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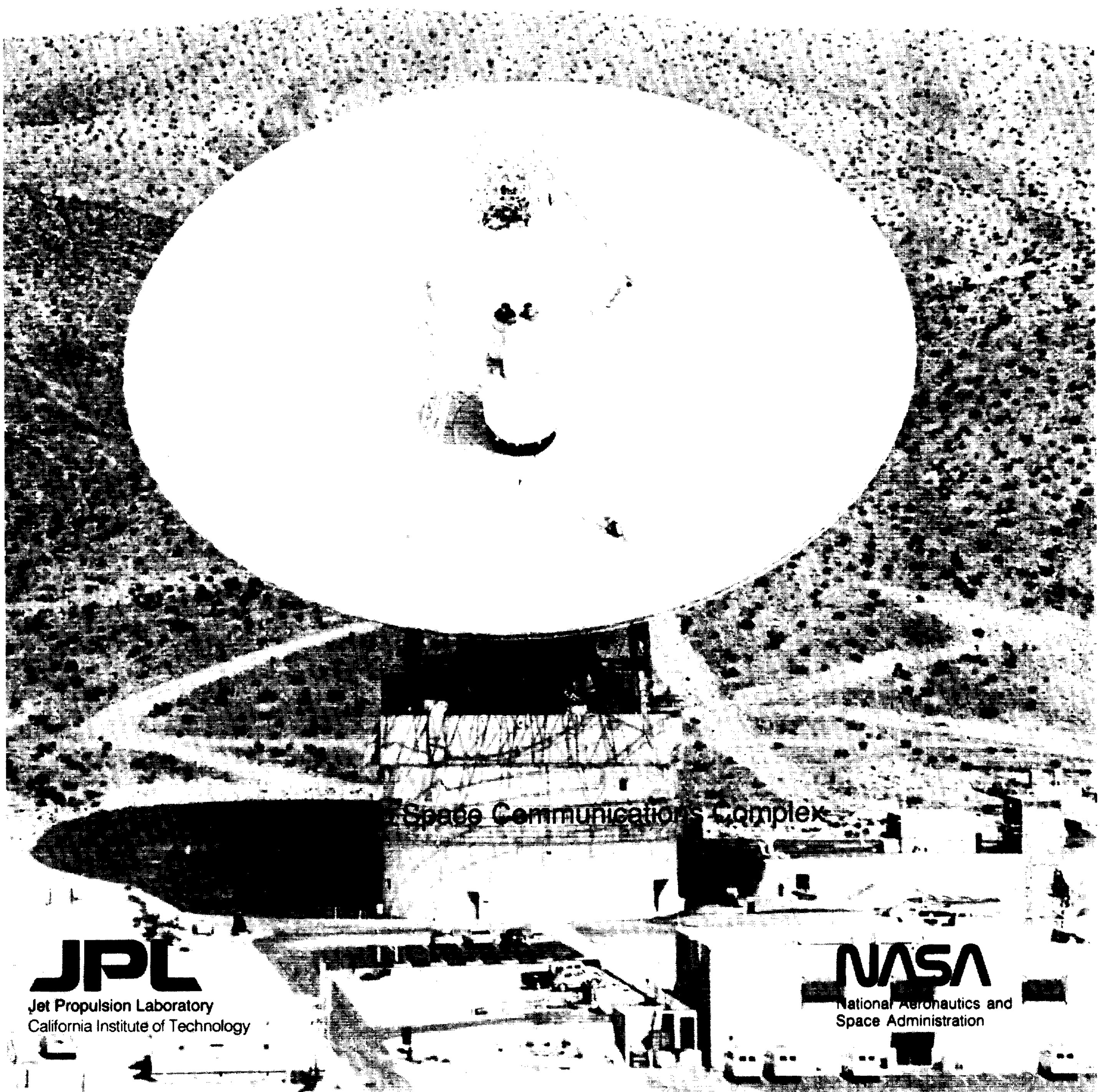
Environmental Projects: Volume 10

Environmental Assessment: New 34-Meter Antenna at Apollo Site



Jet Propulsion Laboratory
California Institute of Technology

National Aeronautics and Space Administration

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Environmental Assessment: New 34-Meter Antenna at Apollo Site

Goldstone Deep Space Communications Complex

JPL
Jet Propulsion Laboratory
California Institute of Technology

NASA
National Aeronautics and
Space Administration

ABSTRACT

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 40 miles north of Barstow, California, and about 160 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each of the first four sites is a Deep Space Station (DSS) that consists of at least one parabolic dish antenna and support facilities. Although there are four DSN operational sites at the GDSCC, there now are six operational parabolic dish antennas because two antennas are located at the Mars Site and two are at the Apollo Site.

At present the Venus Station has an unused 9-meter antenna and a 26-meter (85 ft) antenna known as DSS-13. Construction of a new 34-meter (111.5 ft) antenna at the Venus Site is under way to replace the present DSS-13 26-meter antenna.

This report deals with the proposed construction at the Apollo Site of a new, high-efficiency, 34-meter, multifrequency beam waveguide-type antenna to replace the aging, 29-year old, DSS-12 34-meter antenna located at the Echo Site. This new 34-meter antenna, to be constructed at the Apollo Site and to be known as DSS-18, will be of a design similar to the new DSS-13 34-meter antenna now being constructed at the Venus Site. When the new 34-meter antenna is completed and operational at the Apollo Site (planned for 1993), the old DSS-12 34-meter antenna at the Echo Site will be decommissioned, dismantled, and removed.

The proposed DSS-18 antenna will be the third parabolic dish antenna at the Apollo Site. The other two antennas are DSS-16, a 26-meter (85 ft) antenna, and DSS-17, a 9-meter (24.5 ft) antenna.

The proposed construction of a new antenna at the Apollo Site requires an Environmental Assessment (EA) document that records the existing environmental conditions at the Apollo Site, that analyzes the environmental effects that possibly could be expected from the construction, installation and operation of the new proposed antenna, and that recommends measures to be taken to mitigate any possibly deleterious environmental effects. M.B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL, under Contract No. 957925-71070, to prepare the EA document.

This present report is an expanded JPL-version of the EA document submitted to JPL by MBGA in May 1989. The conclusion of the MBGA-prepared environmental assessment is that there would be no significant adverse effects on the environment due to the construction, installation and operation of the new 34-meter antenna at the Apollo Site.

GLOSSARY

BLM	U.S. Bureau of Land Management
CDFG	California Department of Fish and Game
CEQ	(Federal) Council on Environmental Quality
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
dB	Decibel
DSCC	Deep Space Communications Complex
DSN	Deep Space Network
DSS	Deep Space Station
EA	Environmental Assessment
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FONSI	Finding of No Significant Impact
FWS	U.S. Fish and Wildlife Service (see USFWS)
GDSCC	Goldstone Deep Space Communications Complex
GHz	Gigahertz (one billion cycles/second)
HEF	High efficiency (antenna)
JPL	Jet Propulsion Laboratory
MBGA	M.B. Gilbert Associates
MSL	Mean Sea Level
MSRS	Mars Sample and Return/Survey Mission
MTF	Microwave Test Facility
NAS	National Audubon Society
NASA	National Aeronautics and Space Administration

NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NTC	National Training Center (U.S. Army)
RCN	Rural Conservation
RFI	Radar Frequency Interference
SEDAB	Southeast Desert Air Basin
STD	Standard Network of the DSN
STS	Space Transportation System (Space Shuttle)
TDS	Total dissolved solids
USC	United States Code
USCS	Unified Soil Classification System
USFWS	U.S. Fish and Wildlife Service (see FWS)

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SECTION I

INTRODUCTION

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 40 miles north of Barstow, California, and about 160 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each of the first four sites is a Deep Space Station (DSS) of the DSN that consists of at least one parabolic dish antenna and support facilities. Although there are four operational DSN sites at the GDSCC, there now are six operational parabolic dish antennas because two antennas are located at the Mars Site and two are at the Apollo Site. The Mojave Base Site, while it is part of the GDSCC, is not part of the DSN.

A. PROPOSED CONSTRUCTION OF A NEW 34-METER ANTENNA AT THE APOLLO SITE

At present, the Apollo Site has two parabolic dish antennas: a 26-meter (85 ft) antenna known as DSS-16, and a 9-meter (29.5 ft) antenna designated as DSS-17. The 26-meter antenna originally was constructed in 1965 by NASA's Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Both the 26-meter and the 9-meter antennas now are used to support the Space Transportation System (STS, Space Shuttle) and satellites in both low- and high-Earth orbits.

JPL/NASA now proposes to add a third parabolic dish antenna to the Apollo Site: a new, high-efficiency, 34-meter (111.5 ft) multifrequency beam waveguide-type antenna. This new antenna at the Apollo Site will replace the aging, 29-year old DSS-12 34-meter antenna now operating at the Echo Site. This old DSS-12 antenna was constructed in 1961.

The new 34-meter antenna, to be constructed at the Apollo Site and to be known as DSS-18, will be of a design similar to the new DSS-13 34-meter antenna now being constructed at the Venus Site (see <u>Environmental Projects: Volume 6, Environmental Assessment: New 34-Meter Antenna at Venus Site</u>, JPL Publication 87-4, June 15, 1988). When the new 34-meter antenna is completed and operational at the Apollo Site (planned for 1993), the old DSS-12 34-meter antenna at the Echo Site will be decommissioned, dismantled, and removed.

The reasons for the construction of the new 34-meter antenna are as follows:

(1) <u>Mechanical and Structural Problems</u>: The 29-year old DSS-12 antenna at the Echo Site is part of what is called the Standard Network (STD) of the DSN. The rest of the STD consists of two more antennas: DSS-42 in Australia and DSS-61 in Spain.

The presently 29-year old DSS-12 antenna at the Echo Site will be 32 years old by the time it is replaced and dismantled in 1993.

Each of the STD antennas has severe mechanical and structural problems, due to aging and metal fatigue, that can lead to catastrophic failures. These failures, in turn, can result in the antennas being down and inoperative for extended periods. Engineering modifications needed to correct the most severe metal fatigue and mechanical problems of the DSS-12 antenna could cost more than $5 million. But, even if these costly modifications were made, the refurbished antennas still would be operationally inadequate to support future missions now projected by NASA. Thus, these economic and performance considerations point to the needed construction of a new 34-meter antenna at the Apollo Site at the GDSCC.

