework for that EIS would be the extensive biological surveys of the whole Science Reserve from the summit down to the boundary at approximately 12,000 feet elevation.

Specialists in terrestrial stress environments would investigate the range and components of the astonishing aeolian ecosystem and would monitor the effects of climatic fluctuations over a year's seasonal changes. It appears imperative under both federal and Hawaii [illegible] that

the impacts of large scale mechanical disturbances of the vulnerable Mauna Kea environment be evaluated by qualified biologists.

It is unacceptable to rush the project through the EIS process and bypass acquiring necessary information on significant adverse impacts on the natural environment. The tone of the draft statement toward the summit's aeolian ecosystem and its floral and faunal components may have been revealed without intention in listing the "Description of the Action" as "(1) Disturbance of approximately 0.75 acres of a barren and undeveloped area. . . ." (p. 71) (emphasis added) It's a remarkable "barren" area with some known plant and animal residents!

Instead of scurrying ahead with the CIT project and leaving undone the necessary biological data gathering and evaluation, it would seem a more judicious course -- consonant with the careful planning and high goals of the University's Development Plan for Mauna Kea -- to procede with the comprehensive EIS and its integral data acquisition.

The reported findings (Appendix D) of entomologist F. G. Howarth should send loud warnings to the Institute for Astronomy and other summit users. The fact that snow samples from the project site "did contain almost entirely aeolian debris of man-made origin"-- fibers of several types probably from clothing, paint chips and road dust -- signals man's heavy hand on the mountain top. Since compaction of the ground layer "by construction or virtually any other surface activity (including footsteps) would kill many enclosed animals and close this dispersal route," it is essential to reduce unnecessary crushing of the summit's cinders, and the surface disruption by off-road vehicles must stop now.

Here is a timely opportunity for the Institute for Astronomy to adopt an educational program on the biological wonders of the summit region so that all users will respect the ground surfaces as the habitats of small-sized animals unique to Mauna Kea.

The astronomy objective of the Mauna Kea Plan reads: "Recognize the world-wide significance of Mauna Kea's summit for astronomical research and set a limitation for facilities based on need and environmental concerns." (emphasis added)

The intent of the plan to limit facilities on the mountain is demonstrated by the Plan's requirement that every application for a facility must be accompanied by a "comprehensive justification report" with the contents prescribed. The draft EIS fails to provide the required justification information. If the justification data are sent only to the Board of Land and Natural Resources, there is no opportunity for public review and comment. This justification data should be available to the public, at least in the final EIS.

We would welcome a reply to these comments.

Mae E. Mull

Mae E. Mull
Island of Hawaii Representative

UNIVERSITY OF HAWAII

Vice-President for Administration

19 June 1982

Ms. Mae Mull
Island of Hawaii Representative
Hawaii Audubon Society
P.O. Box 275
Volcano, HI 96785

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Ms. Mull:

Thank you for reviewing the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii. We offer the following responses to your comments:

Comment: "The biological resources of the summit region and of the proposed construction area within the summit are not adequately treated in the draft statement. Biological surveys conducted by specialists in the field were too short, too limited in scope or not conducted on site at all. The immense value to science of the newly found aeolian ecosystem at the Mauna Kea summit is not recognized and its existence there is scarcely acknowledged in the body of the text. The entomology specialist in high stress environments spent only two days in march at the construction site -- under heavy snow -- for an exceedingly brief and incomplete survey of the arthropod fauna.

There was no field survey at all of the vegetation at the summit with reference to the CIT site -- only an archival report. Society members who visit the summit from time to time frequently observe lichens on the undersides of rocks and boulders, apparently of several kinds. Ample field studies over an annual cycle by botanists and entomologists are clearly needed to adequately describe the unreported environmental setting and the potential impacts of construction projects on the fragile ecosystem."

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Response: The entomology specialist was fully aware of the time and climatic constraints when he contracted to conduct the survey. He felt that winter samples would be of value to his research and that it was worthwhile conducting the survey even though it would have to be brief. Since then, he has contracted with the University to conduct more extensive surveys on the mountain.

