

**OPERATING AND SITE DEVELOPMENT AGREEMENT
BETWEEN
ASSOCIATED UNIVERSITIES, INC./
NATIONAL RADIO ASTRONOMY OBSERVATORY
AND THE
UNIVERSITY OF HAWAII
CONCERNING THE
ERECTION AND OPERATION
OF A
VERY LONG BASELINE ARRAY ANTENNA
ON
MAUNA KEA, HAWAII**

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**OSDA ATTACHMENT A: SUBLEASE AND NON-EXCLUSIVE EASEMENT AGREEMENT
BETWEEN THE ASSOCIATED UNIVERSITIES, INC./THE NATIONAL RADIO ASTRONOMY
OBSERVATORY AND THE UNIVERSITY OF HAWAII**

- Exhibit A to Attachment A - General Lease S-4191
- Exhibit B to Attachment A - Consent to Sublease
- Exhibit C to Attachment A - Demised Premises
- Exhibit D to Attachment A - Description of Construction

OSDA ATTACHMENT B: VLBA SPUR ROAD

OSDA ATTACHMENT C: NRAO SITE

OPERATING AND SITE DEVELOPMENT AGREEMENT

THIS AGREEMENT is made this 28th day of September, 1990, by and between the ASSOCIATED UNIVERSITIES, INC./NATIONAL RADIO ASTRONOMY OBSERVATORY ("AUI/NRAO") and the UNIVERSITY OF HAWAII ("UH").

WITNESSETH:

WHEREAS, aperture-synthesis radio antennas for astronomical research have shown great scientific potential for contributing to our understanding of the astronomical universe;

WHEREAS, Mauna Kea, located on the Island of Hawaii, is the strategic location for the westernmost antenna of the array;

WHEREAS, AUI/NRAO has initiated a program to erect and operate an antenna of the Very Long Baseline Array (hereinafter "VLBA") below the summit area, between the 12,200- and 12,400-foot elevation of Mauna Kea approximately 2,600-foot northeast of the Mauna Kea Access Road, and is desirous of locating this antenna and related facilities on Mauna Kea;

WHEREAS, an area of approximately two acres has been delineated for AUI/NRAO use for the antenna and control buildings and to be located near the position 19°48'10"N, 155°27'25"W;

WHEREAS, AUI/NRAO and UH believe that the best interests of both parties are to be served through a program of close scientific cooperation centered around this antenna and related facilities;

WHEREAS, the operation of the VLBA antenna on Mauna Kea will greatly benefit the academic and research programs at UH;

WHEREAS, AUI/NRAO and UH have a common interest in insuring that the development of the Mauna Kea site will enhance the effective operation of this telescope;

WHEREAS, AUI/NRAO and UH executed a Memorandum of Understanding on January 9, 1989, which provides that once AUI/NRAO has identified funds for the construction and operation of astronomical facilities on Mauna Kea, and for a mutually agreed-upon share of (1) the common costs related to the operating antenna facilities on Mauna Kea, (2) costs associated with the infrastructure, and (3) other site improvements and common-purpose expenses and facilities, an Operating and Site Development Agreement shall be negotiated between AUI/NRAO and UH which shall set down the details of a program in which AUI/NRAO will provide technical advice to UH and will participate in the support of the Mauna Kea Public Visitor Center.

NOW, THEREFORE, in consideration of the mutual agreements herein contained, AUI/NRAO and UH agree as follows:

I. DEFINITIONS

For purposes of construing the provisions of this Operating and Site Development Agreement, the following definitions apply:

"Antenna" is a parabolical reflector, 25 meters in diameter, supported by an alt-azimuth mounting structure that permits said antenna to be pointed to any direction above the horizon, to be located on the Demised Premises (see Attachment C), and used for astronomical observations.

"AUI/NRAO" stands for the "Associated Universities, Inc./National Radio Astronomy Observatory", which is a not-for-profit research and development organization, located in Charlottesville, Virginia.

"Base Support Facilities" refer to the headquarters for the AUI/NRAO VLBA operations in Hawaii.

"BLNR" stands for the Board of Land and Natural Resources of the State of Hawaii.

"Demised Premises" refers to the land subleased to AUI/NRAO by UH with the approval of the BLNR. The Demised Premises are a portion of that certain land area leased to UH by BLNR and described in General Lease S-4191, Exhibit A of Attachment A thereto, and more specifically identified in Exhibit C of Attachment A hereto; both Exhibits A and C are incorporated herein by reference.

"Easement" is that non-exclusive easement granted by UH to AUI/NRAO under the terms of the Sublease.

"Facilities" include, but are not limited to, the antenna, the building (the space necessary to support scientific observers and technical personnel; together with instruments, electrical conductors, cableways and tunnels; driveways and parking lots; power, telephone and communications conduits and lines; and access roads within the border of the Demised Premises. "Facilities" does not include the Mid-Level Facilities, the Base Support Facilities, or any other facilities located outside the Mauna Kea Science Reserve.

"IfA" stands for the Institute for Astronomy and refers to that unit within the Manoa campus of UH which is responsible within UH for conducting a research program in astronomy, and for representing the interests of UH on UH-leased land in the Mauna Kea Science Reserve.

"Information Station" is the building and associated infrastructure (access, parking, utilities) near the Mid-Level Facilities of approximately 950 square feet which is used as a public information building.

"Infrastructure Improvements" are any capital improvements made for the common good of the Mauna Kea Observatories including, but not limited to, roads, power, telephone and communications installations, and the Mid-Level Facilities.

"Instruments" include cameras, photometers, spectrometers, receivers, and other special-purpose equipment used to detect and analyze radiation; together with computers, test equipment, and tools required to equip the Facilities.

"Major Astronomical Facility" includes the UH 88-inch Telescope, the Canada-France-Hawaii Telescope, the NASA Infrared Telescope Facility, the United Kingdom

Infrared Telescope, the James Clerk Maxwell Telescope, the Caltech Submillimeter Observatory, the W. M. Keck Observatory, and the VLBA antenna. Future telescope facilities forming a part of the Mauna Kea Observatories shall be considered Major Astronomical Facilities unless otherwise agreed in writing by UH.

"Mauna Kea Observatories" includes, but is not limited to, the Mauna Kea Science Reserve, the astronomical facilities and infrastructure improvements on Mauna Kea, and UH operations which support the astronomical facilities on Mauna Kea.

"Mauna Kea Science Reserve" is the land in the summit area of Mauna Kea consisting generally of that land above 12,000 feet altitude and specifically that which is leased by UH from the BLNR under General Lease S-4191.

"MKSS" stands for Mauna Kea Support Services which is operated by UH through the IfA, and is responsible for providing services to support the Mauna Kea Observatories.

"Mid-Level Facilities" include, but are not limited to, the bedrooms, laboratories, common areas, and offices at Hale Pohaku on Mauna Kea. Construction of the first phase of the Mid-Level Facilities was completed in 1983.

"UH-AUI/NRAO OSDA" stands for the "Operating and Site Development Agreement Between the Associated Universities, Inc./National Radio Astronomy Observatory and the University of Hawaii Concerning the Erection and Operation of a Very Long Baseline Array Antenna on Mauna Kea, Hawaii," and to which is attached the Sublease and Non-Exclusive Easement. The rights and responsibilities of this OSDA shall not concern any other astronomical facilities on Mauna Kea which may involve AUI/NRAO.

"Sublease and Non-Exclusive Easement" is that Agreement between AUI/NRAO and UH, and approved by BLNR, attached hereto as Attachment A, including the exhibits thereto.

"VLBA" stands for the Very Long Baseline Array and includes the Antenna and the entire operation in Hawaii to support the Antenna including the Facilities, the AUI/NRAO share of the Mid-Level Facilities, and any Base Support Facilities, or other facilities that may be built or operated in Hawaii on behalf of AUI/NRAO.

II. LOCATION OF THE FACILITIES

The Sublease (Attachment A) specifies the proposed location of the Facilities on Mauna Kea.

III. INTERACTION BETWEEN AUI/NRAO AND UH

While the principal parties to this OSDA are AUI/NRAO and UH, day-to-day interaction between them will usually be carried out by specified representatives of AUI/NRAO and UH. In the case of UH, this will normally be the Director of the IfA and, in the case of AUI/NRAO, this will normally be the Director of AUI/NRAO, during the erection and operation of the facility.

IV. SOLE RESPONSIBILITIES OF UH

A. Access Road to the Facilities

UH shall provide at no cost to AUI/NRAO a right-of-access to the premises for vehicles and utilities by means of a 40-foot wide easement using, wherever possible, existing roadways and utility ways. The Right-of-Access is discussed in VI.C.1.

B. Management of the Mauna Kea Observatories

UH shall provide a forum to allow the astronomical facilities which form a part of the Mauna Kea Observatories to discuss, on an equal footing, aspects of the management of the Mauna Kea Observatories. Such a forum currently exists and is referred to as the Mauna Kea Users' Committee. AUI/NRAO, as representative of the VLBA, shall be entitled to appoint two representatives to the Mauna Kea Users' Committee. Since UH is the primary lessee with the State of Hawaii, it is recognized that final responsibility for management of the Mauna Kea Science Reserve resides with UH.