(2) Performance: The old DSS-12 antenna at the Echo Site now operates with radio frequencies knows as S-band frequencies [transmission at 2.1 gigahertz (GHz) and reception at 2.3 GHz] and X-band frequencies (reception only at 8.4 GHz). The new 34-meter antenna to be constructed at the Apollo Site also will operate with the same S-band and X-band radio frequencies. The new 34-meter antenna, however, will have the capability for the future addition of transmission with X-band frequencies (7.1 GHz) as well as the reception of Ku-band frequencies (14.0 GHz) and Ka-band frequencies (reception at 32.0 GHz and transmission at 35.0 GHz). Thus, the new beam-waveguide STD antennas, with this multifrequency capability, would allow the 34-meter antennas to support more sophisticated, future NASA missions including the proposed Mars Rover mission, the Cassini Saturn Mission, or the Mars Sample and Return/Survey Mission (MSRS). Such future mission support cannot be provided by the old STD antennas. Thus, a new 34-meter antenna, designed with the latest technological capabilities, would ease the DSN support problem for NASA because it could be used for space missions that now require the use of a 70-meter antenna. This would reduce the constraint for those future space missions that would require the availability of a 70-meter antenna.

In addition, the beam waveguides in the new antennas will permit better performance even during inclement weather (rain, snow, sleet, etc.).

(3) Increase of Availability to the DSN: Because the same antenna beam in the new 34-meter STD antennas can handle multifrequency bands, several missions can be supported by rapidly switching the antenna's support from one particular mission to another. In addition, the loss of tracking of any given mission, during the time it now takes to reconfigure radio frequency reception, will be greatly reduced. Thus, the new 34-meter STD antennas will greatly increase the amount of time the DSN is available for NASA-mission support.

(4) Effects of a Delay in Construction of the New 34-Meter Antenna: The old DSS-12 antenna at the Echo Site is near the end of its useful life. Failures of structure, bearings and gearing are becoming more frequent. The costs of operating the DSN will be reduced by the elimination of the extensive maintenance program now required to keep the STD antennas in operating condition. In addition, the new antenna design also will reduce the time and cost to maintain and repair the complex antenna

electronics. With the new, beam-waveguide antenna design, the antenna electronics no longer are placed onto a small crowded area on the moving part of the antenna, but are located in a non-moving, large laboratory-like area. Thus, both maintenance and modification of the antenna electronics can be performed even during tracking operations.

B. DESCRIPTION OF THE PROPOSED 34-METER ANTENNA AT THE APOLLO SITE

The proposed DSS-18 antenna, to be located at the existing Apollo Site, will be a high-performance, 34-meter wheel-and-track type, azimuth-elevation antenna located approximately 700 feet south-southwest of the existing DSS-16 26-meter antenna. The proposed project includes construction and installation of the antenna structure, a below-grade foundation and equipment enclosure, mechanical drive and controls, and optical elements. The proposed antenna at the Apollo Site is similar in size and structure to both the DSS-15 34-meter Uranus antenna located at the Mars Site in the northern portion of the GDSCC, and to the DSS-13 34-meter antenna currently under construction at the Venus Site in the southern portion of the GDSCC (Figure 1).

C. REQUIREMENT OF AN ENVIRONMENTAL ASSESSMENT

The proposed construction of the new DSS-18 antenna at the Apollo Site requires an Environmental Assessment (EA) Document that records the existing environmental conditions at the Apollo Site, that analyzes the environmental effects that possibly could be expected from the construction, installation and operation of the new proposed antenna, and that recommends measures that could be taken to mitigate any possibly deleterious environmental effects.

The need for an Environmental Assessment Document had its origin in 1978, when the Federal Council on Environmental Quality (CEQ) issued regulations under 40 Code of Federal Regulations (CFR) Parts 1500 - 1508 to implement the procedural requirements of the National Environmental Policy Act (NEPA). Following this action, the National Aeronautics and Space Administration (NASA) procedures to implement NEPA were published in 14 CFR Subparts 1261.1 and 1261.3. The NASA procedures now have been incorporated in the NASA Directives System as NMI 8800.7.

Thus, NASA installations planning qualifying projects must prepare an Environmental Assessment Document (14 CFR 1216.304). As defined in 40 CFR Subpart 1508.9 (Preparation of Environmental Assessments), the purpose of the Environmental Assessment is to provide sufficient evidence and analysis to permit the determination whether to prepare an Environmental Impact Statement (EIS) or a Finding Of No Significant Impact (FONSI).

The EA report must be completed and a decision made as to whether or not an Environmental Impact Statement is required before a decision can be made to begin detailed project definition and planning (NASA, 1980). Evaluation of environmental impacts, therefore, must commence at the onset of project conception. In addition to assessing the probable impacts resulting from the proposed project, the EA must provide an evaluation of alternatives to the proposed project, including the alternative of "no action." While there is no requirement to select the alternative having the least environmental impact, the rationale for selecting the favored alternative must be provided.

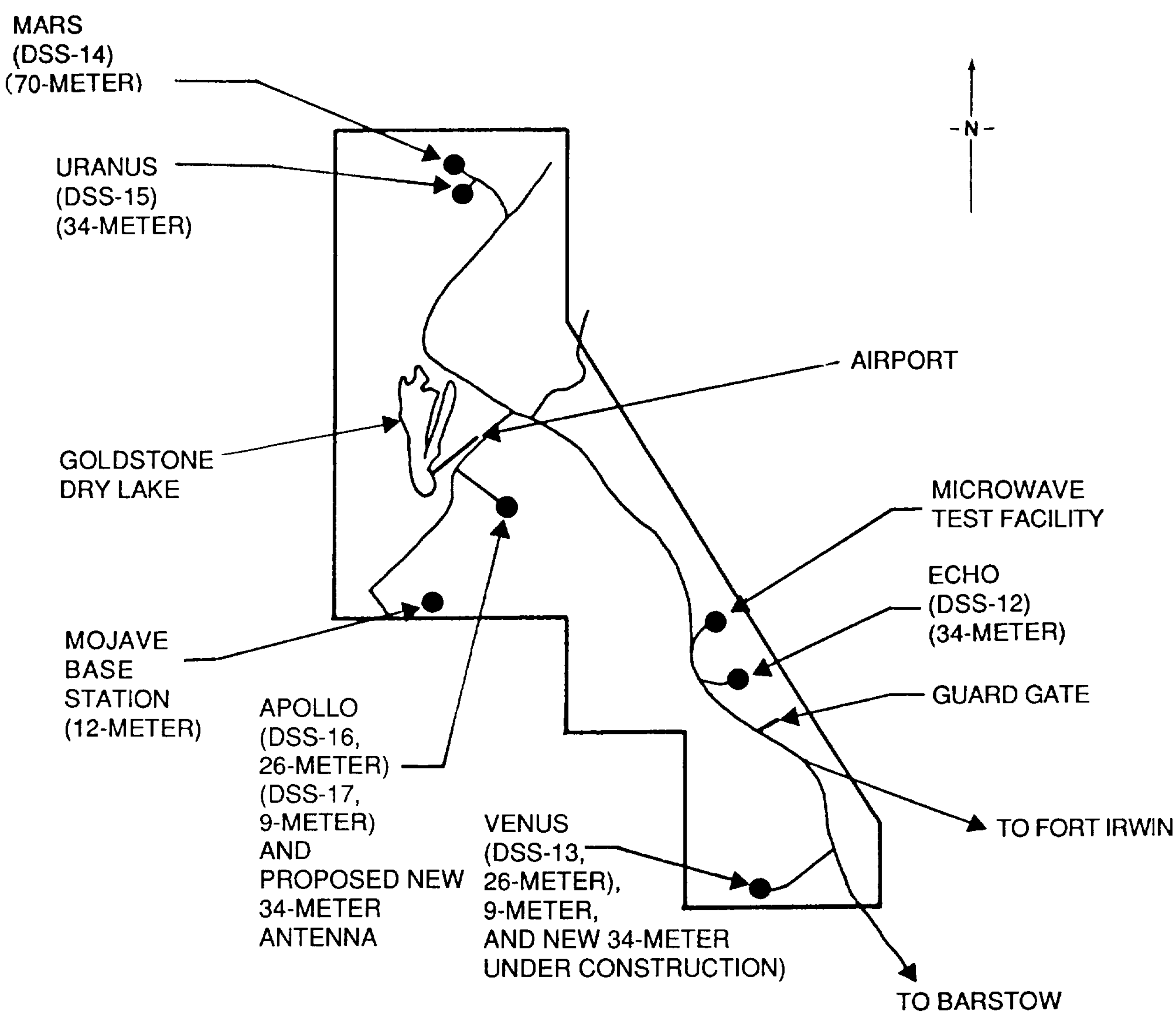

Figure 1. Schematic Map of the Goldstone DSCC Showing Locations of the Five NASA Deep Space Stations (DSSs) and the Mojave Base Station Operated by NOAA

M. B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL to prepare this EA document according to Section 102 of the National Environmental Policy Act (42 United States Code, USC 4321); Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act (40 CFR Code of Federal Regulations, 1500-1508); NASA Policy on Environmental Control (14 CFR 1216.1); NASA Procedures for Implementing the National Environmental Policy Act (14 CFR 1216.3); and NASA Handbook 8800.11. MBGA submitted its prepared EA Document to JPL in May 1989. The MBGA document serves as the Environmental Assessment for the DSS-18 34-meter antenna proposed to be constructed at the Apollo Site at the GDSCC.

This present report is an expanded JPL-version of the EA document submitted to JPL by MBGA. The conclusion of the MBGA-prepared Environmental Assessment is that there would be no significant adverse effects on the GDSCC environment due to the construction, installation and operation of the new DSS-18 34-meter antenna at the Apollo Site.

D. SUMMARY OF THE ENVIRONMENTAL ASSESSMENT

The environmental consequences of the proposed construction of the new DSS-18 34-meter antenna at the Apollo Site are minimal. The construction and operation of the proposed antenna will not result in any significant impacts to the natural environment (geology, seismic conditions, soils, water resources, floodplains, biotic resources, and air quality). Similarly, there are minimal human environmental impacts (socioeconomics, traffic and circulation, noise, cultural resources, solid and hazardous waste, toxic substances and pesticides, and aesthetics), because the proposed antenna is replacing an existing antenna operation.