We don't understand what you mean by the statement that the existence of the ecosystem is "scarcely acknowledged in the body of the text". As you are aware, Federal EIS's are limited to 150 pages plus technical appendices. Since Dr. Howarth's complete entomological report is appended to the EIS, in the interest of space the study was only excerpted in the body of the report.

A site survey by the consulting botanist would have been desirable, however, weather conditions at the site prevented such a survey. These conditions still exist. The University has contracted with the Bishop Museum Department of Botany to conduct more extensive surveys in conjunction with the preparation of a physical plan for the Science Reserve.

Comment: "The biological composition of nearby Lake Waiau is not adequately addressed and assumptions are easily made that the negative impacts of dust from road traffic and construction 'would be miniscule' (p.74). No reference is made to the intensive study of the biology of Lake Waiau first conducted in 1976 by Jane Massey, a doctoral candidate in the Department of Botany, University of Hawaii at Manoa. Her Ph.D. thesis focused on establishing baseline data on the highest-altitude permanent lake in the Pacific basin -- at 13,200 feet elevation -- before significant pollution and degradation of its waters accrued from continuing summit construction and greatly increased human use.

Since three observatories have been constructed since the Massey study, it would be timely to replicate her research to determine the present biology of the lake and to see whether any changes are attributable to pollution".

Response: We do not agree with your assessment of our discussion on Lake Waiau. Dr Edward Laws, an acknowledged expert on the Lake, commented during the public review period of the Draft EIS that, "I am only qualified to judge the potential impact of the facility on Lake Waiau, and I feel the EIS adequately addresses that issue". In addition, it should be noted that Lake Waiau is not leeward of the Caltech site and therefore airborne dust from a construction site 4,000 feet away would be very small.

We appreciate the information provided on Jane Massey's doctorate dissertation on Lake Waiau. We have referenced the work in the Revised EIS.

Comment: "Again the Society emphasizes that the time is ripe for the comprehensive EIS on the University's Research and Development Plan for Mauna Kea which encompasses construction projects at the summit and downslope into the 1990's. The framework for that EIS would be the extensive biological surveys of the whole Science Reserve from the summit down to the boundary at approximately 12,000 feet elevation".

Response: An EIS is currently being prepared for the University's Research and Development Plan (NOP issued July 8, 1982). Biological studies are being conducted in conjunction with the physical planning process which is being undertaken concurrently with the EIS.

Comment: "Specialists in terrestrial stress environments would investigate the range and components of the astonishing aeolian ecosystem and would monitor the effects of climatic fluctuations over a year's seasonal changes. It appears imperative under both federal and Hawaii environmental statutes that the impacts of large scale mechanical disturbances of the vulnerable Mauna Kea environment be evaluated by qualified biologists".

Response: Although it is reasonable to investigate the range and components of biota present in the environment, climatic fluctuations (macro) are not within the control of the astronomers and thus monitoring changes due to such fluctuations does not seem to be applicable.

Comment: "It is unacceptable to rush the project through the EIS process and bypass acquiring necessary information on significant adverse impacts on the natural environment. The tone of the draft statement toward the summit's aeolian ecosystem and its floral and faunal components may have been revealed without intention in listing the 'Description of the Action as (1) Disturbance of approximately 0.75 acres of a barren and undeveloped area. . . .' (p.71) (emphasis added). It's a remarkable 'barren' area with some known plant and animal residents!"

Response: The use of the term 'barren' in the subject statement on page 71 should not be misinterpreted to suggest an intended disregard towards the aeolian ecosystem. The site is relatively barren compared to other areas of the mountain. As Dr. Jane Massey states in her dissertation on Lake Waiau, "The area surrounding the lake and the alpine zone of Mauna Kea from timberline (2896M) is, in general, a botanical desert".

Comment: "Instead of scurrying ahead with the CIT project and leaving undone the necessary biological data gathering and evaluation, it would seem a more judicious course -- consonant with the careful planning and high goals of the University's Development Plan for Mauna Kea -- to proceed with the comprehensive EIS and its integral data acquisition".