V. SOLE RESPONSIBILITIES OF AUI/NRAO

A. Erection and Operation of the Facilities

AUI/NRAO shall be solely responsible for securing the funding for the erection and operation of the Facilities.

B. Scientific Cooperation

AUI/NRAO shall be solely responsible for funding the areas of scientific cooperation mentioned in IX.A., B., and C.

C. AUI/NRAO Spur Road

AUI/NRAO shall design, construct, and exclusively fund the VLBA spur road (Attachment B), which design shall be subject to the approval of UH and BLNR.

D. Telephone and Data Communications Conduits and Lines

AUI/NRAO shall fund and arrange for the installation of power, data communications, and telephone conduits and lines from a mutually agreed upon handhole located to the west of the Mauna Kea access road near the 12,200 foot elevation to the Facilities, all of which shall be individually metered.

VI. RESPONSIBILITIES SHARED JOINTLY BY AUI/NRAO AND UH

A. Research Environment

Under General Lease S-4191 between UH and BLNR (Exhibit A of Attachment A), UH is to use the Mauna Kea Science Reserve as a scientific complex and as a buffer zone to prevent the intrusion of activities inimical to said scientific complex. UH, in its role as custodian of the Mauna Kea Science Reserve, carries the responsibility

also to protect the site from interference that may emanate from within or from outside the Mauna Kea Science Reserve.

1. UH:

a. UH shall continue to protect the interests of the astronomical facilities in the Mauna Kea Science Reserve from interference emanating from within the Mauna Kea Science Reserve which would affect the scientific integrity of the sites on which the astronomical facilities are located.

b. UH shall continue to pursue actively the initiation, improvement of existing local, county and state laws and ordinances, and/or enforcement, as are necessary to assure that the nighttime level and character of man-made light, or radio frequency emissions, emanating from other areas of the County of Hawaii does not increase significantly over time, so as to interfere with the effectiveness of optical, infrared or radio frequency observations.

2. AUI/NRAO:

AUI/NRAO shall conduct its activities in the Mauna Kea Science Reserve in a manner compatible with and not inimical to the activities of other astronomical facilities located there, and shall conform to applicable regulations established by UH, by the State of Hawaii, and by the United States of America for the preservation of the environmental quality and the scientific integrity of the Mauna Kea Science Reserve.

B. Permits:

1. UH:

UH shall submit to the appropriate local authorities, and on behalf of AUI/NRAO or its designee(s) such applications for permits connected with the Facilities as are required and have been prepared by AUI/NRAO for use of State of Hawaii land, including Mid-Level Facilities and Base Support Facilities.

2. AUI/NRAO:

AUI/NRAO or its designee(s) shall prepare such applications for permits connected with the Facilities as are required for use of State of Hawaii land, including Mid-Level Facilities and Base Support Facilities.

C. Rights of Access

1. UH:

UH shall ensure AUI/NRAO right-of-access to the Demised Premises, and shall ensure their right to have access to a handhole or handholes for the commercial power, telephone, and data communications described in VI.D.1, under the conditions described therein. UH shall grant to or use its best efforts to obtain for AUI/NRAO such other rights-of-access as may be needed by AUI/NRAO for utilities and cableways.

2. AUI/NRAO:

AUI/NRAO shall pay any costs, fees and other charges associated with the rights-of-access described in VI.C.1.

D. Infrastructure Improvements Shared in Common with Other Astronomical Facilities at the Mauna Kea Observatories

UH has taken responsibility to fully or partially fund and arrange for infrastructure improvements to the Mauna Kea Observatories which will be of common benefit to all the astronomical facilities which operate there. All of the infrastructure improvements described in VI.D. are subject to State and County permits, approvals, and funding.

1. Commercial Power, Data Communications Conduits and Lines, and Road Improvements

UH has completed the installation of commercial power to Hale Pohaku and to the astronomical facilities located near the summit within the Mauna Kea Science Reserve. Paving and improvement of the upper section of the Mauna Kea access road is currently underway. Additional telephone capacity beyond that which is currently provided the major astronomical facilities operating on Mauna Kea; high-bandwidth data communications capability and improvement of the access road at intermediate altitudes are desirable. The conditions under which these infrastructure improvements will be provided are discussed below.

a. UH:

(i) UH has arranged for the construction of a commercial power conduit and line to serve the Mid-Level Facilities and the astronomical facilities in the Mauna Kea Science Reserve, and shall grant to AUI/NRAO access to commercial power for the Facilities to a peak capacity of 225 kW. The connection for the Facilities to the commercial power line shall be via a spur conduit and line to a mutually agreed upon handhole near the 12,200 foot elevation of the Mauna Kea access road.

(ii) UH is under no obligation to provide access to the fiber-optic cable data communications link.

(iii) UH intends to make available to Hawaiian Telephone Company a conduit from the summit area to Hale Pohaku for the purposes of running a communications cable between these two locations. UH will not object to Hawaiian Telephone Company using this conduit to provide telephone service to the Facility, with access to the conduit at a mutually agreed upon handhole near the 12,200 foot elevation of the Mauna Kea access road.

(iv) UH intends to continue to improve and pave the main access road in whole or in part, including safety devices, to Hale Pohaku from the summit area.

b. AUI/NRAO:

AUI/NRAO shall contribute a total of SIX HUNDRED TWENTY-SEVEN THOUSAND SEVEN HUNDRED SEVEN DOLLARS AND ZERO

CENTS (\$627,707.00) (in December 31, 1989 dollars, with escalation following the most recently published State of Hawaii All Urban Consumers Price Index), toward:

(i) The provision of an underground power spur line (to the same HELCO approved standards as the main line to the summit and with parallel circuit capacity of no less than 2,000 kVA) together with communications conduits from an agreed handhole of the summit line to a handhole at or near the facility which allows for future extension of, or connection to, the spur line and communications conduits. This spur line and communications conduits will be part of the Mauna Kea infrastructure. Actual costs of the spur line, up to a maximum of half of the infrastructure contribution, will be credited against the VLBA infrastructure contribution.

(ii) The provision of repeater station infrastructure and equipment below Hale Pohaku.

This contribution shall be made within THIRTY (30) DAYS of the execution of this OSDA.

2. Information Station Expansion

a. UH:

UH anticipates that it may be in the best interests of the astronomical facilities forming a part of the Mauna Kea Observatories to expand the Information Station after three additional major astronomical facilities beyond the existing six major astronomical facilities join the Mauna Kea Observatories. UH shall consider this possibility and pursue it if this becomes appropriate.

b. AUI/NRAO:

Fund the design and installation of an information station display for the VLBA, up to a maximum of \$5,000.00, which display must be accepted by UH.

3. Other Infrastructure Improvements to the Mauna Kea Observatories:

It may become necessary or desirable for the greater benefit of the astronomical facilities that form a part of the Mauna Kea Observatories to construct infrastructure improvements beyond those described in VI.D.1. through VI.D.2. If such infrastructure improvements are funded entirely by contributions from new funding sources (e.g., new astronomical facilities which join the Mauna Kea Observatories), and/or UH, then AUI/NRAO shall enjoy access to such improvements on an equal footing with the other astronomical facilities except where extension of such improvements to the NRAO site would involve additional costs or access to the mid-level facility. If such infrastructure improvements require contributions from some or all of the astronomical facilities for which there are signed operating and site development agreements with UH, then AUI/NRAO shall have access to such improvements, and AUI/NRAO shall be liable to contribute to the cost of such improvements, only if and to the extent that AUI/NRAO and UH have agreed in writing to such access and contributions. If AUI/NRAO elects to participate in any such improvements, AUI/NRAO and UH shall negotiate in good faith to determine the fair share of the cost of such improvements which AUI/NRAO shall contribute. The amount of this fair share shall be set forth in separate written agreements and normally shall be based on the

fractional utilization by AUI/NRAO of any such improvements. In cases where utilization is not readily quantifiable, the share paid by AUI/NRAO shall not exceed a fraction, the numerator of which is ONE (1), and the denominator of which is the number of subleases, including the AUI/NRAO sublease, which have been executed for land within the Science Reserve for separately identified telescope facilities.

E. Access to the Mid-Level Facility.

AUI/NRAO will not have access to the Mid-Level Facility.

F. Base Support Facilities

1. UH:

If AUI/NRAO elects to construct Base Support Facilities on State of Hawaii land, UH shall make every effort to make State land available at a location desired by AUI/NRAO and/or to coordinate the development of common Base Support Facilities. AUI/NRAO participation on State land shall be governed by the terms of separate agreement(s) between UH and AUI/NRAO.

2. AUI/NRAO:

If AUI/NRAO elects to site and operate its Base Support Facilities on land owned by the State of Hawaii, it shall do so in a manner which fosters cooperation with other telescope projects located on the same premises.

G. Operations and Maintenance

1. UH:

a. UH shall provide services on a basis of no profit-no loss to AUI/NRAO through MKSS. Such services may include, but shall not be limited to, food and lodging under conditions to be established; utilities, transportation; library and auxiliary services; road maintenance and snow removal; access control and public information services; and general administration.

b. The cost of all MKSS services shall be shared among the astronomical facilities operating or under construction at the time the costs are incurred; AUI/NRAO shall have the right to use these services at an annually negotiated rate.

c. AUI/NRAO shall be represented on the MKSS Oversight Committee which reviews existing activities and recommends changes to the activities of MKSS.