E. CONCLUSIONS OF THE ENVIRONMENTAL ASSESSMENT

The Environmental Assessment (EA), concerning the construction and operation of the new DSS-18 34-meter antenna proposed to be located at the Apollo Site at the GDSCC, has analyzed and focused upon many areas of possible environmental concern.

Key issues associated with potential impacts were identified during preliminary discussions with NASA, JPL, Fort Irwin and Goldstone contractor personnel. The conclusion of the EA analysis is that the proposed action would cause no significant adverse impacts to the natural or human environment. A Finding of No Significant Impact (FONSI), therefore, would be appropriate in accordance with NASA procedures in 40 CFR 1216.306(b).

SECTION II

THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)

A. LOCATION OF THE GDSCC

The Goldstone Deep Space Communications Complex (GDSCC) is located in southern California in a natural, bowl-shaped depression in the Mojave Desert, in San Bernardino County about 40 miles north of Barstow, California, and about 160 miles northeast of Pasadena, California, where the Jet Propulsion Laboratory (JPL) is located.

As indicated in Section I, the GDSCC is part of the National Aeronautics and Space Administrations's (NASA) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, California.

The 52-square-mile Goldstone Complex lies within the western part of the Fort Irwin Military Reservation (Figure 2). A Use Permit for the use of the land was granted to NASA by the U.S. Army. The Complex is bordered by the Fort Irwin Military Reservation on the north, east and southeast, the China Lake U.S. Naval Weapons Center on the northwest, and state and Federal lands managed by the U.S. Bureau of Land Management (BLM) on the south.

B. FUNCTIONS OF THE GDSCC

After the Space Act of 1958 had accelerated U.S. plans and programs for space exploration, JPL initiated construction work at Goldstone to build the first tracking station of what is now known as the Deep Space Network (DSN). Thus, for more than three decades, the primary purpose of the DSN has been and continues today to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

As indicated above, in addition to its participation in numerous scientific explorations, Goldstone performs the following functions in support of DSN operations:

(1) Tracking: Locating a spacecraft, measuring its distance from Earth, its velocity and position, and following its course.

(2) Data Acquisition: Gathering information coming in from a spacecraft.

(3) Command: Sending of instructions from the ground that guide a spacecraft in its flight to the target. Commands also tell a spacecraft when to perform required operations, including the switching on and off of instruments for performance of the mission's scientific experiments.

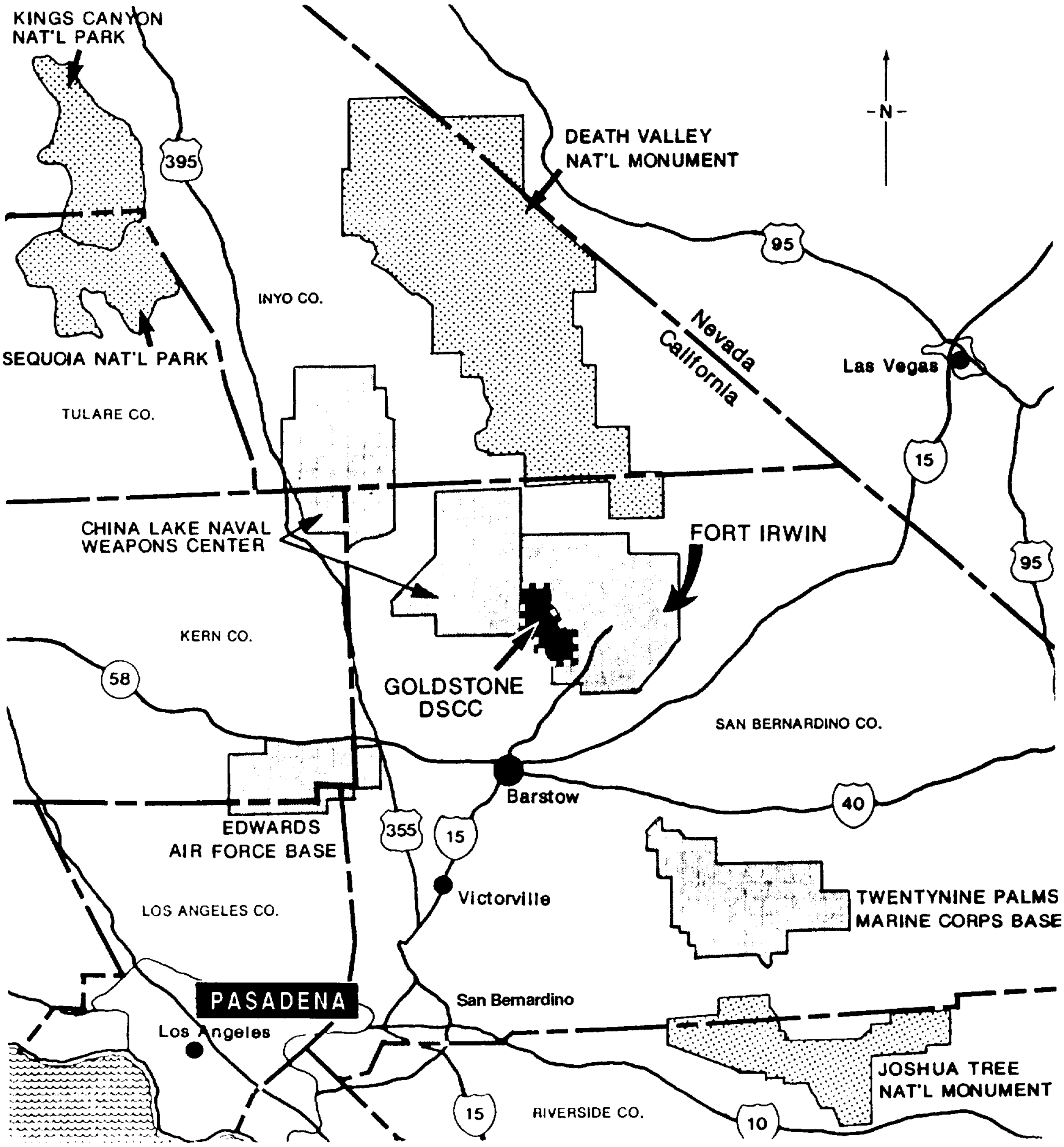

Figure 2. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

Goldstone also is a research and development center to extend the communication range and to increase the data acquisition capabilities of the DSN. It serves as a proving ground for new operational techniques. Prototypes of all new equipment are thoroughly tested at Goldstone before they are duplicated for installation at overseas stations (see Section II, C below).

C. FACILITIES AT THE GDSCC

The GDSCC is a self-sufficient, working community with its own roads, airstrip, cafeteria, electrical power, and telephone systems and is equipped to conduct all necessary maintenance, repairs, and domestic support services. Facilities at the GDSCC include about 100 buildings and structures that were constructed during a 30-year period from the 1950s through the 1980s. The construction of additional buildings and structures continues today as the GDSCC increases its activities and operations.

Goldstone is one of three Deep Space Communications Complexes (DSCCs) operated by NASA that are located on three continents: at Goldstone in Southern California's Mojave Desert; in Spain, about 60 kilometers (37 miles) west of Madrid at Robledo de Chavela; and near the Tidbinbilla Nature Reserve, in Australia, about 40 kilometers (25 miles) southwest of Canberra. Because these three DSCCs are approximately 120 degrees apart in longitude, a spacecraft always is in view of one of the DSCCs as the Earth rotates on its axis (Figure 3).

Activities at the GDSCC operate in support of six parabolic dish antennas, at five sites called Deep Space Stations (DSSs): Four sites are operational, while one is devoted to research and development (R&D) activities. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the NASA DSN consists of a worldwide network of 12 operational DSSs. In addition, a seventh parabolic dish antenna at the Venus Site now is unused, while an eighth parabolic dish antenna at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA).

A Network Operations Control Center (NOCC), located at JPL in Pasadena, controls and monitors the DSN. A Ground Communications Facility (GCF) of the DSN operates to link together the NOCC at JPL with the three DSCCs at Goldstone, Spain, and Australia.

Total NASA/JPL facilities at the GDSCC (see Figure 1) include the six DSN parabolic dish antennas, an airport, a microwave test facility, miscellaneous support buildings, and a remote support facility in Barstow located about 40 miles south of the GDSCC. The GDSCC support staff consists of about 260 personnel on site and at the Barstow facility. Table 1 summarizes the major facilities, buildings (number and square footage), and antennas (construction date and size). Three sites within the GDSCC have antennas (referred to as stations) devoted to NASA operations (Echo Station, Mars Station, Uranus Station, and Apollo Station [two antennas]). Two other sites have antennas devoted to research and development: Venus, operated by the GDSCC, and Mojave, operated by the National Oceanic and Atmospheric Administration.

A 26-meter (85 ft) antenna, located at the Pioneer Site, was deactivated in 1981. In 1985, the Pioneer antenna (DSS-11) was designated a National Historic Landmark by the U.S. Department of Interior and the Pioneer Site was returned to the U.S. Army. Each of the Goldstone sites is briefly described below.