Response: Caltech, in good faith, retained biological consultants to assess the impact of their project on the environment. Caltech has stated in the EIS the potential impacts that their project might generate on these aspects of the environment. Caltech, by publishing the reports as appendices to the EIS, has fully declared, to the extent of their knowledge, the environmental implications of the proposed action and has discussed relevant and feasible consequences of the action.

Comment: "The reported findings (Appendix D) of entomologist F.G. Howarth should send loud warnings to the Institute for Astronomy and other summit users. The fact that snow samples from the project site 'did contain almost entirely aeolian debris of man-made origin' -- fibers of several types probably from clothing, paint chips and road dust -- signals man's heavy hand on the mountain

top. Since compaction of the ground layer 'by construction or virtually any other surface activity (including footsteps) would kill many enclosed animals and close this dispersal route', it is essential to reduce unnecessary crushing of the summit's cinders, and the surface disruption by off-road vehicles must stop now".

Response: As an unpaved spur road to the project already exists, no new areas will have to be compacted for transportation purposes. All project-related vehicles will limit their movement to existing roads. Caltech and other astronomy-related users of the summit have no control of visitors who drive off-road. We, however, concur with your opinion on off-road vehicular activity.

Comment: "Here is a timely opportunity for the Institute for Astronomy to adopt an educational program on the biological wonders of the summit region so that all users will respect the ground surfaces as the habitats of small-sized animals unique to Mauna Kea".

Response: The Mauna Kea Science Reserve Master Plan NOP (July 1982) includes a description of a proposed visitor information station. The University of Hawaii will welcome any suggestions that you may have on an educational program on biological resources of the summit region.

Comment: "The astronomy objective of the Mauna Kea Plan reads: 'Recognize the world-wide significance of Mauna Kea's summit for astronomical research and set a limitation for facilities based on need and environmental concerns'. (emphasis added)

The intent of the plan to limit facilities on the mountain is demonstrated by the Plan's requirement that every application for a facility must be accompanied by a 'comprehensive justification report' with the contents prescribed. The draft EIS fails to provide the required justification information. If the justification data are sent only to the Board of Land & Natural Resources, there is no opportunity for public review and comment. This justification data should be available to the public, at least in the final EIS."

Response: The function of an EIS is to fully disclose the potential environmental consequences of a proposed project. As stated in Chapter 343, sub-part E :40, "An EIS should not be merely a self-serving recitation of benefits and rationalization of the proposed action." Therefore, the "comprehensive justification report" will not be included in the EIS. Feel free to contact Dr. John Jefferies at the Institute for Astronomy for additional information on this matter.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

Hawaii Island
Chamber of Commerce

June 22, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii 96813

Gentlemen:

Thank you for the opportunity to review the draft Environmental Impact Statement for the California Institute of Technology's 10-meter telescope.

We support fully the application by California Institute of Technology to construct and utilize this millimeter telescope on Mauna Kea. This additional scientific research tool will certainly enhance the capabilities of this premier observatory site. We also note that this proposal is in accordance with the "Hawaii State Plan" and it's priority actions.

Sincerely,

Donald Yamada
President
Hawaii Island Chamber of Commerce

DY:pk

CC: University of Hawaii
Vice-President for Administration
2444 Dole Street
Honolulu, Hawaii 96822
Attn: Walter Muraoka

Group 70
924 Bethel Street
Honolulu, Hawaii 96813
Attn: Marilyn Metz

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Mr. Donald Yamada, President
Hawaii Island Chamber of Commerce
180 Kinoole Street, Suite 203
Hilo, HI 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. Yamada:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

We also believe that the project will enhance the value of the summit as a premier observatory site and that this proposal is compatible with the objectives and policies of the "Hawaii State Plan".

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

A-100

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Mauna Kea Ski Patrol
Hawaii

605 Inuwai Place, Honolulu, HI 96825

June 10, 1982

Office of Environmental Quality Control
550 Halekauwila Street, Room 301
Honolulu, Hawaii

Re: California Institute of Technology 10-Meter Telescope Environmental Impact Statement.

Dear Sir;

This letter is to acknowledge receipt of the Environmental Impact Statement (EIS) for the proposed California Institute of Technology 10-Meter Telescope at the summit of Mauna Kea.