2. AUI/NRAO:

a. AUI/NRAO shall provide the funds necessary to operate and maintain the Facilities.

b. Contribute an annually negotiated share of common costs for services provided by MKSS as described in VI.G.1 and, during the construction of the Facilities, contribute to a separately negotiated share of such costs, including road maintenance and snow removal.

c. Fund the cost of operating and maintaining the commercial power lines from the handhole described in VI.D.1.a.(i) to the Facilities, and for telephone lines from Hale Pohaku to the Facilities. In addition, AUI/NRAO shall pay an annually negotiated share of any data communications service provided to the Facilities.

VII. DELEGATION OF RIGHTS AND ASSIGNMENT OF RESPONSIBILITIES BY AUI/NRAO

AUI/NRAO may delegate certain of its rights, and assign certain of its obligations and responsibilities hereunder to other agents. However, it is understood that AUI/NRAO shall be ultimately responsible to UH for the obligations and responsibilities undertaken by them in this OSDA.

VIII. ASSIGNMENT OF RIGHTS

Any assignment of rights to the facility shall be bound by paragraph III.F. of the sublease and non-exclusive easement agreement. AUI/NRAO undertakes that, if considering any such assignment of an interest in the facility or subleasing of the facility, it will so notify UH so as to provide adequate time for UH to review the proposed assignment of rights, secure a consent agreement from the new party or parties and to obtain the necessary prior written consent approval by the UH Board of Regents, the State of Hawaii Board of Land Natural Resources, and any other bodies whose consent is required under the terms of the lease, the sublease, or other agreements and documents.

IX. SCIENTIFIC COOPERATION

In recognition of the potential for scientific interaction between AUI/NRAO and UH which the Facilities offer, and of the contribution of UH in making the site available to AUI/NRAO, AUI/NRAO and UH agree on the following matters with regard to the operational phase of the Facilities.

A. UH Use of the Facilities

1. Observing time on the Facilities shall be allocated to proposals sponsored by UH under the following ground rules:

a. Observing time shall first be allocated to the NRAO Director for engineering purposes and for the scheduling of the Hawaii antenna as an element of the VLBA.

b. Of the remaining time scheduled for single dish observing, one-third of the time shall then be reserved for UH for observations with the Hawaii antenna, up to a maximum of 15% of the total time.

c. Only proposals having a UH staff member, student or bona fide visitor as principal investigator, and forwarded by the IfA Director shall be considered in scheduling UH single dish observing time.

d. Scheduling of observing time shall be performed by a single individual designated to perform this function for the Observatory.

2. UH-sponsored personnel and the instrumentation they bring to the VLBA antenna shall be subject to the authority of the NRAO Director or his/her designee when using the Facilities.

3. UH personnel shall also have full access to observing time on the VLBA on the same basis as other members of the U.S. astronomical community.

B. Proposed Astronomy Facilities

AUI/NRAO will, on request, advise the IfA regarding the scientific potential and importance of any proposed radio astronomy facilities to be located in Hawaii.

C. Proposed Radio Transmitters

AUI/NRAO will, on request, advise the IfA regarding the impact of proposed radio transmitters, or other radio frequency emitting installations, which have the potential to affect astronomical research on Mauna Kea and Haleakala.

D. Site Characterization

AUI/NRAO will, on request, characterize the radio frequency environment within the Science Reserves on Mauna Kea and Haleakala.

E. Facilities Attribution

In all publications and news releases regarding results obtained from work performed at the Facilities, AUI/NRAO shall be given appropriate credit and shall be referred to as the "Very Long Baseline Array Antenna of the Associated Universities, Inc./National Radio Astronomy Observatory" operating under a cooperative agreement with the National Science Foundation. Results obtained at the Facilities by IfA faculty or on IfA-developed instruments shall have credit for these results also given to "the University of Hawaii, Institute for Astronomy" in any publications or news releases.

X. **INSURANCE/INDEMNIFICATION**

AUI/NRAO shall indemnify, defend and hold harmless UH and the State of Hawaii, their officers, agents, employees or any person acting on their behalf from and against any claim or demand for loss, liability or damages, including, but not limited to, claims for property damage, personal injury or death, based upon any accident, fire, or other incident on the Demised Premises and roadways adjacent thereto which arises from any act or omission of AUI/NRAO, its officers, agents, employees, or invitees, or occasioned by any failure on the part of AUI/NRAO to maintain the Demised Premises in a safe condition or to observe or perform any of the terms and conditions herein or any regulations, ordinances and laws of the Federal, State, Municipal or County governments.

Additionally, AUI/NRAO shall, at its own cost and expense, maintain liability insurance for personal injury or death and property damage in the minimum amounts of ONE MILLION DOLLARS (\$1,000,000.00) per person and FIVE MILLION DOLLARS (\$5,000,000.00) per occurrence for personal injury or death, and FIVE HUNDRED THOUSAND DOLLARS (\$500,000.00) against claims for property damage for any one occurrence, subject to revision every FIVE (5) years in writing. Said insurance is subject to the approval of UH and shall name UH and the State of Hawaii as

additional insureds. A Certificate of Insurance evidencing that said insurance is in full force and effect shall be deposited with the Director of Procurement and Property Management, University of Hawaii, 1400 Lower Campus Road, Room 15, Honolulu, Hawaii 96822, U.S.A.

XI. ATTORNEY'S FEES

AUI/NRAO and UH shall each pay their own attorney's fees and any other legal expenses.

XII. SERVICE OF PROCESS

AUI/NRAO shall designate a representative within the State of Hawaii duly authorized to accept service of process on its behalf.

XIII. GOVERNING LAW: SEVERABILITY

The validity, construction and performance of this OSDA and the legal relations among the parties to this OSDA shall be governed by and construed in accordance with the laws of the State of Hawaii, excluding that body of law applicable to choice of law. In the event any provision of this OSDA shall be held by a court of competent jurisdiction to be contrary to law, the remaining provisions of this OSDA shall remain in full force and effect.

XIV. AMENDMENTS TO THIS OSDA

This OSDA may be amended in writing at any time by mutual agreement of AUI/NRAO and UH.

XV. TERM OF THIS OSDA

This OSDA shall become effective on the date first above written to execute this document or the effective date of the Sublease, whichever is later, and shall terminate as provided in XVII.

XVI. RENEGOTIATION OR EXTENSION OF THIS OSDA

If UH and the BLNR either renegotiate or extend General Lease S-4191 beyond December 31, 2033, or if UH obtains a lease providing the same general terms and conditions as General Lease S-4191 for a period beyond December 31, 2033, UH shall extend this OSDA accordingly, except that AUI/NRAO and UH agree to negotiate in good faith any revisions thereto proposed at the time by either AUI/NRAO or UH.

XVII. TERMINATION

This OSDA shall be terminated upon the first of any of the following events to occur:

1. Mutual written agreement of AUI/NRAO and UH.
2. Termination of the Sublease.
3. Termination of management or operation of the Facilities by AUI/NRAO.
4. December 31, 2033, when General Lease No. S-4191 terminates, unless a suitable extension or new lease as allowed for in XVI has been negotiated.

XVIII. DISPOSITION OF FACILITIES ON TERMINATION

Disposition of the Facilities on termination shall be conducted pursuant to the provisions of the Sublease.

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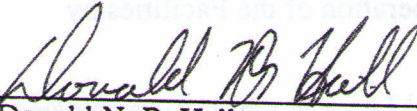
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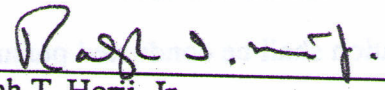
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IN WITNESS WHEREOF, the parties hereto have executed these presents on the day and year first above written.

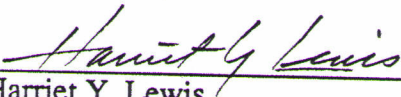
FOR THE UNIVERSITY OF HAWAII:

By  9/28/90
Donald N. B. Hall
Its Director, Institute
for Astronomy
Date


By  _____
Ralph T. Horii, Jr.
Its Vice President
for Finance and Operations
Date

By  _____
Albert J. Simone
Its President
Date

Approved as to form:

By  9/17/90
Harriet Y. Lewis
Its Deputy Attorney General
Date

FOR THE NATIONAL RADIO ASTRONOMY OBSERVATORY:

By  9/21/90
Paul Vanden Bout
Its Director
Date

FOR ASSOCIATED UNIVERSITIES, INC.:

By  9/25/90
Robert E. Hughes
Its President
Date

IPA copy

Sublease Exhibits:

- A-General Lease
- B-Consent to Sublease
- C-Demised Premises
- D-Planned Construction

SUBLEASE AND NON-EXCLUSIVE EASEMENT AGREEMENT

OSDA ATTACHMENT A

SUBLEASE AND NON-EXCLUSIVE EASEMENT AGREEMENT

BETWEEN

THE ASSOCIATED UNIVERSITIES, INC.