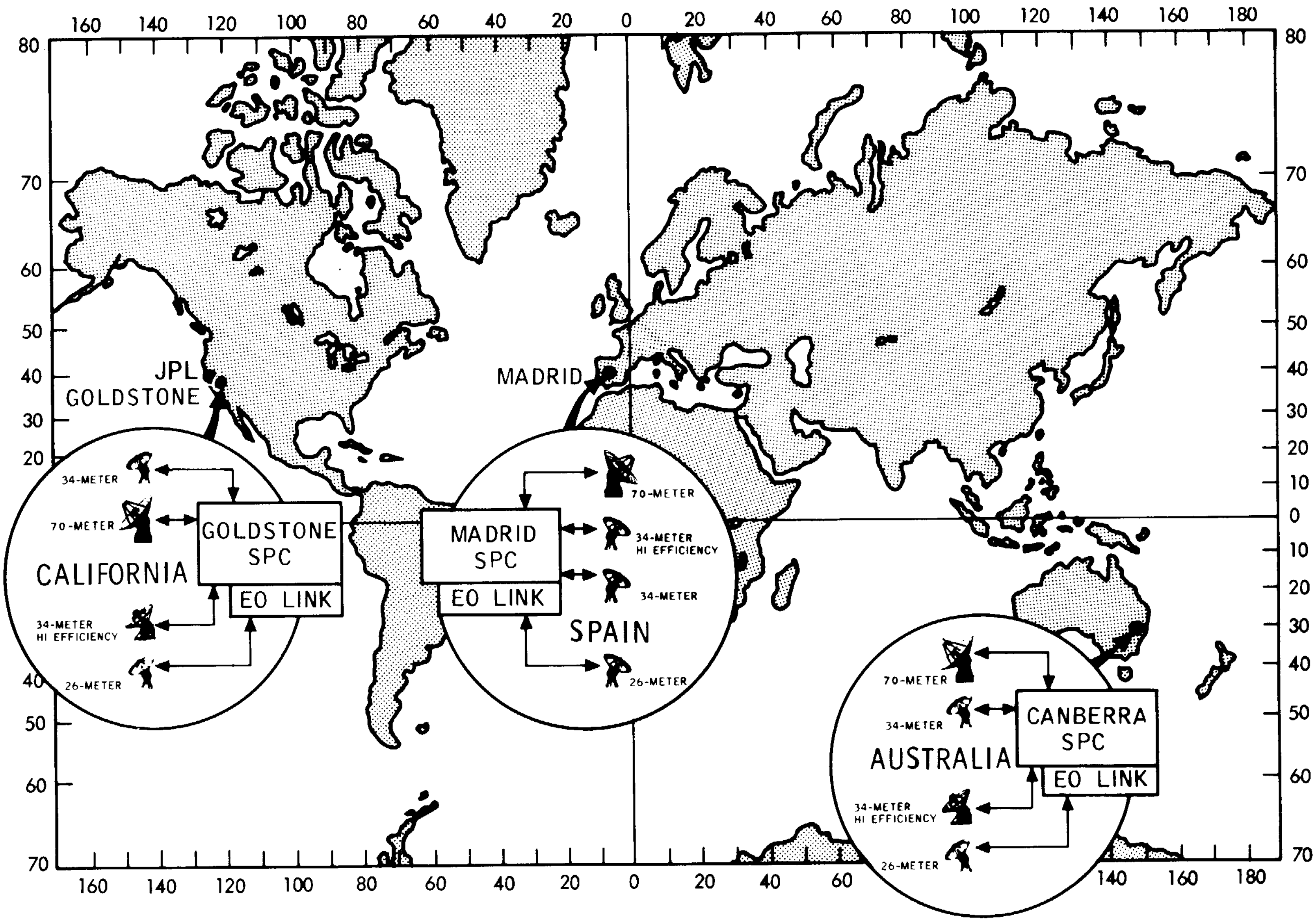

Figure 3. The Three-Continent NASA Deep Space Network as It Exists in 1990

Table 1. Major Facilities at the GDSCC

Site	Station Number	Buildings: Number	Buildings: (ft^2)	Antennas: Date of Construction	Antennas: Size (Meters)
Echo Site	DSS-12	24	86,662	1961[a]	34[b]
Venus Site	DSS-13 (present antenna)	12	12,502	1962[c]	26 9
	DSS-13 (now under construction)				34
Mars Site	DSS-14 DSS-15	11	36,834	1966 1984	70[d] 34
Apollo Site	DSS-16 DSS-17 DSS-18 (proposed)	23	43,985	1965[e]	26 9 34
Mojave Site		5	11,850	1964	12[f]
Airport[g]		2	710	1963/1970	--
Microwave Test Facility	MTF	1	2,880	1963	--
Miscellaneous	--	3	1,430	--	--
Barstow Facility[h]		1	28,343	--	--

[a]Original antenna, built in 1959, was moved to Venus Site in 1962. A 26-meter antenna, built in 1961, was extended to 34 meters in 1978.

[b]This antenna is to be dismantled and removed after the DSS-18 antenna at the Apollo Site becomes operational in 1993.

[c]Antenna was constructed at Echo Site in 1959 and moved to the Venus Site in 1962.

[d]Originally constructed as a 64-meter antenna in 1966. Enlarged to a 70-meter antenna in 1988.

[e]Antenna originally was constructed for the NASA Goddard Space Tracking and Data Network. JPL/GDSCC/DSN operation of the antenna began in October 1984.

[f]This antenna is operated by the National Oceanic and Atmospheric Administration (NOAA).

[g]The airport is located at the Goldstone Dry Lake.

[h]This site, a leased facility, is located in Barstow, California about 40 miles southwest of the GDSCC.

Source: Directory of Goldstone DSCC Buildings and Supporting Facilities (Gold Book, Document 890-165, JPL internal document), Jet Propulsion Laboratory and National Aeronautics and Space Administration, Revised Edition, October 1989.

D. ANTENNA STATIONS AT THE GDSCC

1. Echo Site (DSS-12)

The Echo Site, as the administration center and operations headquarters of the GDSCC, is the most extensively developed site on the complex. It has one 34-meter (111.5 ft) antenna and 24 support buildings having a combined area of 86,622 ft^2. Support buildings include administration and engineering offices, cafeteria, dormitory, transportation and maintenance facilities, storage areas, and warehouses. Echo Station originally was built in 1959 as a 26-meter (85 ft) antenna. The antenna was first used in 1960 in support of the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the reflective Mylar surface of a passive balloon-type satellite. In 1962, this original 26-meter antenna was moved to the Venus Site. In anticipation of this move, a newer 26-meter antenna had been built at the Echo Site in 1961. In 1978, this antenna was enlarged to 34 meters (111.5 ft). The present antenna is approximately 35 meters (113 ft) high and weighs about 270,000 kilograms (300 tons). It is to be replaced by the new DSS-18 34-meter antenna proposed to be constructed at the Apollo Site.

2. Venus Site (DSS-13)

The Venus Site consists of two antennas: a 26-meter (85 ft) antenna, and a 9-meter (29.5 ft) antenna. The smaller antenna is no longer used. There are 11 buildings having a combined area of 12,502 ft^2. The support buildings provide space for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The 26-meter antenna, which was originally located at Echo Site, was moved to the Venus Site in 1962. The antenna was used for a radar astronomy study of the planet Venus. Currently, its primary function is research and development and performance and reliability testing of high-power radio-frequency transmitters and new systems and equipment prior to their introduction into the Deep Space Network.

A new 34-meter (111.5 ft) antenna is now under construction to replace the 26-meter antenna. The new DSS-13 antenna is planned to begin research and development activities in 1991. An Environmental Assessment concerning this new antenna is the subject of JPL Publication 87-4, Volume 6, Environmental Assessment: New 34-Meter Antenna at Venus Site (June 15, 1988).

3. Mars Site (DSS-14 and DSS-15)

The Mars Site consists of two antennas and 13 buildings with a combined area of 36,834 ft^2. The support buildings provide facilities for operations control, offices, training, mechanical equipment, storage, and security. In May 1989, M.B. Gilbert Associates (MBGA), Long Beach, California, submitted to JPL an Environmental Assessment concerning the construction work needed for a proposed addition to the Operations Building (Bldg. G-86) at the Mars Site. This environmental assessment will be the subject of a future JPL report in this continuing series of reports dealing with Environmental Projects at the GDSCC.

The Mars Station Antenna (DSS-14), at 70 meters (230 ft) in diameter, is one of the larger antennas of its kind in the world (see Front Cover). The antenna, which was constructed as a 64-meter antenna in 1966 and enlarged to 70 meters in 1988, is 7.25 times more powerful and sensitive than a 26-meter antenna, extending the range of deep space communications by 2.7 times. It can maintain communications with spacecraft to the edge of the solar system. Standing more than 235 ft high, this antenna is one of the more striking features to be seen in the GDSCC geographic area. The 70-meter antenna was used in August 1989 for the Voyager 2 spacecraft's encounter with the planet Neptune, which is located at a distance from Earth of 4.5 billion kilometers (2.8 billion miles).

The Uranus Station Antenna (DSS-15) is a 34-meter, high efficiency (HEF), precision-shaped antenna, located approximately 1,600 ft southeast of the Mars Station Antenna. Built in 1984, this latest antenna-addition at the GDSCC first was used in January 1986 to support the encounter of the Voyager 2 spacecraft with the planet Uranus, which is located at a distance of more than 3 billion kilometers (1.8 billion miles) from Earth. The new, proposed 34-meter, precision-shaped antennas, now under construction at the Venus Site (see above) and proposed for the Apollo Site (see below), are similar in size and structure to this Uranus antenna.

4. Apollo Site (DSS-16 and DSS-17)

The Apollo Site has a 26-meter (85-ft) antenna (DSS-16), a 9-meter (29.5 ft) antenna (DSS-17), and 18 buildings with a combined total site-area of 43,985 ft^2. The buildings provide space for operations, equipment, storage, and warehousing. The 26-meter antenna originally was constructed in 1965 by NASA's Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of this antenna under JPL management began in October 1984. Both the 26-meter and the 9-meter antennas now are used to support the missions of the Space Shuttle (STS) and satellites in both low- and high-Earth orbits. In May 1989, M.B. Gilbert Associates, Long Beach, California, submitted to JPL an Environmental Assessment concerning the construction work needed for a proposed new 34-meter (111.5 ft) antenna (DSS-18) at the Apollo Site. This environmental assessment, concerning the new DSS-18 34-meter precision-shaped antenna at the Apollo Site, is the subject of this expanded JPL report in a continuing series of reports concerning Environmental Projects at the GDSCC.

5. Mojave Base Site (NOAA Antenna)

The Mojave Base Site has one antenna and five buildings with a combined area of 11,850 ft^2. At one time, these buildings provided support facilities for operations, equipment, and maintenance. Except for the NOAA operations buildings, however, these buildings now are not in use.

The Mojave Base Site Antenna is a 12-meter (40 ft) antenna operated by the National Oceanic and Atmospheric Administration (NOAA). The antenna is involved in several programs including monitoring of shifts in the Earth's tectonic plates, monitoring weather changes, and retrieving information from very low-orbiting Earth satellites.

E. SUPPORT FACILITIES AT THE GDSCC

1. Goldstone Dry Lake Airport

The airport consists of an approximately 6,000 ft by 100 ft paved runway. There are two buildings at the airport site, neither of which is presently in use. An open hangar is used to provide shelter for a single aircraft. For its personnel, NASA operates three scheduled shuttle flights per week to the GDSCC that originate from the Burbank-Glendale-Pasadena Airport. In addition, the Goldstone airport is used infrequently by administrative Army flights. Both NASA and the U.S. Army use propeller-driven aircraft.