The Mauna Kea Ski Patrol is an affiliate of the National Ski Patrol System, Inc., Far West Division. The Ski Patrol provides patrol services on Mauna Kea on as many ski weekends as possible during the year. Our primary function and concern is the safety of skiiers and the general public while they are on Mauna Kea.

We have reviewed the EIS and see nothing in the proposed action that would adversely affectskiier safety, however, care should be taken to insure that there are no fixed objects placed in the primary ski runs as a result of this construction.

Thank you for the opportunity to comment on this EIS and we look forward to being included in the review of any future proposals for Mauna Kea.

Yours truly,

Thomas E Fake

Thomas E. Fake
Patrol Leader

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Mr. Thomas E. Fake
Patrol Leader
Mauna Kea Ski Patrol Hawaii
605 Inuwai Place
Honolulu, HI 96825

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Mr. Fake:

Thank you for reviewing the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

In answer to your comments concerning the possibility of placing construction materials or machinery in the primary ski runs, please be assured that construction will be completed before the skiing season, in order to avoid inclement weather. As shown in Figure 3 of the EIS (p.13), "Preliminary Site Plan", infrastructure facilities such as the fuel tank, auxiliary generator and septic tank are underground. The proposed project should not affect skier safety on the Menehune's Run.

We appreciate your interest in this project.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

A-102

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HAMAKUA DISTRICT DEVELOPMENT COUNCIL

HONOKAA, HAWAII 96727

June 6, 1982

University of Hawaii
Vice-president for Administration
2444 Dole Street
Honolulu, HI 96822
Attn: Walter Murioka

RE: EIS: 10-meter CalTech
Telescope Mauna Kea,
May 1982

Dear Sir:

The Hamakua District Development Council affirms its previous endorsement of the subject project.

The present EIS has satisfactorily responded to concerns expressed over the Preparation Notice of January 1982.

We retain our anxiety about uncontrolled access to the summit, forward- the notion that overall the invasion of offroad vehicles in time may be more damaging to the summit ecosystem and geologic features than the much restricted obliterations at the various installation sites.

The agreement of CalTech (p. 76 c) to participate in the funding of a visitor information and (hopefully) a control station at Hale Pohaku is a positive step for which they are to be commended.

We realize that the function of controlled access to Mauna Kea is fundamentally one of DLNR, not UH or its associated astronomy facilities.

CC: Group 70
924 Bethel St.
Honolulu, HI 96813
Attn: Marilyn Metz

Sincerely yours,

Evelyn Vallon
Acting President

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Ms. Evelyn Vallon
Acting President
Hamakua District Development Council
Honokaa, HI 96727

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Ms. Vallon:

Thank you for reviewing the Environmental Impact Statement for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

We appreciate the support of the Hamakua District Development Council in encouraging astronomical development of the Mauna Kea Summit. Be assured that every effort will be made to insure that this telescope project will enhance the reputation of the summit, the island of Hawaii and the State.

We share your concern over uncontrolled access to the summit. The University of Hawaii, in cooperation with the Department of Land and Natural Resources, is preparing a management plan for the summit as part of a Master Plan for the Mauna Kea Science Reserve and related facilities. Control of off-road vehicles will be specifically addressed within this plan.

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

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BROCK AND ASSOCIATES
SURVEYORS · ENGINEERS · PLANNERS

48 MARKET STREET
WAILUKU, MAUI, HAWAII 96793
(808) 244-7464 · 536-0552
TELEX (SDX) 395311

2395 KAANAPALI PARKWAY
LAHAINA, MAUI, HAWAII 96761
(808) 667-7402

820 MILILANI STREET
HK BUILDING, SUITE 615
HONOLULU, OAHU, HAWAII 96813
(808) 526-0872

FILE: 7000
June 22, 1982
Reply to Wailuku Office

Office of Environmental
Quality Control
550 Halekauila Street, Room 301
Honolulu, Oahu, Hawaii
96813

Subject: Draft EIS
California Institute of Technology
Ten Meter Telescope for
Millimeter and Submillimeter Astronomy at
Mauna Kea, Hamakua, Hawaii

Sirs:

Thank you for allowing us an opportunity to review the subject Draft EIS.