(NATIONAL RADIO ASTRONOMY OBSERVATORY)

AND

THE UNIVERSITY OF HAWAII

1 GENERAL

A. Location

The location of the portion of the certain land was identified in Exhibit A and more specifically identified in Exhibit C attached hereto.

Recordation Requested by:

After Recordation, Return to:

When completed: Mail ()

Pick up () Phone:

SUBLEASE AND NON-EXCLUSIVE EASEMENT AGREEMENT

THIS Sublease and accompanying non-exclusive Easement is made this 28th day of September, 1990, by and between the UNIVERSITY OF HAWAII, hereinafter called "Sublessor," and the ASSOCIATED UNIVERSITIES, INC./NATIONAL RADIO ASTRONOMY OBSERVATORY, hereinafter called "Sublessee." This Sublease and Easement is approved pursuant to General Lease S-4191, dated June 21, 1968, between Sublessor and the State of Hawaii, Board of Land and Natural Resources, hereinafter called "Lessor." A copy of said General Lease S-4191 and "Consent to Sublease of General Lease S-4191," are attached hereto as Exhibits A and B, respectively, and are incorporated herein by reference.

WITNESSETH THAT:

Sublessor, in consideration of the rent hereinafter reserved and upon the conditions, covenants and agreements hereinafter expressed, does hereby demise and let to Sublessee the parcel of land described in Exhibit C, attached hereto and incorporated herein by reference, and Sublessee does hereby sublease from Sublessor said parcel for the purpose of erecting an antenna facility to be constructed and operated by and at the expense of Sublessee through a contractual arrangement set forth in a separate "Operating and Site Development Agreement Between the Associated Universities, Inc./National Radio Astronomy Observatory and the University of Hawaii Concerning the Erection and Operation of a Very Long Baseline Array Antenna (hereinafter "VLBA") on Mauna Kea, Hawaii" (hereinafter "OSDA").

Construction will include the VLBA control buildings and antenna with related equipment and instrumentation and related support facilities and infrastructure improvements required on the demised premises to support the operations of the VLBA (collectively "Facilities").

I. GENERAL

A. Location/Area

The location/area comprises a portion of that certain land area, described in General Lease S-4191 and its Exhibit A, and more specifically identified in Exhibit C attached hereto.

B. Non-Exclusive Easement

Sublessee shall have the right of access to and egress from the Demised Premises over and across the Mauna Kea Science Reserve, utilizing the common entrances and rights of way, together with others entitled thereto under such rules and regulations as may be established by and amended from time to time by Sublessor. Sublessee shall also have the right to construct and utilize an unpaved spur road, the VLBA spur road, from the Mauna Kea access road to the Demised Premises, and to install and utilize power and communication conduits and lines from a handhole located near the 12,000 foot elevation to the Facilities, all of which shall be individually metered.

C. Survey/Specific Description

The site designated in Exhibit C is subject to survey by Sublessee within SIX (6) months from the date of this Sublease. The exact area covered by this Sublease, and the non-exclusive Easement for the spur road and power and communication conduits and lines granted to Sublessee, shall be more specifically described and agreed to by Sublessor and Sublessee after the aforesaid survey has been completed, and is subject to approval by the County of Hawaii. Such description shall be binding upon Sublessor, Sublessee and the State of Hawaii.

D. Term of Sublease

The term of this Sublease shall be from the date first above written and shall expire on December 21, 2033, unless sooner terminated or extended, as respectively provided for in IV.F. and II.C.

E. Rental Charge

Sublessee hereby covenants and agrees to pay rental for the Demised Premises at ONE DOLLAR (\$1.00) per year in legal tender of the United States of America for the duration of the Sublease. Such fee shall be paid to the University of Hawaii, Vice President for Finance & Operations, 2444 Dole Street, Honolulu, Hawaii 96822, U.S.A.

F. Fire or Destruction of the Facilities

If all three of the following events occur: (1) the Facilities are destroyed by fire or other causes rendering the same unsuitable for purposes of radio astronomy, (2) Sublessee elects not to restore the Facilities, and (3) this Sublease is terminated as provided for in IV.F.6., Sublessee shall have such unsuitable damaged property or debris removed within ONE (1) year, after written notice to remove, and shall restore the property or any portion affected thereby to even grade. In the event Sublessee fails to remove such damaged property or debris and restore the land within ONE (1) year, such property may be removed and the land affected thereby restored to even grade by Sublessor at the expense of Sublessee.

If the Facilities or a portion thereof are restored, such restoration shall be subject to approval by Sublessor, and shall be in keeping with III.H. Such approval by the Sublessor will not be unreasonably withheld.

G. Controlling Lease

Sublessee shall observe and comply with all terms and conditions of General Lease S-4191.

In the event that any term or condition contained herein is inconsistent with or contrary to General Lease S-4191, said General Lease shall be controlling.

H. Operation of the Facilities

Neither Sublessee nor its successor or assigns shall operate or permit to be operated the aforementioned Facilities for purposes of research without an effective OSDA. The Facilities may be operated by Sublessee in the absence of the aforesaid OSDA only when necessary to ensure the safety of personnel or of the Facilities.

I. Indemnity/Insurance

Sublessee shall indemnify, defend and hold harmless Lessor and Sublessor, their officers, agents, employees or any person acting on their behalf from and against any claim or demand for loss, liability or damages, including, but not limited to, claims for property damage, personal injury or death, based upon any accident, fire, or other incident on the Demised Premises and roadways adjacent thereto which arises from any act or omission of Sublessee, its officers, agents, employees, or invitees, or occasioned by any failure on the part of the Sublessee to maintain the Demised Premises in a safe condition or to observe or perform any of the terms and conditions herein or any regulations, ordinances and laws of the Federal, State, Municipal or County governments.

Additionally, Sublessee shall, at its own cost and expense, maintain liability insurance for personal injury or death and property damage in the minimum amounts of ONE MILLION DOLLARS (\$1,000,000.00) per person and FIVE MILLION DOLLARS (\$5,000,000.00) per occurrence for personal injury or death, and FIVE HUNDRED THOUSAND DOLLARS (\$500,000.00) against claims for property damage for any one occurrence, subject to revision every FIVE (5) years in writing. Said insurance is subject to the approval of Lessor and Sublessor and shall name Lessor and Sublessor as additional insureds. A certificate of insurance evidencing that said insurance is in full force and effect shall be deposited with the Director of Procurement and Property Management, 1400 Lower Campus Road, Room 15, Honolulu, Hawaii 96822, U.S.A.

II. SUBLESSOR HEREBY COVENANTS WITH SUBLESSEE AS FOLLOWS:

A. Peaceful Enjoyment

Upon provision to Sublessor of the rights (in lieu of rent) provided in the aforesaid OSDA and upon observance and performance of all the terms, covenants and conditions contained herein, Sublessee shall peaceably hold and enjoy the Demised Premises during the term hereof without hindrance or interruption. Any proposed use of the Demised Premises by Sublessor or Lessor, their successors or assigns, as contemplated in, but not limited to, those paragraphs entitled "Hunting Recreation Rights" and "Right to Use Demised Land" as set forth in General Lease S-4191, shall be subject to coordination with Lessor, Sublessor and Sublessee; such proposed use shall not interfere unreasonably with Sublessee's use of the demised premises.

B. Covenant Against Contingent Fees

Sublessee warrants that no person or selling agency has been employed or retained to solicit or secure this Sublease upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by Sublessee for the purpose of securing business. For breach or violation of this warranty, Sublessor shall have the right to annul this Sublease without liability or, in its discretion, to deduct from said Sublease price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

C. Renewal

At least SIX (6) months prior to the expiration of the General Lease S-4191 on the 31st day of December 2033, Sublessor shall seek to negotiate a renewal of said General Lease with Lessor or its successor. In the event of renewal, Sublessor shall renew or extend this Sublease, or shall negotiate in good faith a new Sublease with Sublessee, if so desired by Sublessee, and under such terms and conditions as may then be mutually acceptable. Sublessor shall make every effort to ensure renewal, extension or renegotiation of said General Lease.

D. Faithful Performance

Sublessor and Sublessee recognize that in reliance upon the faithful performance by Sublessor of its obligations hereunder and under the terms of the General Lease S-4191, Sublessee has agreed to make a substantial commitment of financial and human resources. In view of this reliance and commitment by Sublessee, Sublessor agrees to perform faithfully its obligations under General Lease S-4191 and this Sublease so that neither of these agreements is terminated earlier than its natural expiration date.

III. SUBLESSEE HEREBY COVENANTS WITH SUBLESSOR AS FOLLOWS:

A. Right of Entry

Sublessee shall allow Sublessor or its agent(s) known to Sublessee or carrying suitable identification, free access at all reasonable times to the Demised Premises for the purpose of examining the same and determining whether the covenants herein are being fully observed and performed.

B. Janitorial and Other Services

Sublessee shall provide janitorial and custodial services to the Demised Premises, including sewerage and sanitation facilities and services.

C. Repairs and Maintenance

At all times during the term of this sublease, Sublessee shall, at Sublessee's own cost and expense, keep and maintain the Demised Premises and the Facilities in good order and repair and in a clean condition. This obligation shall include,

but not be limited to, the obligation to paint the Facilities as appropriate and to make any modification or alteration thereof when necessary.