2. Microwave Test Facility and Fire-Training Area

The Microwave Test Facility (MTF) and Fire-Training Area consists of a single building of 2,880 ft^2 along with areas identified for fire fighting. The MTF is used for research and development testing of antenna microwave equipment. Fire training includes procedures for the quenching of fires.

3. Miscellaneous Buildings in the GDSCC Area

Three buildings and structures at the GDSCC that fall into this category include the main gatehouse, pump house, and radio spectrum monitor. Total area of these three buildings/structures is 1,430 ft^2.

4. Off-Site Facility at Barstow, California

In addition to the above-mentioned on-site facilities, the GDSCC leases an office and warehouse support facility in the nearby city of Barstow. The facility is a single-story, 28,343-ft^2 structure located at 850 Main Street.

F. NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC

1. Transportation Network

The major roadways in the area are shown in Figure 4. The only surface public transportation route to the GDSCC is by the Fort Irwin Road that leads to Fort Irwin. The NASA Road cutoff from Fort Irwin Road leads into the GDSCC. NASA Road merges with Goldstone Road, which is the only north-south paved access road within the complex. Both NASA and Goldstone Roads are paved two-lane roads and are maintained by the Ft. Irwin Post Engineer. Two-lane paved access roads also lead to each of the sites and major facilities.

2. Utilities and Services

The Southern California Edison Company provides electricity for the Goldstone Complex. The GDSCC provides its own backup diesel-engine generators for operations during emergencies and to ensure continuity of electrical service

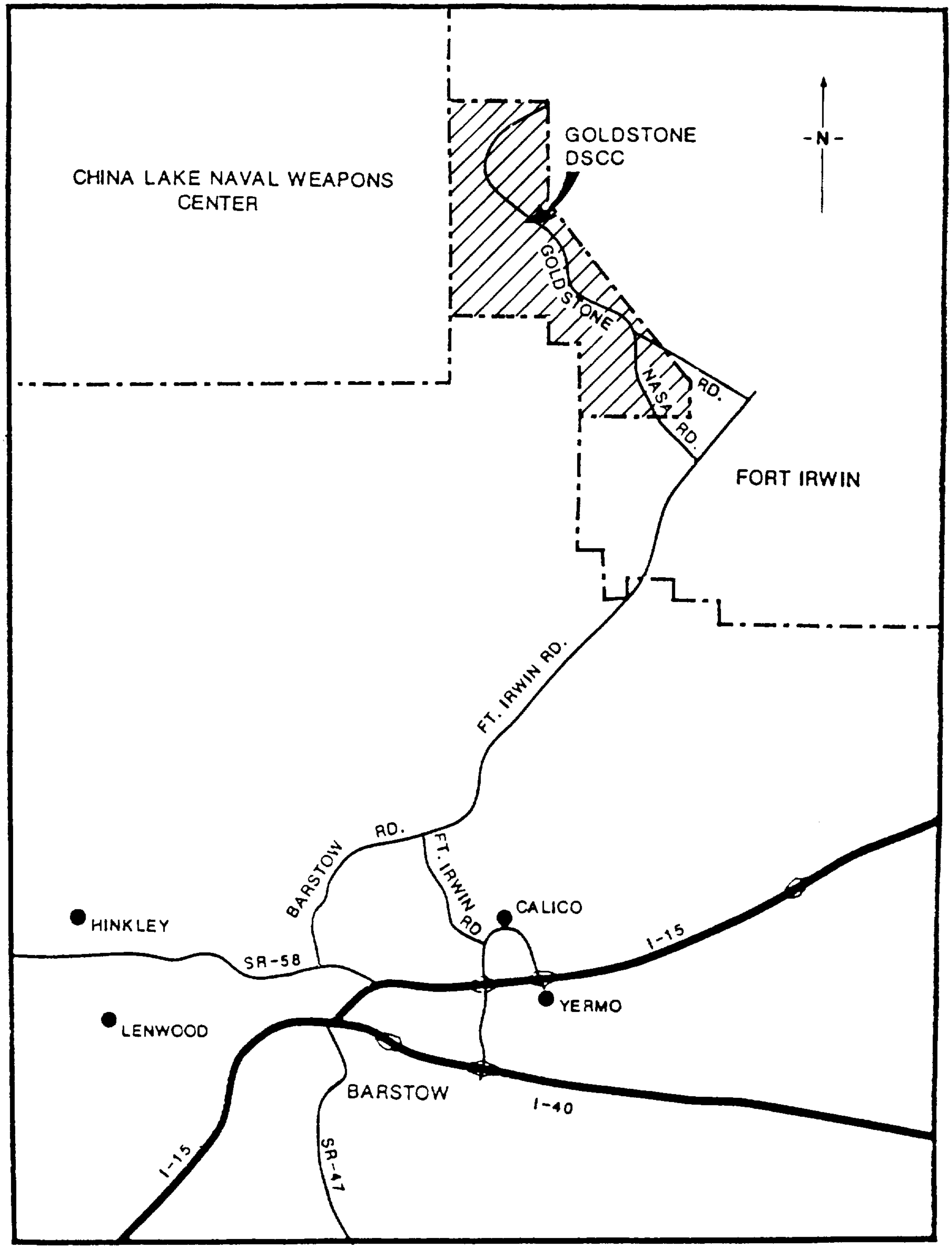

Figure 4. Major Roads Leading to and at the Goldstone DSCC

for prescheduled periods of time. Gasoline, diesel oil, and hydraulic oil are stored in double-walled underground storage tanks fitted with sensors between the walls to detect leaks. Water is supplied by Fort Irwin from groundwater basin wells. Sanitary sewage is discharged through septic tank systems to leaching fields. The Echo and Mars Sites discharge wastewater to evaporation ponds (see Environmental Projects: Volume 8, Modifications of Wastewater Evaporation Ponds, JPL Publication 87-4, October 15, 1989).

G. SOLID-WASTE MANAGEMENT FACILITIES AT THE GDSCC

At the Echo Site, the GDSCC operates its own 10-acre, Class III solid-waste landfill. This facility accepts only non-hazardous, solid wastes.

Most of a small quantity of hazardous waste, generated at the GDSCC each year, is sent to off-site commercial facilities for reclamation and eventual reuse. The remainder is transported to off-site commercial treatment or disposal facilities within 90 days of generation. The GDSCC now has two, new, properly managed storage facilities for hazardous materials and wastes, one at Echo Site and the other at Venus Site, but operates no facilities requiring a hazardous waste permit. Details concerning the construction of these two new storage facilities for hazardous materials and wastes at the Echo and Venus Sites are described in Environmental Projects: Volume 9, Construction of Hazardous Materials Storage Facilities, JPL Publication 87-4, November 15, 1989. Two more storage facilities for hazardous materials and wastes, one at Mars Site and the other at Apollo Site, are to be completed early in 1990. In accordance with its environmental management program, the GDSCC conducts all of its waste-management operations in strict compliance with environmental regulations, in a manner consistent with protection of human health and the environment.

H. WASTEWATER MANAGEMENT FACILITIES AT THE GDSCC

Four functioning sewage evaporation ponds - one pair at the Echo Site and another pair at the Mars Site - are designed to receive effluent from upstream septic tank systems. Extensive work was completed in the spring of 1989 to repair and reshape the previously eroded embankments of the wastewater evaporation ponds. Details of this construction work are recorded in Environmental Projects: Volume 8, Modifications of Wastewater Evaporation Ponds, JPL Publication 87-4, October 15, 1989.

I. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is located within the Fort Irwin property, the two installations potentially can affect each other's roles and missions. Fort Irwin is a U.S. Army installation serving as the U.S. Army National Training Center (NTC). The remote desert environment allows military task forces to practice large-scale training maneuvers that could affect natural, historic, and cultural resources at the GDSCC. This especially is true when the maneuvers involve the movement of heavy equipment (tanks, large trucks) within the GDSCC. Most maneuvers occur at the eastern border of the GDSCC and every effort is made by both the GDSCC and Ft. Irwin personnel to avoid the use of sensitive areas for such maneuvers.

J. NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC

1. Geology

The GDSCC is located in the North Central section of the Mojave Desert Province. Typically, the Mojave Desert Province consists of broad, flat plains separated by low mountains (1,000 to 2,000 ft of topographic relief). The GDSCC is situated within one of these low mountain areas.

The GDSCC is located in a naturally-occurring bowl-shaped depression bounded on three sides by geological faults. The Garlock Fault lies to the north, while the Blackwater and Calico Faults lie, respectively, to the west and south. The GDSCC is bounded on the east by the Tiefort Mountains. Each antenna site at the GDSCC is located on natural alluvial material, ranging in thickness from 15 feet at the Venus Site to more than 70 feet at the Echo Site. The alluvium is derived from the surrounding hills.

2. Hydrology

Groundwater in the Goldstone area is generally confined and is found at depths ranging from 170 ft near the Minitrack Site to approximately 1,000 ft below the Echo Site. Chemical analyses of the groundwater have yielded total dissolved solids (TDS) values in excess of 1,000 ppm indicating the groundwater is brackish. The Goldstone Complex currently obtains potable water from a group of wells located at Fort Irwin, approximately ten miles to the southeast.

3. Climatic Conditions

The GDSCC lies within the U.S. Naval Weather Service's Southwest Desert, Climatic Area A. Mean annual temperatures for the area range from 50° to 80°F. Temperatures can climb as high as 114°F during the summer months, and drop as low as 11°F during the winter months. Mean annual precipitation for the area is approximately 2.5 inches with most precipitation falling between November and February.

SECTION III

PURPOSE OF AND NEED FOR CONSTRUCTION OF A NEW DSS-18 34-METER ANTENNA AT THE APOLLO SITE OF THE GDSCC

The Jet Propulsion Laboratory (JPL), in conjunction with the National Aeronautics and Space Administration (NASA), proposes to construct a new, precision-shaped, 34-meter, beam waveguide antenna at the Apollo Site, Goldstone Deep Space Communications Complex (GDSCC), Goldstone, California. See Figures 1 and 2 for vicinity and regional maps. The new antenna is to be known as DSS-18.