The draft document does not fully address the impacts this project will have on existing unpaved access roads to the Mauna Kea summit. The document makes no statement regarding restoring existing surfaces to original or better conditions following construction. We would expect this statement to be in the project specifications, but it should also be in the project EIS.

The proposed facility's contribution to the cumulative impact on infrastructure is glossed over in the interest of time. The document begs the questions, "How large a facility would require road improvements in the summit area and below?" and "How much development within the Science Reserve can the existing infrastructure support?"

While the proposed facility will undoubtedly advance man's knowledge of the universe, the location must not compromise the safety of the scientists, technicians, and visitors who

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will commute up and down the mountain. We favor the project but feel these issues on a cumulative basis must first be addressed.

Very truly yours,
BROCK AND ASSOCIATES

David K. Hein, p.e.
Principal, Engineering

:gka
cc: [redacted]
Ms. Marilyn Metz - Group 70

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Mr. David K. Hein
Brock and Associates
48 Market Street
Wailuku, Maui, Hawaii 96793

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Hein:

Thank you for reviewing the Draft EIS for the subject project. In answer to your specific comments:

Comment: "The draft document does not fully address the impacts this project will have on existing unpaved access roads to the Mauna Kea summit. The document makes no statement regarding restoring existing surfaces to original or better conditions following construction. We would expect this statement to be in the project specifications, but it should also be in the project EIS."

Response: The access roads within and to the summit are maintained by the observatories. They will insure that road surfaces are restored, if necessary, following construction of the telescope.

Comment: "The proposed facility's contribution to the cumulative impact on infrastructure is glossed over in the interest of time. The document begs the questions, "How large a facility would require road improvements in the summit area and below?" and "How much development within the Science Reserve can the existing infrastructure support?"

Response: Road improvements (safety, surfacing etc.) are on-going, even with the existing telescopes on the mountain. Technically, several more telescopes could be placed on the mountain without requiring major road

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improvements such as widening and paving because even the largest telescopes only generate about 12-14 round trips per day. Practically, the road should eventually be paved to reduce maintenance costs and to abate dust.

In answer to your question on how much additional development could the existing infrastructure support, the 850kv generator could support one or two additional telescopes with requirements similar to Caltech's. This also is not a satisfactory long-term solution, even for the existing telescopes, both because the generator is not a reliable source of power and because the cost of diesel fuel is getting prohibitive. A permanent connection to a HELCO power source is being proposed for the future.

Comment: "While the proposed facility will undoubtedly advance man's knowledge of the universe, the location must not compromise the safety of the scientists, technicians, and visitors who will commute up and down the mountain. We favor the project but feel these issues on a cumulative basis must first be addressed."

Response: Safety is a very important planning consideration. Safety improvements for the road were requested from the 1982 legislature.

In addition, many of your concerns related of cumulative issues will be addressed in the forthcoming Master Plan for the Science Reserve. A Notice of Preparation of EIS for this Mauna Kea Science Reserve Master Plan was sent to you on July 8, 1982.

Thank you for your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

Enclosure

University of Hawaii at Manoa

Department of Oceanography
Division of Natural Sciences
2525 Correa Road • Honolulu, Hawaii 96822
Telephone: (808) 948-7633 • Cable Address: UNIHAW

June 9, 1982

University of Hawaii
Vice President for Administration
2444 Dole Street
Honolulu, Hawaii 96822
Attn: Walter Muraoka

Dear Sirs:

I am enclosing the EIS for the Cal Tech 10-meter telescope proposed for Mauna Kea, Hawaii. I have done a small amount of research on Lake Waiau, and I assume the document was sent to me for that reason. I am only qualified to judge the potential impact of the facility on Lake Waiau, and I feel the EIS adequately address that issue. I think it is reasonable to assume that the impact of the facility on Lake Waiau will be negligible as long as the sewage from the facility is disposed of in the manner described in the EIS.