D. Utilities and Other Charges

Except as may be agreed in the aforesaid OSDA, Sublessee shall pay for or shall cause to be paid when due all charges associated with the Facilities and all charges, duties and rates of every description, including electricity, water, communications, sewer, gas, refuse collection or any other similar charges, as to which said Demised Premises, or any part thereof, or any improvements thereon, or which Sublessor or Sublessee in respect thereof, may during said term become liable, whether assessed to or payable by Sublessor or Sublessee.

E. Taxes and Assessments

If, at any time in the future, government taxes or assessments are made, Sublessee shall pay or cause to be paid when due, the amount of all taxes, rates, assessments, and other outgoings of every description as to which said demised premises or any part thereof, or any improvements thereon, of Sublessor or Sublessee in respect thereof, are now or may be assessed or become liable by authority of law during the term of this Sublease.

F. Assignment and Subleasing

Neither Sublessee nor its successors or assigns shall, without the prior written consent of Lessor and Sublessor, assign, sublease or mortgage this Sublease or any interest therein, or sublet the Demised Premises, in whole or in part; provided, however, that such consent shall not be arbitrarily or capriciously withheld or delayed, and that this provision shall not operate to prevent Sublessee from making the Demised Premises available to invitees for the purposes permitted hereunder.

G. Use of Demised Premises

1. Sublessee shall use the Demised Premises exclusively for the Facilities, which are to be constructed and operated by and at the expense of Sublessee or others working in cooperation with Sublessee through the aforesaid OSDA and through any other agreements which may be agreed to by Sublessor and Sublessee.

2. All goods, wares, merchandise, equipment or other property of Sublessee shall be kept on the Demised Premises at the sole risk of Sublessee.

3. Sublessee shall not permit or make any waste or strip, or make any unlawful, improper or abusive use of the Demised Premises or any part thereof, and Sublessee shall be liable to Sublessor for all damages beyond reasonable wear and tear. As used in the Sublease, the term "reasonable wear and tear" shall include without limitation such grading, excavation and filling of the demised premises as may be reasonably required for the construction of the improvements contemplated by this Sublease. Such grading, excavation and filling shall not be deemed to constitute strip or waste. Sublessee shall make reasonable effort to minimize grading, excavation and filling.

H. Improvements and Alterations

Sublessee shall, at the Sublessee's sole cost and expense, construct the Facilities or cause them to be constructed on the Demised Premises.

In the event that Sublessee desires to make a substantive structural alteration of or addition to the Facilities, which will significantly alter the external appearance or structure of the Facilities, Sublessee must first seek and obtain written approval of Sublessor prior to commencing work on such structural alteration or addition.

Sublessor shall use its best efforts to secure Lessor's consent and to provide its own approval or objection within SIXTY (60) days after receipt by Sublessor or any request for approval for such structural alteration or addition.

I. Laws, Rules and Regulations, etc.

The Sublessee shall observe and comply with Regulation 4 of the Department of Land and Natural Resources and with all other laws, ordinances, rules and demised lands or improvements.

IV. AND THE PARTIES MUTUALLY COVENANT AS FOLLOWS:

A. Service of Process

Sublessee shall designate a representative within the State of Hawaii duly authorized to accept service of process on its behalf. In the event that Sublessee fails to so designate such a representative or such designated representative is unavailable, Sublessee consents that service of any notice or process issued against it may be served upon it by filing the same with the Director of Commerce and Consumer Affairs, State of Hawaii or, in his/her absence, with the Deputy Director. Sublessor shall forward by certified mail to Sublessee a copy of any such notice or process served on the Director of Commerce and Consumer Affairs.

B. Governing Law: Severability

The validity, construction and performance of this Sublease, and the legal relations among the parties to this Sublease shall be governed by and construed in accordance with the laws of the State of Hawaii, excluding the body of law applicable to choice of law. Should any provision of this Sublease be held by a court of competent jurisdiction to be either invalid, void, or unenforceable, the remaining provisions of the Sublease shall remain in full force and effect.

C. Binding on Successors

This Sublease shall be binding on and inure to the benefit of the successors of the parties hereto.

D. Final Agreement

This Sublease constitutes the final agreement between Sublessor and Sublessor regarding the Sublease of the Demised Premises and the grant of Easement to Sublessee for purposes of Sublessee's construction of the Facilities. All prior discussions and/or agreements among the parties concerning the subject matter addressed in this Sublease shall have no force and effect.

E. Notices

All notices required or permitted to be given hereunder by Sublessor to Sublessee, or Sublessee to Sublessor, shall be in writing and sent to the following address:

If to Sublessor: University of Hawaii
2444 Dole Street
Honolulu, HI 96822
Attn: Vice President for Finance & Operations

If to Sublessee: National Radio Astronomy Observatory
520 Edgemont Road
Charlottesville, VA 22903
Attn: J. L. Desmond

Sublessor and Sublessee may change the address of the recipient of notices by sending a written notice of each such change to the last designated address or the addressee.

F. Termination

This Sublease shall terminate upon the occurrence of any of the following events:

1. If the planned construction of the Facilities described in Exhibit D is not substantially completed by the 31st of December 1994, unless otherwise agreed to in writing between Sublessor and Sublessee.

2. Termination of the aforesaid OSDA unless a new OSDA between UH and another party or parties is executed and Lessor, Sublessor, and Sublessee agree to in writing to a continuation of this Sublease.

3. The expiration of General Lease No. S-4191 on December 31, 2033 without renewal, extension or renegotiation. If said General Lease is renewed, extended or renegotiated, then this Sublease shall be renewed, extended or renegotiated at that time in accordance with II.C.

4. If Sublessee fails to observe or comply with any of the terms or conditions herein within SIXTY (60) days after being notified in writing by Sublessor of such failure. In the event that more than SIXTY (60) days are reasonably required to observe or perform, Sublessee shall in good faith and within said SIXTY (60) days, initiate action and provide a plan for observance or performance, and shall diligently prosecute the same to completion.

5. If Sublessee peaceably surrenders or abandons the Demised Premises.

6. Destruction of the Facilities by fire or other causes rendering the same unsuitable for purposes of radio astronomy, unless Sublessee notifies Sublessor in writing within SIX (6) months of the date of casualty of its intention to restore the Facilities to their prior condition as specified in I.F.

7. By Sublessee upon SIX (6) months' notice in writing, in the event Sublessee's contemplated sources of funding become unavailable and, after diligent effort, Sublessee is unable to procure alternate sources of funding which, in Sublessee's good faith judgment, are adequate.

8. By Sublessee, if Sublessee gives Sublessor ONE (1) years' prior written notice.

9. Mutual agreement in writing between Sublessor and Sublessee.

G. Title to the Facilities, Alterations, Additions, and Improvements, and Disposition in Event of Termination or Expiration

1. Title to the Facilities, alterations, additions, and improvements (collectively referred to herein as "Property") on, affixed or installed in, or placed on the Demised Premises by Sublessee are the property of the U.S. Government (specifically, the National Science Foundation) for use by the Sublessee.

2. If this Sublease terminates or expires, and Sublessor has neither voluntarily terminated General Lease S-4191, nor defaulted on either this Sublease nor on General Lease S-4191, Sublessee shall be responsible for removal of the Property from the Demised Premises within ONE (1) year of the termination or expiration of this Sublease, unless agreed to in writing between Sublessor and Sublessee. If Lessor and Sublessor grant written approval, which approval shall not be arbitrarily or capriciously withheld, said Property can be sold, abandoned, or surrendered in whole or in part and the following conditions shall apply:

a. Sale. Sublessee may sell the Property to Sublessor and/or to a third party acceptable to Sublessor. Such sale by Sublessee to a party other than Sublessor shall be contingent upon the execution of a new Sublease and Operating and Site Development Agreement between the new party and Sublessor.

b. Surrender. Sublessee may peaceably surrender all or part of the Property in place and good repair, order, and clean condition, reasonable wear and tear excepted.

3. Unless otherwise agreed in writing by Sublessor, the following conditions shall apply if all or part of the Property is removed under this Section IV.G:

a. Said removal will be at the expense of Sublessee;

b. Sublessee shall restore the Demised Premises, or any portion affected thereby, to even grade to the extent that Property is removed, and shall repair any damage done to the Property not removed in the event that equipment is removed.

c. In the event that Sublessee fails to remove such Property or debris and restore the Demised Premises within TWELVE (12) months, such Property may be removed and the land restored as described above by Sublessor at the expense of Sublessee.

4. If this Sublease terminates or expires, and Sublessor has either voluntarily surrendered General Lease S-4191, or defaulted on either this Sublease or General Lease S-4191, and if Sublessee is allowed its continued right to quiet enjoyment of the Property and the Demised Premises under the terms of the Consent to Sublease as stated in Exhibit B, then Sublessee agrees to honor the terms of this Sublease.