A. PURPOSE OF THE CONSTRUCTION OF THE NEW DSS-18 34-METER ANTENNA

The GDSCC is the largest of three DSN complexes located on three continents. As part of the NASA Deep Space Network, these three complexes represent one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The major purpose of expanding deep space communications technology is to support the tracking of manned and unmanned spacecraft missions and to provide means for radio and radar astronomy to explore the solar system and universe. During the last 27 years of operation of the GDSCC, the DSN has supported numerous spacecraft missions including Explorer, Ranger, Mariner, Surveyor, Pioneer, Viking, Helios and Voyager.

The purpose of the construction of the new DSS-18 antenna is not only to replace the aging, metal-fatigued DSS-12 antenna, but also to further develop deep space communications knowledge by constructing an antenna that will increase scientific data returns, improve antenna microwave optics, improve performance of transmitting and receiving capability, and improve antenna pointing, spacecraft tracking, and spacecraft navigation. The proposed new DSS-18 antenna will improve the efficiency, performance and availability of existing DSN equipment and allow for the execution of space-exploration projects not currently possible using existing technology. See Section IA of this report for further details.

B. NEED FOR THE CONSTRUCTION OF THE NEW DSS-18 34-METER ANTENNA

There now are six DSN antenna stations at the GDSCC. An additional (12-meter, 40 ft) antenna is operated by NOAA. The DSN antennas were built between 1961 and the present, with three built before 1965. As a result, the old antennas not only have structural and mechanical problems due to aging, but also operate with technology that is relatively outdated. To adequately meet the technological challenges of the 21st century in space exploration, upgrades of the DSN are required. The new proposed DSS-18 antenna, to be constructed at the Apollo Site, is to replace the existing 34-meter antenna at the Echo Site. The latter is an aging antenna suffering from metal fatigue, mechanical, and structural problems. It was constructed in 1961, 29 years ago. Several technological advances have occurred recently that make possible the proposed new Apollo antenna with resultant improvements in deep space communications capabilities.

SECTION IV

CONSTRUCTION OF THE PROPOSED NEW ANTENNA AT THE APOLLO SITE AND CONSIDERATIONS OF ALTERNATIVE ACTIONS

A. DESCRIPTION OF THE PROPOSED CONSTRUCTION

The proposed Apollo Site antenna is located in the central section of the GDSCC within the Fort Irwin National Training Center in San Bernardino County, California (Figure 1). The GDSCC is approximately 40 miles north of Barstow, California in the Mojave Desert. The complex covers 52 square miles and consists primarily of hilly topography with a desert scrub habitat. Access to the proposed antenna site is via Goddard Road and Covington Road.

The proposed DSS-18 34-meter antenna will be located at the Apollo Site and will replace an existing 34-meter antenna that was built at the Echo Site in 1961.

The existing Apollo Site facilities comprise 16 buildings, along with the DSS-16 26-meter antenna and the DSS-17 9-meter antenna. The on-site existing structures provide for operations control, administration, fire fighting, storage, power generation, and equipment maintenance and repair. The existing DSS-16 26-meter antenna was originally constructed in 1965 to support the manned Apollo missions to the moon. Currently, its primary function is to support the missions of the Space Shuttle (STS) and satellites in both low- and high-Earth orbits. See Figure 5 for the existing Apollo Site plan and Figures 6 and 7 for respective photographs of the presently existing DSS-16 26-meter and DSS-17 9-meter antennas and surrounding support structures.

The Apollo Site is located on ground that slopes to the west at an approximate 2 percent decline. The existing Apollo DSS-16 and DSS-17 antennas are located in the central portion of the Apollo Site and are supported by offices, workshops and other facilities. The existing DSS-16 26-meter antenna is on a concrete foundation adjacent to the operations and administration buildings, the DSS-17 9-meter antenna, and associated electrical and storage facilities. The existing building uses at the Apollo Site and their associated areas (in square feet) are provided in Table 2. There are presently 42 employees supporting the existing Apollo Site antennas and facilities.

Electrical power for existing site operations is provided by the Southern California Edison Company. The GDSCC on-site generators will provide back-up power. Archeological approval has been obtained for running a new underground power line between the Echo Site and the Apollo Site to support DSS-18 (Appendix C).

The proposed Apollo Site DSS-18 antenna is a high-performance, 34-meter, wheel-and-track type, azimuth-elevation beam-waveguide antenna to be located approximately 700 feet south-southwest of the existing DSS-16 26-meter antenna. The proposed project includes construction and installation of the antenna structure, a below-grade foundation and equipment enclosure, the mechanical drive and controls, and the optical elements. The proposed Apollo Site DSS-18 antenna will be similar in size and structure to both the DSS-15 34-meter Uranus antenna located in the northern portion of the GDSCC, and the DSS-13 34-meter Venus antenna now being constructed at the Venus Site in the southern portion of the GDSCC (see Figure 1).