I did find one error. On appendix B page A-6, a statement is made near the bottom that, "an upward head from groundwater beneath the lake sediments tends to circulate nutrient-rich sediments into the water column." Actually it is very unlikely that the sediments themselves are circulated. In my opinion it is probably the circulation of nutrient-rich interstitial water which causes the phytoplankton bloom.

Sincerely,

Edward Laws

Edward Laws
Associate Professor

EAL:mf

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Dr. Edward Laws
Associate Professor
University of Hawaii at Manoa
Department of Oceanography
Division of Natural Sciences
2525 Correa Road
Honolulu, HI 96822

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at *Mauna Kea, Hamakua, Hawaii* - EIS

Dear Dr. Laws:

Thank you for your comments on the Draft EIS for Caltech's 10-Meter Telescope at Mauna Kea, Hawaii. We offer the following responses to your specific comment:

Comment: "I did find one error. On Appendix B page A-6, a statement is made near the bottom that, 'an upward head from groundwater beneath the lake sediments tends to circulate nutrient-rich sediments into the water column. Actually it is very unlikely that the sediments themselves are circulated. In my opinion it is probably the circulation of nutrient-rich interstitial water which causes the phytoplankton bloom."

Response: We appreciate the infomation provided; Appendix B will be revised accordingly.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

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United Kingdom Infrared Telescope Unit
of the Royal Observatory, Edinburgh

Astronomer in charge: Dr. T. J. Lee

Telephone: (808) 961-3756 Telex: 633135
(808) 935-4332

UK Infrared Telescope Unit
900 Leilani Street
Hilo
Hawaii 96720
USA

9 June 1982

State of Hawaii
Environmental Quality Commission
OEQC
550 Halekauwila St., Room 301
Honolulu, Hawaii 96813

Dear Sir:

EIS ON CALTECH'S PROPOSED 10.4 METRE TELESCOPE
FOR MILLIMETRE AND SUBMILLIMETRE ASTRONOMY

Millimetre and submillimetre observations will contribute strongly to our understanding of the universe, in particular the formation of stars, planetary systems and organic chemicals in space. Mauna Kea is a truly unique site for this work since from this mountain one has more viewing time with good transparency in the appropriate wavelength regions than any other ground-based site. The construction of this facility and others of its type gain full advantage of the qualities of Mauna Kea for astronomy. Millimetre and submillimetre telescopes will complement the Infrared and Visible light telescopes existing on the mountain and enhance the overall scientific productivity.

Many believe that millimetre and submillimetre work will produce the most important advances in astrophysics over the next two decades. Scientists now at the California Institute of Technology are among those eminent in the field and will ensure that the project will be a success.

Positive impacts of new astronomical facilities will increase scientific prestige for the County and State and improve educational and job opportunities for young people.

I thank you for the opportunity to review the EIS.

Yours sincerely,

T. J. Lee

TJL:yb A-111

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Dr. T.J. Lee
Astronomer-In-Charge
United Kingdom Infrared Telescope Unit
900 Leilani Street
Hilo, HI 96720

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Dr. Lee:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii.

We appreciate your highly regarded recognition of the possible contributions to the field of astrophysics that could be made by Caltech's telescope.

We appreciate your interest in the project.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

A-112

2444 Dole Street · Room 202 · Honolulu, Hawaii 96822
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Canada - France - Hawaii Telescope Corporation
P. O. Box 1597 Kamuela, Hawaii 96743 USA

Société du Télescope Canada - France - Hawaii
Telephone (808) 885-7944 Telex 633147 CFHT

21 June 1982

Office of Environmental Quality Control
550 Halekauwila St., Room 301
Honolulu, Hawaii 96813

Dear Sir/Madam:

Thank you for the copy of the Draft Environmental Impact Statement for the California Institute of Technology's proposed 10-meter Telescope for Mauna Kea.

We are satisfied that Caltech's project would not interfere with our own technical and astronomical activities on Mauna Kea. Indeed, we perceive the eventual coming of such a world leading facility as a very welcome neighbor in Hawaii and on Mauna Kea.