If said surrender or default results in Sublessor's rights of General Lease S-4191 being (a) returned to Lessor, then Sublessee agrees to negotiate in good faith a new Operating Agreement with Lessor on the terms and conditions of Sublessee's continued use of the Demised Premises; or (b) transferred to an organization other than Sublessor, then Sublessee agrees to negotiate in good faith a new Operating Agreement with the new sublessor of the Demised Premises, and to honor the terms and conditions of said superseding Operating Agreement with said new sublessor. Continued right to quiet enjoyment of the Property and the Demised Premises is contingent upon satisfactory negotiation of an Operating Agreement with Lessor or said new sublessor.

IN WITNESS WHEREOF, the parties hereto have executed these presents the day and year first written above.

SUBLESSOR:

FOR THE UNIVERSITY OF HAWAII:

By Ronald N. B. Hall 9/28/90
Donald N. B. Hall Date
Its Director, Institute
for Astronomy

By Ralph T. Horii, Jr. 9/28/90
Ralph T. Horii, Jr. Date
Its Vice President for
Finance and Operations

By Albert J. Simone
Albert J. Simone Date
Its President

APPROVED AS TO FORM:

By Harriet Y. Lewis 9/17/90
Harriet Y. Lewis Date
Deputy Attorney General
University of Hawaii

SUBLESEE: STATE OF VIRGINIA
COUNTY OF ALBERTA

THE NATIONAL RADIO
ASTRONOMY OBSERVATORY

By Paul Vanden Bout 9/21/90
Paul Vanden Bout Date
Its Director

ASSOCIATED UNIVERSITIES,
INC.

By Robert E. Hughes 9/25/90
Robert E. Hughes Date
Its President

APPROVED AS TO FORM:

By Michael M. Goldman 9/25/90
Michael M. Goldman Date
Deputy General Counsel
Associated Universities, Inc.

STATE OF VIRGINIA
COUNTY OF ALBEMARLE } ss.

On this 21 day of September, 1990, before me appeared Paul A. Vanden Bout, personally known to me, who, being by me duly sworn, did say that he is Director of Associated Universities, Inc.\National Radio Astronomy Observatory, a non-profit, public-benefit corporation; that the seal affixed to the foregoing instrument is the corporate seal of said corporation, that said instrument was signed and sealed on behalf of said corporation; and said Paul A. Vanden Bout acknowledged the instrument to be the free act and deed of said corporation.

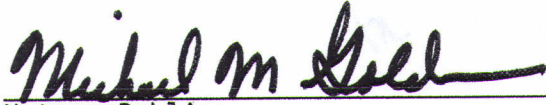
Phyllis D. Jackson

Notary Public

My commission expires:
November 4, 1990

STATE OF NEW YORK)
) ss.:
COUNTY OF SUFFOLK)


On this 25th day of September, 1990, before me appeared Robert E. Hughes, personally known to me, who, being by me duly sworn, did say that he is President of Associated Universities, Inc., a non-profit, public-benefit corporation; that the seal affixed to the foregoing instrument is the corporate seal of said corporation; that said instrument was signed and sealed on behalf of said corporation; and said Robert E. Hughes acknowledged the instrument to be the free act and deed of said corporation.


Notary Public

My commission expires: _____

MICHAEL M. GOLDMAN
Notary Public, State of New York
No. 52-4625416
Qualified in Suffolk County
Term Expires December 31, 1990

On this 21st day of March 1991, before me appeared Albert J. Simon and Ralph T. Hunt, Jr. personally known to me, who, being by me duly sworn, did say that they are the President and Vice President for Finance and Operations, respectively, of the University of Hawaii, a Hawaii corporation, and the seal affixed to the foregoing instrument is the corporate seal of said corporation; that said instrument was signed and sealed on behalf of said corporation by the authority of its Board of Regents; and said Albert J. Simon and Ralph T. Hunt, Jr. acknowledged the instrument to be the free act and deed of said corporation.



Notary Public, State of Hawaii
My commission expires: _____

STATE OF HAWAII)
) ss.
CITY AND COUNTY OF HONOLULU)

On this 21st day of March 1991, before me appeared Donald N. B. Hall, personally known to me, who, being by me duly sworn, did say that he is the Director of the Institute for Astronomy, University of Hawaii, a Hawaii corporation; that the seal affixed to the foregoing instrument is the corporate seal of said corporation; that said instrument was signed and sealed on behalf of said corporation by the authority of its Board of Regents; and said Donald N. B. Hall acknowledged the instrument to be the free act and deed of said corporation.

Nancy L. Lyttle
Notary Public, First Circuit
State of Hawaii

My commission expires: 4/4/92

STATE OF HAWAII)
) ss.
CITY AND COUNTY OF HONOLULU)

On this 21st day of March 1991, before me appeared Albert J. Simone and Ralph T. Horii, Jr., personally known to me, who, being by me duly sworn, did say that they are the President and Vice President for Finance and Operations, respectively, of the University of Hawaii, a Hawaii corporation; that the seal affixed to the foregoing instrument is the corporate seal of said corporation; that said instrument was signed and sealed on behalf of said corporation by the authority of its Board of Regents; and said Albert J. Simone and Ralph T. Horii, Jr. acknowledged the instrument to be the free act and deed of said corporation.

Helen J. Nakamura
Notary Public, First Circuit
State of Hawaii

My commission expires: 3/27/94

EXHIBIT "A"

MAUNA KEA SCIENCE RESERVE

Kaohē, Hamakua, Island of Hawaii, Hawaii

Being a portion of the Government Land of Kaohē

Beginning at a point on the south boundary of this parcel of land, the coordinates of said point of beginning referred to Government Survey Triangulation Station "SUMMIT 1955" being 12,325.95 feet South and 471.84 feet West, as shown on Government Survey Registered Map 2789, thence running by azimuths measured clockwise from True South:-

1. Along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 135° 00' 18,667.62 feet;
2. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, still on a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 225° 00' 18,667.62 feet;
3. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, still on a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 281° 18' 04.6" 5173.56 feet;
4. 207° 49' 06.5" 841.83 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
5. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 1200.00 feet, the chord azimuth and distance being: 297° 49' 06.5" 2400.00 feet;

6. 27° 49' 06.5" 841.83 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
7. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 306° 59' 47.4" 1824.16 feet;
8. 227° 29' 00.9" 2805.06 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
9. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 1500.00 feet, the chord azimuth and distance being: 317° 29' 00.9" 3000.00 feet;
10. 47° 29' 00.9" 2805.06 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
11. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 13200.00 feet, the chord azimuth and distance being: 325° 31' 55.2" 701.87 feet;
12. 245° 46' 12.7" 2760.45 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
13. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 2000.00 feet, the chord azimuth and distance being: 335° 46' 12.7" 4000.00 feet;
14. 65° 46' 12.7" 2760.45 feet along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909;
15. Thence along Mauna Kea Forest Reserve, Governor's Proclamation dated June 5, 1909, on a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 352° 14' 32.9" 3563.50 feet;

On a curve to the right with a radius of 13,200.00 feet, the chord azimuth and distance being: 45' 00' 18,667.62 feet to the point of beginning and containing an AREA OF 13,321.054 ACRES.

EXCEPTING and RESERVING to the State of Hawaii and to all others entitled thereto, the Mauna Kea-Humuula and Mauna Kea-Umikoia Trails, and all other existing trails within the above-described parcel of land, together with rights of access over and across said trails.

ALSO, EXCEPTING and RESERVING to the State of Hawaii, its successors and assigns, the waters and all riparian and other rights in and to all the streams within the above-described parcel of land.

SUBLEASE EXHIBIT B

LAND COURT SYSTEM

REGULAR SYSTEM

Return by Mail () Pickup () To:

Total Number of Pages:

Tax Map Key No. (3)4-4-15:09

CONSENT TO SUBLEASE OF GENERAL LEASE NO. S-4191

CONSENT is hereby given by the STATE OF HAWAII, by its Board of Land and Natural Resources, Lessor under unrecorded General Lease No. S-4191 dated June 21, 1968 leased to the University of Hawaii, a body corporate, as Lessee, to the attached Sublease and Non-Exclusive Easement Agreement ("Sublease") dated September 28, 1990 from the UNIVERSITY OF HAWAII, a body corporate, as "Sublessor," to the ASSOCIATED UNIVERSITIES, INC./NATIONAL RADIO ASTRONOMY OBSERVATORY, a non-profit, public-benefit corporation, whose address is 520 Edgemont Road, Charlottesville, Virginia 22903, recorded in the Bureau of Conveyances of the State of Hawaii as Document No. _____, as "Sublessee"; SUBJECT, HOWEVER, to the provisions of Section 171-21, Hawaii Revised Statutes, as amended, relating to the rights of holder of security interests, PROVIDED, FURTHER, that nothing contained herein shall change, modify, waive or amend the provisions, terms, conditions