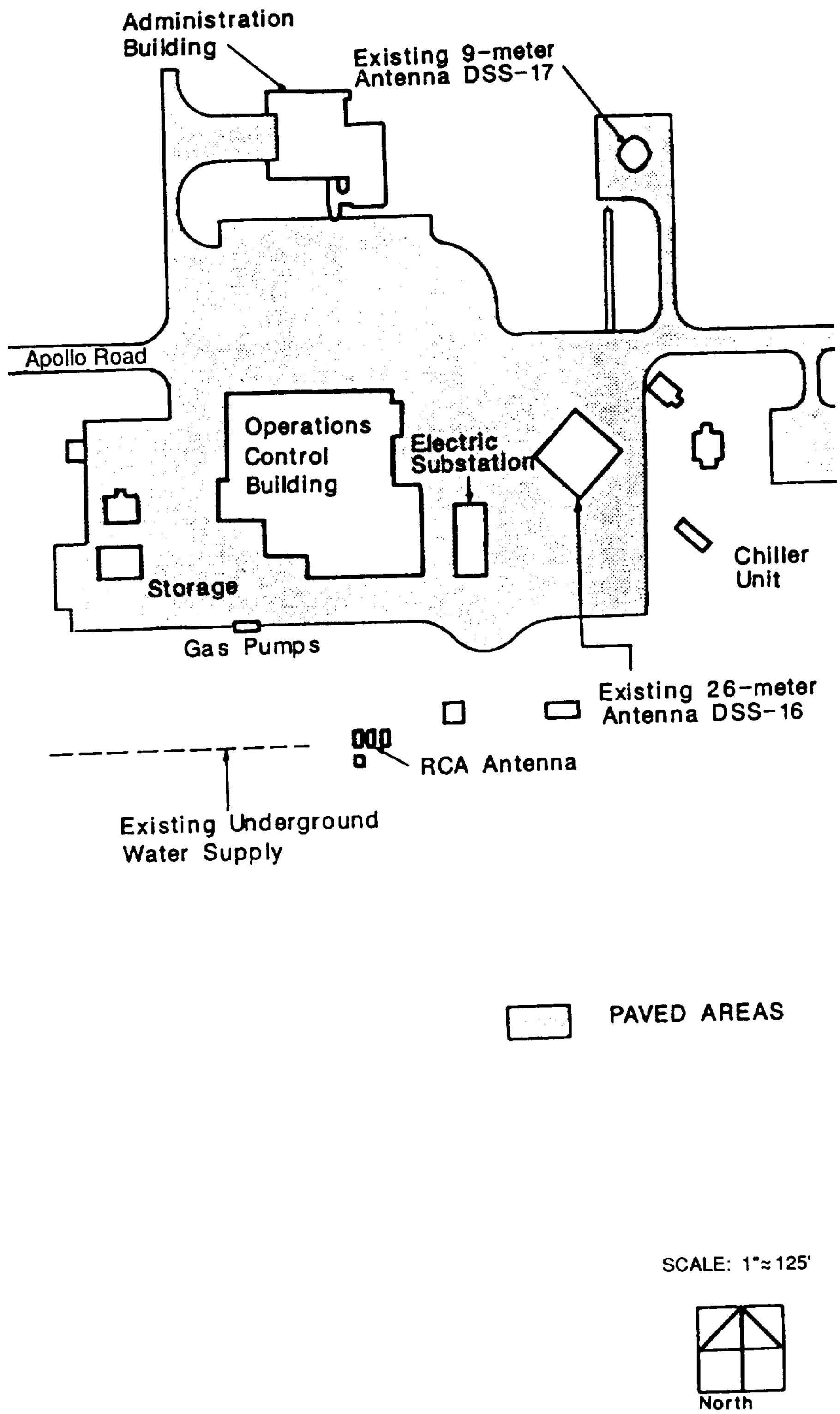

Figure 5. Apollo Site: Existing Site Plan

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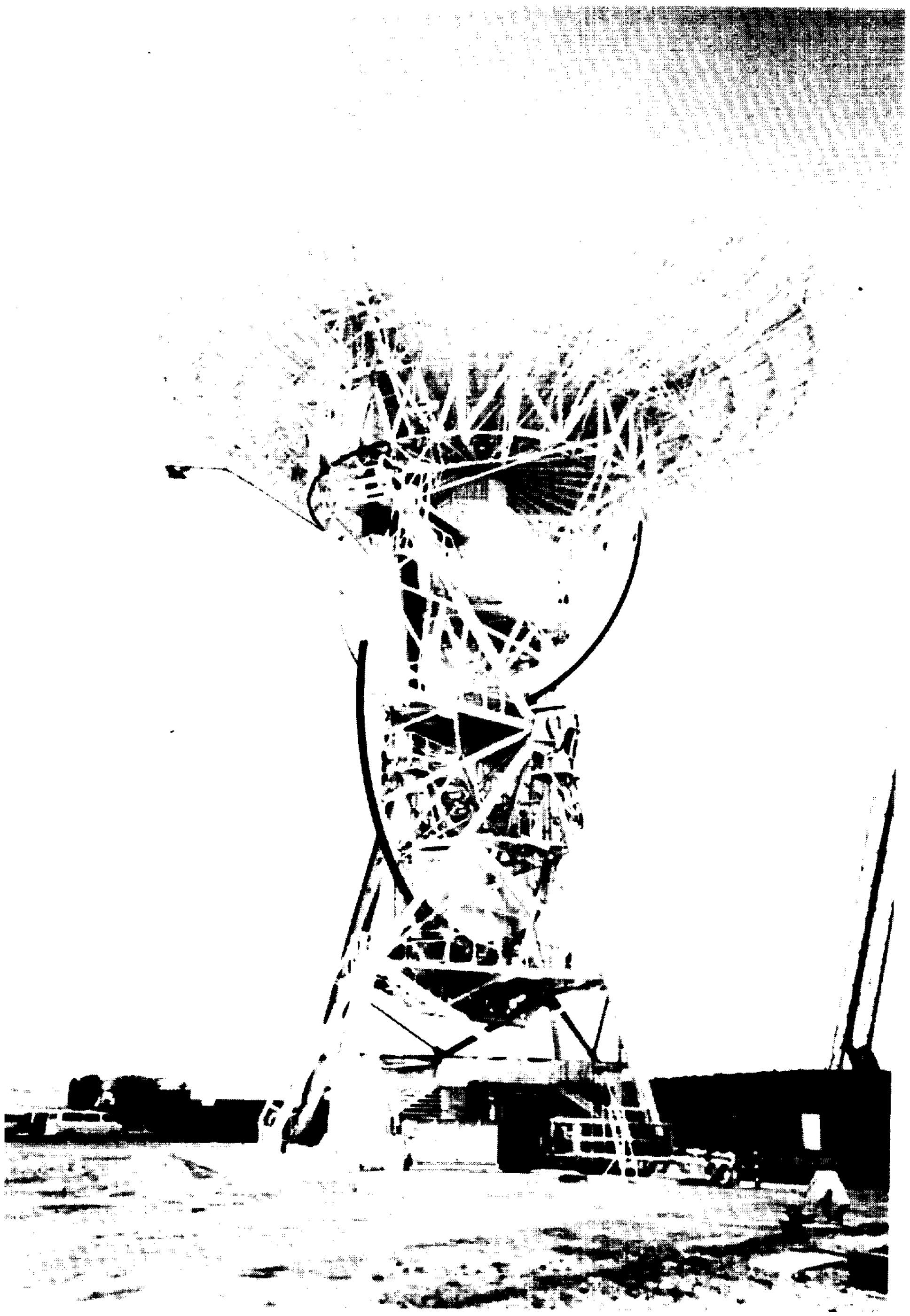

Figure 6. Apollo Site: Existing 26-Meter Antenna

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Figure 7. Apollo Site: Existing 9-Meter Antenna

Table 2. Existing Structures at the Apollo Site at the GDSCC

Building Number	Description of Structure	Square Feet
A-1	Operations	17,409
A-2	Cafeteria and Administration	6,134
A-3	Hydromechanical Building	576
A-4	Collimation Tower for 26-meter antenna	242
A-5	Hydro-repair Building	473
A-6	Microwave	660
A-7	Equipment House for 9-meter antenna	---
A-8	Collimation Tower for 9-meter antenna	128
A-12	Fire Pump House	754
A-14	Logistics storage	400
A-85	26-meter Antenna (85 feet)	---
A-87	9-meter Antenna (29.5 feet)	360
M-1	Minitrack	3,226
M-2	Warehouse	1,536
M-3	Utility Building	440
M-4	Camera Shelter	247
M-6	Telemetry	4,729
M-7	Transmitter	166
M-9	Generator	5,911
M-10	Flammable Storage	200
M-17	Fire Pump House	754

Source: Directory of Goldstone Buildings and Facilities. (Gold Book, Document Number 890-165, JPL internal document, Revised Edition October 1989).

The new high-performance DSS-18 34-meter antenna will have a beam waveguide configuration that will allow for multiple frequency use and future frequency additions. This antenna will have the capability for multiple frequency reception and transmission within one antenna beam, and for more precise tracking, navigation and control. Technical descriptions of the proposed Apollo Site DSS-18 antenna are similar to those of the Venus DSS-13 34-meter antenna now under construction at the Venus site and are described in Advanced Engineering Study Report for Design and Construction of a Beam Waveguide 34-meter X-Band AZ-EL Antenna (TIW Systems, Inc., 1986) (see Figure 8).

The proposed Apollo Site 34-meter DSS-18 antenna (Figure 9) will require the transfer of employees from the Echo Site to the Apollo Site. No net increase in employees is foreseen at this time. Approximately 400 ft of roadway will be constructed to provide access to the proposed antenna, along with 400 ft of underground water supply pipeline and 500 ft of power cables in a 4-inch rigid conduit. Approximately 400 ft of aboveground cable tray and 125 ft of cable trench will be installed to provide for communications between the antenna and front-end computer facilities. No ancillary support buildings are anticipated to be constructed in conjunction with this proposed project.

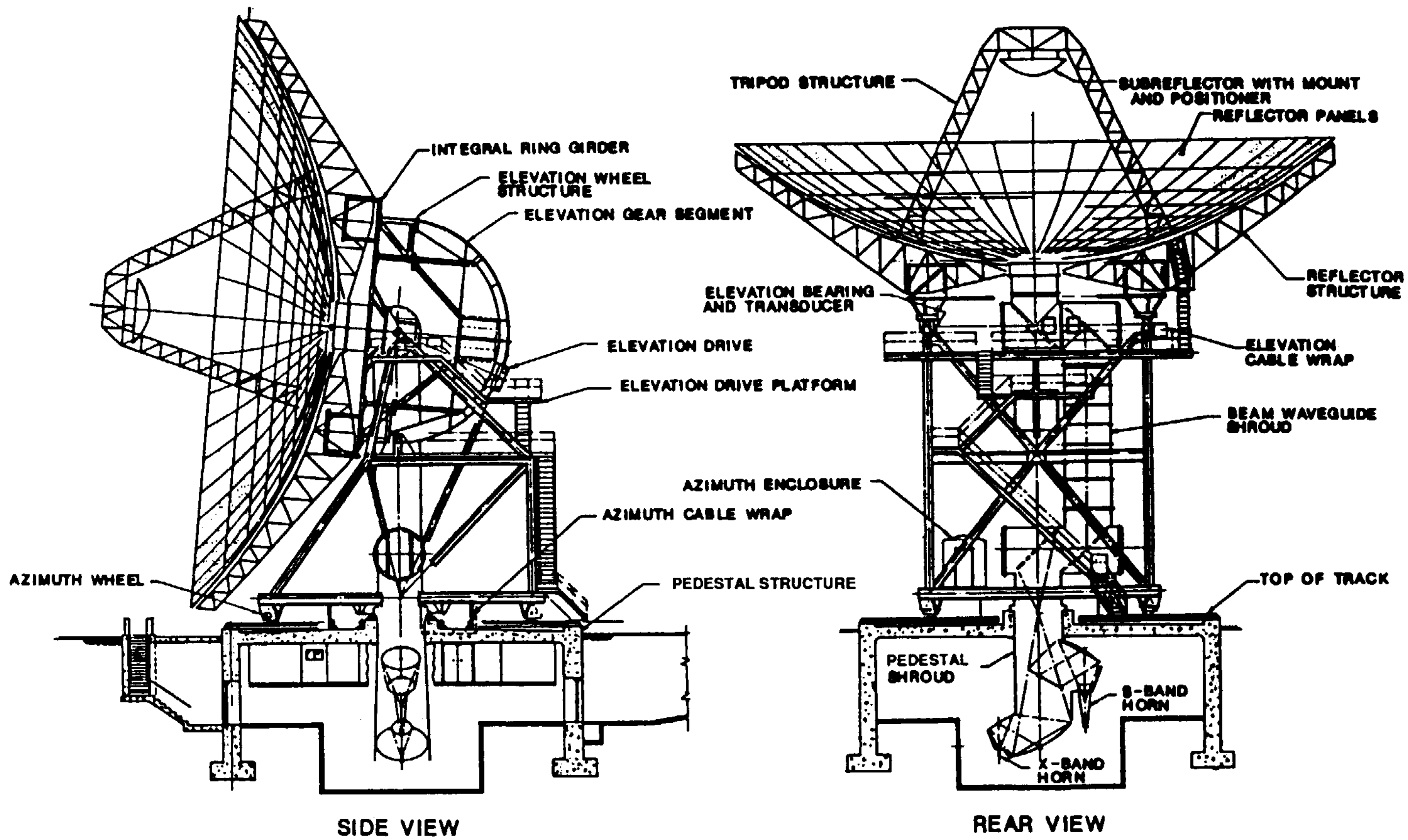


Figure 8. Artist's Drawing of the New 34-Meter Antenna Under Construction at the Venus Site. This Antenna Is Similar to the Antenna Proposed for the Apollo Site