Yours sincerely,

René Racine
Executive Director

RR/lf/4428

cc: Vice President for Administration, UH
Group 70

encl: Draft EIS

UNIVERSITY OF HAWAII

Vice-President for Administration

12 July 1982

Dr. Rene Racine
Executive Director
Canada-France-Hawaii Telescope
Corporation
P. O. Box 1597
Kamuela, HI 96743

SUBJECT: California Institute of Technology - Proposed 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hamakua, Hawaii - EIS

Dear Dr. Racine:

Thank you for your comments on the Draft EIS for Caltech's proposed 10-Meter Telescope at Mauna Kea, Hawaii. We concur with your assessment that the Caltech telescope will not interfere with the 3.6 meter Canada-France-Hawaii Optical Telescope.

We appreciate your recognition of the benefits of the development of the Caltech telescope to scientific research.

Very truly yours,

Harold Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

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HENRY A. ROSS

Governor George Ariyoshi
State Capitol
Honolulu, HI, 96813

12 June 1982

Re. Draft EIS for Caltech 10 meter Telescope
on Mauna Kea, Island of Hawaii.

Dear Governor,

I am writing to you as the accepting authority for the above captioned EIS, of which I received a draft. How pleasant to receive a draft EIS that is properly labeled as such and which does not have a fancy cover to impress people about its subject. Rather this one has substance behind its plain title page. It is exactly what it should be in order to enable interested parties to judge what the adverse impacts on the environment might be compared to the advantages it has to offer the community and in this particular case the world. The telescopes on our biggest mountain are the world's best eyes into our universe, the grandeur of which should make us feel humble. And to have a scientific endeavor of such magnitude on this island is not only a privilege, but also will contribute to the status of Hawaii as a prime site, where mankind studies its origins and possibly also its future.

Although the project will contribute relatively little to the economy of this island directly, it must be regarded as a non-polluting industry, which does not have any measurable negative effects (for practical purposes) on anything, but which will surely enhance our image as a progressive state and thus will indirectly contribute to our visitor industry world-wide.

It was with pleasure that I read this draft EIS. I think it is comprehensive and after some polishing by answering individual judgemental reviewers, I am sure that the final EIS will reflect the impacts, whether positive or negative, properly. It happens to be a document, that maybe by its very nature sets itself apart from most of the very self-serving draft EISes that I read which are written for the pleasure of private developers or special interests.

I would like to commend the authors of this draft EIS on a job well done and I would like to add that I agree with the purported view in this draft that it would serve no diligent purpose to wait for an all encompassing EIS going into the year 2000 for the overall total development of the Mauna Kea facilities for astronomy. One should not become overly bureaucratic and lose valuable funds, now available for this project from sources outside the state.

And for all agencies involved, I would like to point out again that this is a non-polluting project, that might entice others with similar useful research projects or industries to try Hawaii for a pied-a-terre. I must sound a warning though. With the word similar I did not mean a manganese nodule industry, because it definitely does not qualify as non-polluting, and the geothermal proposal of Campbell Estate is highly questionable and needs severe scrutiny.

cc. Mr Susumu Ono, DL&NR
Mr Hideto Kono, DP&ED
Mr Sidney Fuke, H. Pl.Dept
Mr Harold Masumoto, U.H.
County Council; Env.Qual.Comm.
Mr Yoshito Takamine, St.Repr.
Dr Meiomalama Solomon
Mr Richard Santiago

H Ross

UNIVERSITY OF HAWAII

Vice-President for Administration

19 July 1982

Mr. Henry A. Ross
Box 99
Kapaau, HI. 96755

SUBJECT: California Institute of Technology 10-Meter Telescope for Millimeter and Submillimeter Astronomy at Mauna Kea, Hawaii - Draft EIS

Dear Mr. Ross:

Thank you for commenting on the draft EIS for the subject project. Our consultants, Group 70, also thank you for your compliments on the document.

In preparing the statement, every effort was made to fully declare the environmental implications of the proposed action and to discuss all relevant and feasible consequences to the action. Responsible opposing views were also included. We believe that the EIS process has served to improve the project and to minimize potential adverse impacts.

Thank you again for your comments. We will send you a copy of the Revised document.

Very truly yours,

Harold S. Masumoto

Harold Masumoto
Vice President for Administration

HM:MM:cf

Enclosure

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