PRELIM. APPR'D.
Department of the
Attorney General

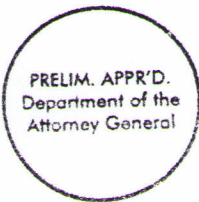
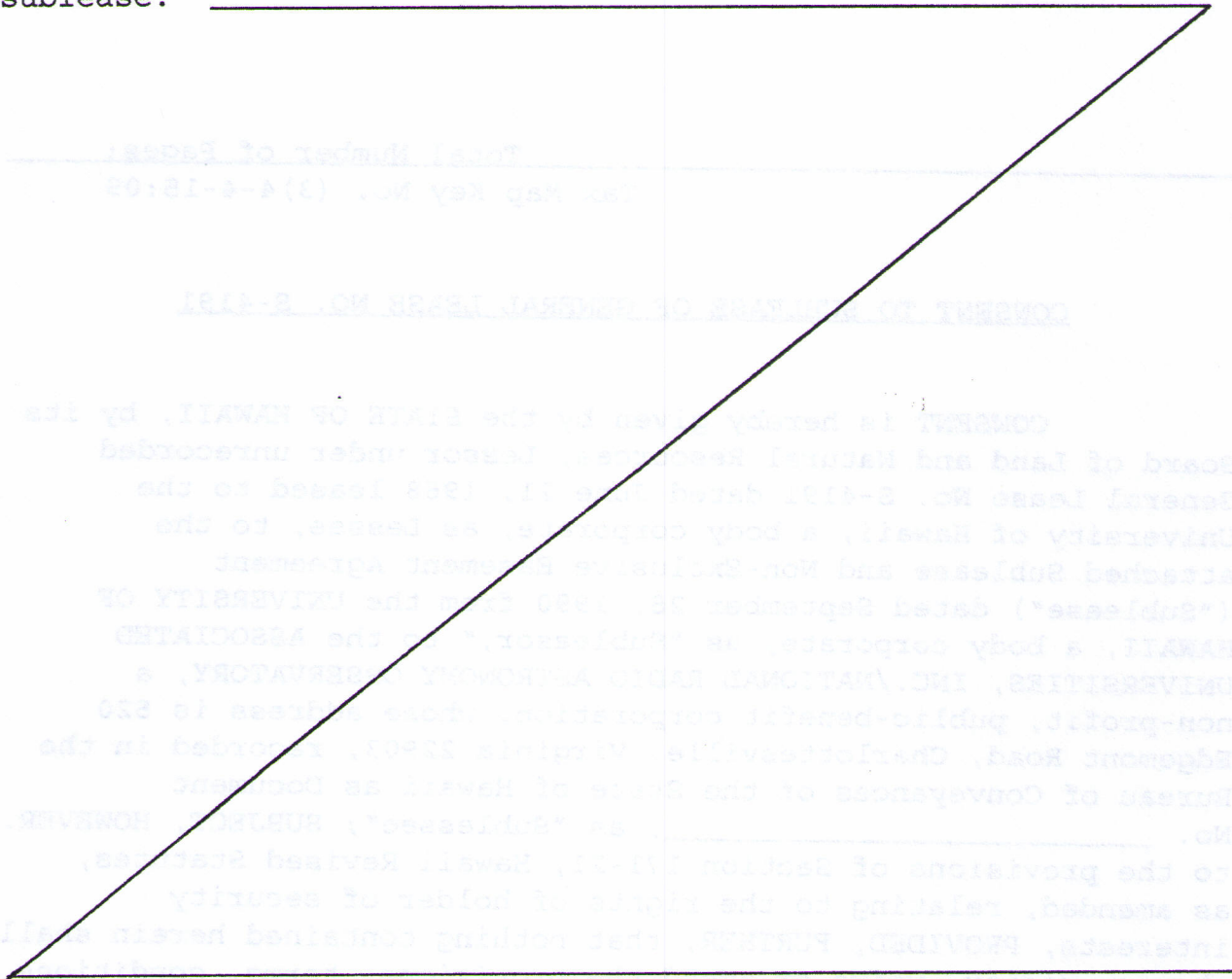
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
P.O. BOX 621
HONOLULU, HAWAII 96809

EXTRA COPY
TO BE MAINTAINED
IN THE OFFICE

and covenants or the duties and obligations of the Lessee or Sublessee under General Lease No. S-4191.

IT IS UNDERSTOOD that except as provided herein, should there be any conflict between the terms of General Lease No. S-4191 and the terms of the Sublease, the former shall control; and that no further sublease or assignment of any interest of the premises or any portion thereof shall be made without the prior written consent of the Board of Land and Natural Resources.

FURTHERMORE, Lessee hereby acknowledges that the Lessor's consent to sublease under General Lease No. S-4191, does not release the Lessee of any and all responsibilities, obligations, liabilities, and claims respecting or arising under or out of said General Lease prior to the effective date of this sublease.



IN WITNESS WHEREOF, the STATE OF HAWAII, by its Board of Land and Natural Resources, has caused the seal of the Department of Land and Natural Resources to be hereunto affixed and these presents to be duly executed this 20th day of

July, 1999.

STATE OF HAWAII

By *James E. Kawoos*

Approved by the Board of Land and Natural Resources at its meeting held on August 21, 1997.

Chairperson and Member Board of Land and Natural Resources

LESSOR

UNIVERSITY OF HAWAII, a body corporate

By *Eugene S. Imai*

Eugene S. Imai
Its Senior Vice President for Administration

By _____
Its _____

APPROVED AS TO FORM:

DNS
Deputy Attorney General

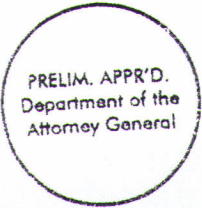
Dated: 7/13/99

By *Kenneth P. Mortimer*
Kenneth P. Mortimer

Its President, University of Hawaii and
Chancellor, University of Hawaii at
Manoa

LESSEE

2692(4)
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STATE OF HAWAII)
) SS.
CITY AND COUNTY OF HONOLULU)

On this 19th day of April, 1999,
before me appeared KENNETH P. MORTIMER and
EUGENE S. IMAI, to me personally
known, who, being by me duly sworn, did say that they are the
President, University of Hawai'i and Chancellor, University of
Hawai'i at Mānoa and Senior Vice President for
Administration, respectively, of the UNIVERSITY OF HAWAI'I, a
body corporate, and that seal affixed to the foregoing instrument
is the corporate seal of said University and that the foregoing
instrument was signed and sealed in behalf of said University by
authority of its Board of Regents, and the said KENNETH P.
MORTIMER and EUGENE S. IMAI acknowledged said instrument to
be the free act and deed of said University.

Helen J. Nakamura
Notary Public, State of Hawai'i
HELEN T. NAKAMURA

My Commission expires: 3-27-2002



Exhibit C to OSDA Attachment A

NRAO Site—Demised Premises

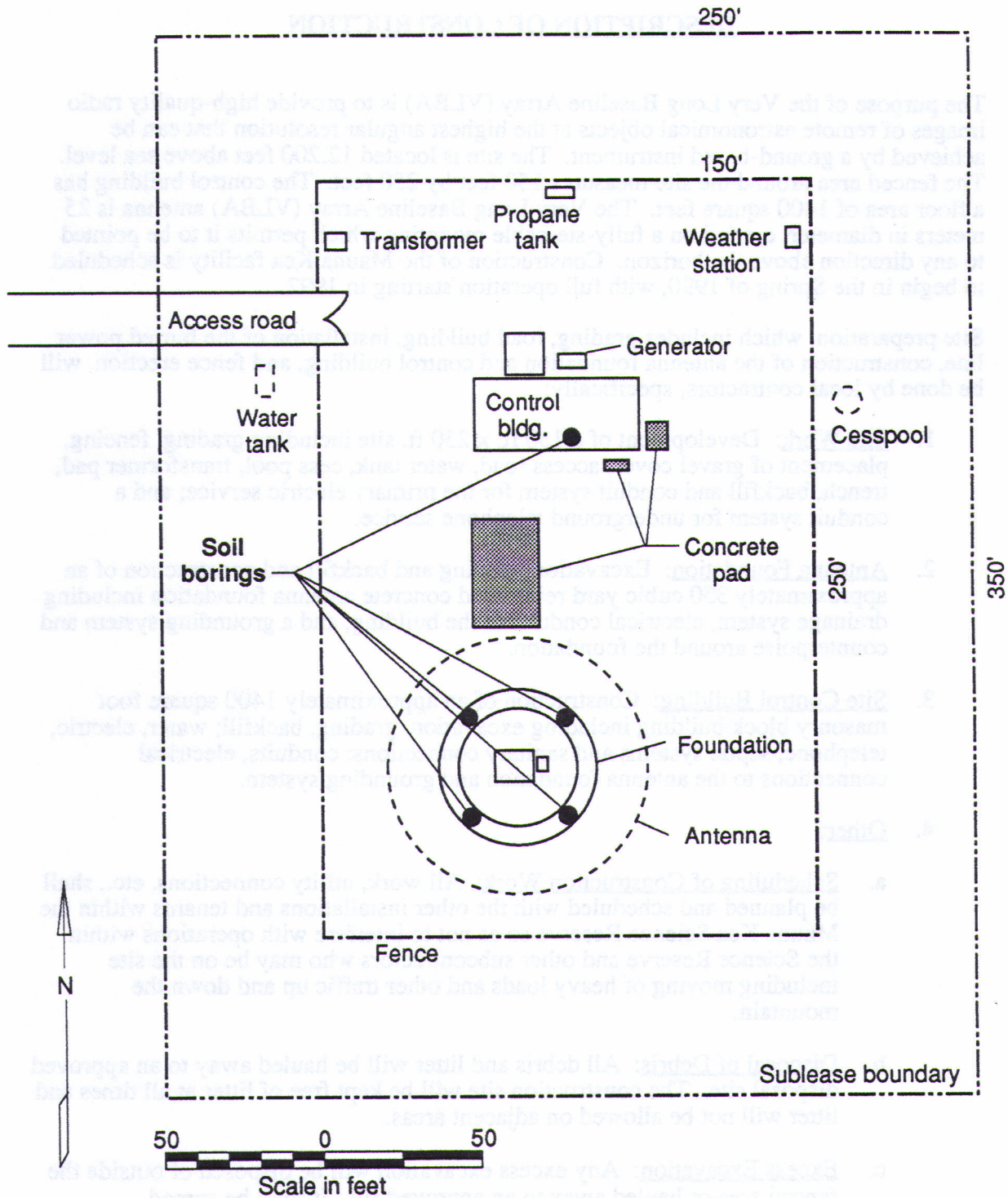


EXHIBIT D

to

OSDA Attachment A

DESCRIPTION OF CONSTRUCTION

The purpose of the Very Long Baseline Array (VLBA) is to provide high-quality radio images of remote astronomical objects at the highest angular resolution that can be achieved by a ground-based instrument. The site is located 12,200 feet above sea level. The fenced area around the site measures 150 feet by 250 feet. The control building has a floor area of 1400 square feet. The Very Long Baseline Array (VLBA) antenna is 25 meters in diameter, carried on a fully-steerable mounting which permits it to be pointed to any direction above the horizon. Construction of the Mauna Kea facility is scheduled to begin in the Spring of 1990, with full operation starting in 1992.

Site preparation, which includes grading, road building, installation of the buried power line, construction of the antenna foundation and control building, and fence erection, will be done by local contractors; specifically:

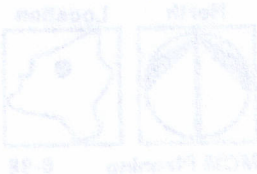
1. Site Work: Development of a 150 ft. x 250 ft. site including grading, fencing, placement of gravel cover; access road, water tank, cess pool, transformer pad, trench, backfill and conduit system for the primary electric service; and a conduit system for underground telephone service.
2. Antenna Foundation: Excavation, grading and backfill and construction of an approximately 350 cubic yard reinforced concrete antenna foundation including drainage system, electrical conduits to the building, and a grounding system and counterpoise around the foundation.
3. Site Control Building: Construction of an approximately 1400 square foot masonry block building including excavation, grading, backfill; water, electric, telephone, septic systems and sanitary connections; conduits, electrical connections to the antenna foundation and grounding system.
4. Other:
 - a. Scheduling of Construction Work: All work, utility connections, etc., shall be planned and scheduled with the other installations and tenants within the Mauna Kea Science Reserve so as not to interfere with operations within the Science Reserve and other subcontractors who may be on the site including moving of heavy loads and other traffic up and down the mountain.
 - b. Disposal of Debris: All debris and litter will be hauled away to an approved disposal site. The construction site will be kept free of litter at all times and litter will not be allowed on adjacent areas.
 - c. Excess Excavation: Any excess excavation will be disposed of outside the fenced area or hauled away to an approved fill. It shall be spread uniformly, graded free of large rocks and left in a neat and clean manner.

- d. **Erosion and Silt Control**: Plastic barriers and/or bales of straw shall be provided to minimize erosion and prevent silt and soil being carried away.
- e. **Dust Control**: Dust control will be maintained during construction by exposing the smallest area possible at any time and halting construction during high winds and storms. Strict adherence to county regulations concerning excavating and grading is required. Dust control will conform to State health and environmental rules.
- f. **Blasting**: Controlled blasting for excavating and removing boulders will only be used if maximum safety precautions are taken to protect people and property and is scheduled with other installations within the Science Reserve.
- g. **Construction Activities**: All subcontractors will be advised that all construction activities must remain within the NRAO/AUI subleased area and access road easement boundaries. The surrounding terrain will not be driven over, used or disturbed.
- h. **Archaeological Finds**: There are four archaeological sites in the vicinity of the construction site. The sites are well marked with visual barriers. Subcontractors will ensure that these barriers are not disturbed and the sites are protected. When all construction is complete the subcontractors will remove the barriers and make the sites look undisturbed.
- i. **Cut and Fill**: It is the intent of the access road and site design to balance out, cut and fill as there are no borrow pits or disposal sites on Mauna Kea. Since the construction area is strewn with cobble and small boulders, with the likely possibility of more being uncovered in excavating, a portable crusher might be used to minimize the problem by making the cobble and boulders usable as fill, 6 inches and smaller.

The estimated cost of this work is 1.3 million dollars.

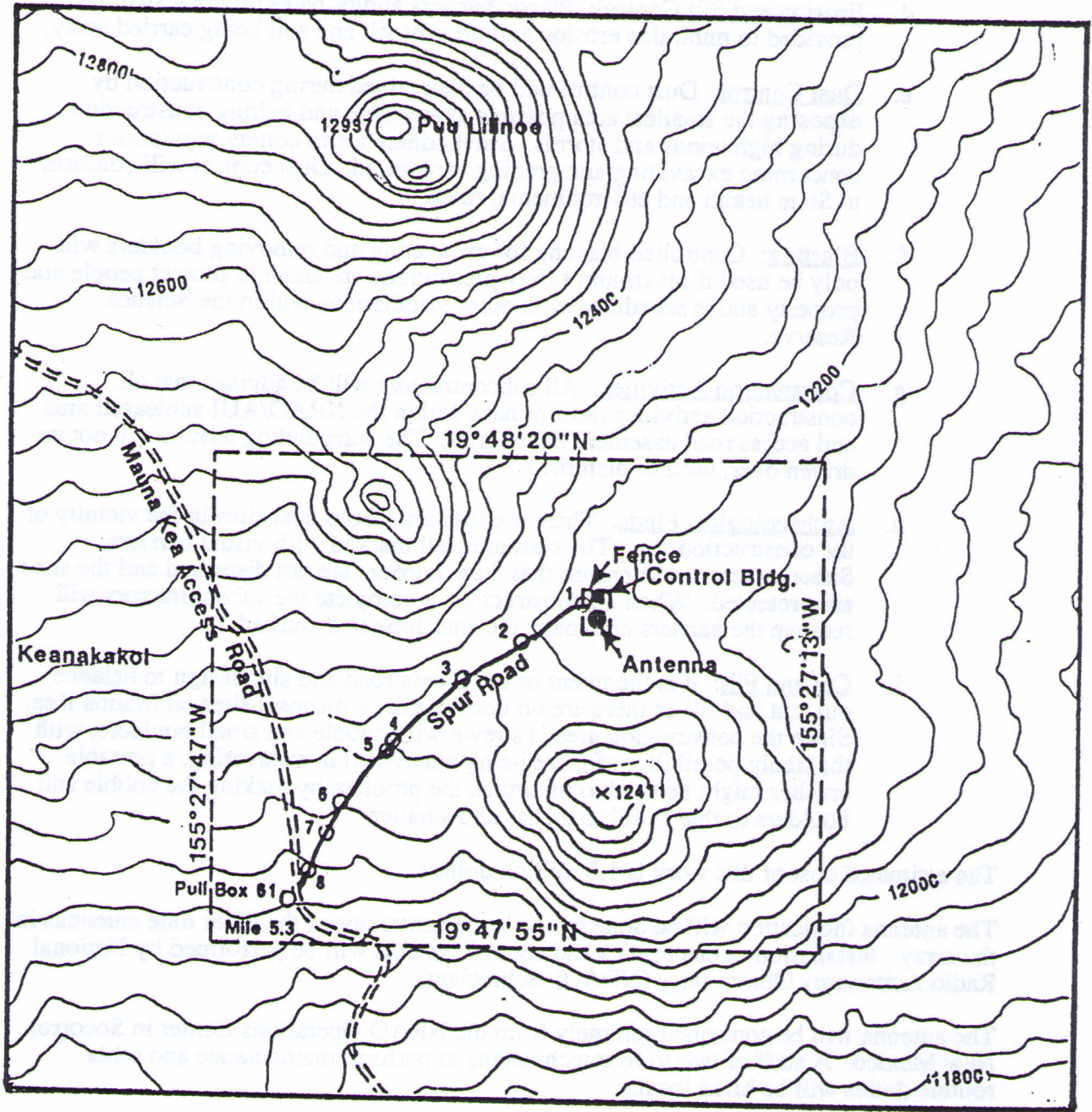
The antenna fabrication will be done by the same contractor as the other nine antennas in the array. Installation of electronics and control systems will be performed by National Radio Astronomy Observatory (NRAO) technicians.

The antenna will be controlled remotely from the NRAO Operations Center in Socorro, New Mexico. A staff of two to four technicians to perform maintenance and other routine duties will be hired locally.

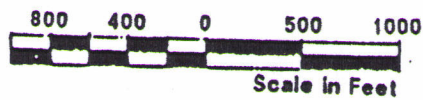




OSDA Attachment B

VLBA Spur Road



VLBA Site



North	Location
	
MCM Planning	6-88

OSDA Attachment C

NRAO Site-Subleased Area