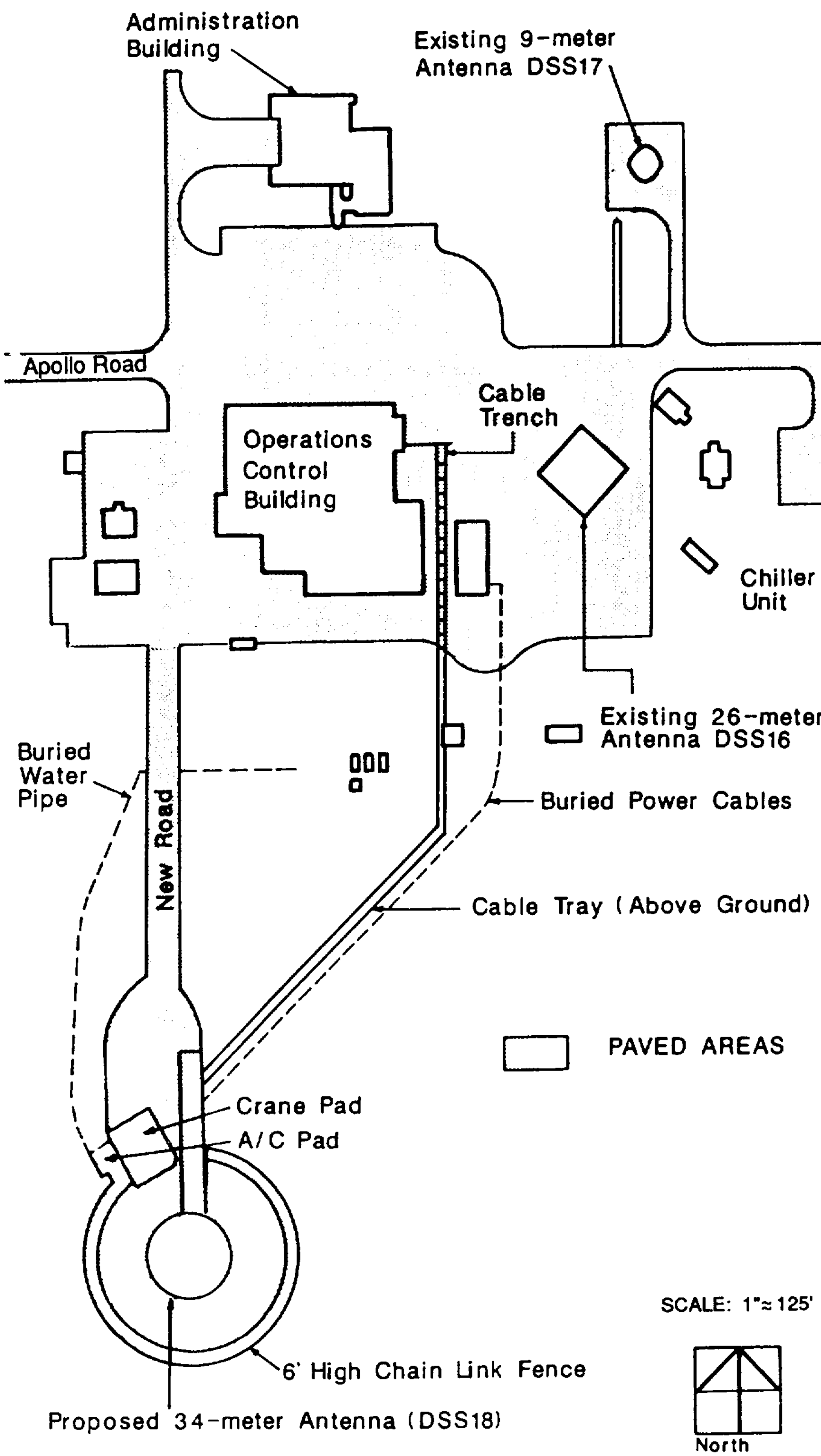


Figure 9. Apollo Site: Site Plan for Proposed New 34-Meter Antenna

B. ALTERNATIVES TO CONSTRUCTION OF THE NEW 34-METER ANTENNA AT THE APOLLO SITE AT THE GDSCC

A number of alternatives to the proposed Apollo Site DSS-18 34-meter antenna were considered as part of the environmental assessment. These included the alternative of nonconstruction of the proposed antenna, along with the alternatives of construction of the proposed antenna at other locations inside and outside the GDSCC. The environmental advantages and disadvantages of these alternatives are described in more detail in the following paragraphs.

1. Alternative One: Non-Construction of the 34-Meter Antenna

Discussion of the alternative involving not constructing the new antenna is required under the National Environmental Policy Act (NEPA). No action would mean the GDSCC would remain as it presently exists, with the five operational NASA/JPL antenna stations and the existing National Oceanic and Atmospheric Administration antenna. The existing 34-meter Echo DSS-12 antenna would remain and would not be replaced. This would preclude the opportunity to greatly improve upon deep space communications capabilities.

With respect to environmental considerations, the No-Action alternative would not require physical alteration to the Apollo Site. Thus, removal of animal and plant habitats and construction-related effects associated with the proposed action would not occur. Yet, in spite of the minimal impact of these construction-related issues, their avoidance by the No-Action alternative does not present a substantial, if any, environmental advantage.

The No-Action alternative would not eliminate the concern regarding antenna operating constraints, since the proposed antenna is replacing an existing antenna which also operates under constraints. While operating conditions would be different for the existing and proposed antennas, there are standard safety practices in place to minimize radiation hazards. Thus the No-Action alternative would not provide a substantial, if any, environmental advantage.

The primary disadvantage of the No-Action alternative is the loss of opportunity to greatly improve NASA deep-space communications capability worldwide and provide a means to advance specific scientific knowledge to a level not possible with the existing technology.

2. Alternative Two: Relocation of the 34-Meter Antenna Within the Apollo Site

One potential alternative to the proposed project would be to locate the new 34-meter antenna several hundred feet north or northeast of the existing DSS-16 antenna instead of 700 feet to the south-southwest as proposed. This is not feasible, however, because the proposed site is the only potentially viable alternative at the Apollo Site due to the topographic constraints. The operational constraints at the alternative location would be essentially the same as for the proposed antenna location.

With respect to environmental considerations, the move of the proposed antenna to a different location within the Apollo Site would not result in benefits to the environment. The topography, geology, biology, and visual setting of other areas within the Apollo Site would be similar to the proposed location. Therefore, environmental impact issues associated with the antenna's operation would be similar, regardless of its location within the Apollo Site.

The primary disadvantage of relocating the proposed antenna to another location within the Apollo Site is radar frequency interference (RFI). JPL studies indicate the proposed location, 700 ft south-southwest of the existing 26-meter antenna, would result in the minimum amount of RFI between the proposed 34-meter antenna and other DSN antennas at the GDSCC.

3. Alternative Three: Relocation of the 34-Meter Antenna Within the GDSCC but at a Site Other than the Apollo Site

Locating the proposed 34-meter antenna at a GDSCC site other than the Apollo Site is a potential alternative. The most likely candidate would be the Echo Site, where it would replace the existing DSS-12 34-meter antenna. Other existing sites were considered but were found to be unsuitable based on operational constraints, such as the presence of more powerful antennas, unsuitable topography, and radar interference.

Relocation of the proposed Apollo antenna to an undeveloped area would require the reconstruction of all existing support facilities presently on site at Apollo. Congressional approval for a major increase in funding would need to be obtained, resulting in a delay in project construction and operation of several years. Relocating the proposed antenna to an undeveloped site within the GDSCC would pose a significant environmental disadvantage due to the need to construct new support buildings and roadways.

With respect to environmental considerations, the environmental impacts from locating the proposed project at the Apollo Site would be minimal. Thus, there is little to gain by relocating the project at another site within the GDSCC. There are no known sensitive environmental conditions at other GDSCC antenna sites, however, that would preclude relocation of the antenna.

JPL personnel recently completed a study of possible relocation of facilities and resources within the GDSCC as part of a program to consolidate operations and reduce operating costs. Based on considerations of cost-effectiveness and operational constraints, the study concluded that the proposed new 34-meter antenna should be located at either the Apollo or the Echo Site. A recent radar interference study by JPL concluded that the antenna configuration causing the least amount of interference would result from the construction of the proposed antenna at the Apollo Site rather than at the Echo Site.

4. Alternative Four: Relocation of the 34-Meter Antenna at a Site Other than the GDSCC

Locating the proposed antenna outside the GDSCC is a possible alternative to the proposed Apollo Site. Although this alternative would require the relocation of the entire complex, along with the new proposed Apollo antenna, this concept has been considered by NASA/JPL in the past. Likely locations for a new complex similar in size and function to the GDSCC include sites within Arizona and New Mexico. Minimum requirements would include locating a substantial area of undeveloped land within the critical tracking range that is geographically compatible with DSN operations in Spain and Australia.

Relocating the new antenna off-site is not the preferred alternative because of environmental concerns, excessive relocation costs, years of delays in project implementation incurred while seeking the necessary Congressional approval, and time incurred to redevelop a base of operating and maintenance capabilities.

With respect to environmental considerations, the relocation of the antenna project to an off-site location (e.g., Arizona, New Mexico) cannot be characterized sufficiently to provide a detailed environmental review. Moving the project to a distant location, however, likely involves substantial additional construction activity, compared to the action now proposed to build the new 34-meter antenna at the Apollo Site. This additional construction would pose a significant environmental disadvantage.

5. Preferred Alternative: Construction of the 34-Meter Antenna at the Apollo Site

Location of the proposed antenna at Apollo Site is the preferred alternative since it will not result in significant environmental impacts, will result in the shortest implementation schedule, is the most economical of the alternatives, and is anticipated to provide the United States with a much needed improved deep-space communications technology.

SECTION V

ENVIRONMENTAL FACTORS AT THE GDSCC THAT MUST BE ASSESSED IN THE PROPOSED CONSTRUCTION AND OPERATION OF A NEW 34-METER ANTENNA AT THE APOLLO SITE

A. GEOLOGICAL SETTING

The GDSCC is located in the north central section of the Mojave Desert Province, a wedge-shaped, down-faulted block that is bounded by mountain ranges to the north-northwest and south-southwest (Sharp, 1972). The structure and topography of the Province are largely fault controlled (Norris and Webb, 1976). The Mojave Desert is bounded on the south-southwest by the San Andreas Fault. The San Andreas Fault, which is the principal fault of a northwesterly trending shear zone is at least 600 miles in length with 350 miles of right-lateral displacement. The Garlock Fault, at the northern boundary of the Province, trends to the northeast and east and has left-lateral displacement.

Typically, the Mojave Desert Province is characterized by broad, flat plains with occasional low (1,000 to 2,000-ft high) mountains. The Goldstone area, situated within one of these low mountain areas, trends in the northwest-southeast direction (parallel to the regional structural trend). Elevations in the Goldstone area range from 2,895 to 4,491 ft above mean sea level (MSL). The GDSCC lies within a 70-square-mile internal drainage area that includes Goldstone Lake, the largest of several dry lakes in the area. The elevation of Goldstone Lake is 3,021 ft above MSL (Kieffer, 1961).

B. CLIMATIC CONDITIONS

The climate at the GDSCC is arid with characteristic wide ranges in daily and seasonal temperatures, as well as high variability of precipitation. Average annual rainfall is approximately 5.5 in. Recorded annual precipitation ranges from a low of 0.5 to a high of 15 in. Precipitation is typified by short-lived, high-intensity storms that may produce local flash floods. More than one-half of the average annual precipitation has been known to fall in a three day period, during which peak rainfall may be as high as two inches in one hour (Kieffer, 1961).

C. SEISMOLOGY

The Mojave Block is broken by several major vertical to near-vertical shear faults. The primary fault system in the GDSCC area trends northwest, from the southern boundary of the facility to the southern tip of Goldstone Lake. This fault system follows the regional structural trend that is characteristic of that portion of the Mojave Desert Province south of the GDSCC, which roughly parallels the San Andreas Fault zone. The Goldstone area is located in a transition zone between the northwest-trending structural area to the south, and an east-west-trending structural area to the north that roughly parallels the Garlock fault. Minor faults in the Goldstone area trend in nearly all directions, the main directions being west, northwest, and north. The general relationships between the two structural systems enclosing the Goldstone area are not known, but both systems are active, and neither predominates over the other.

The GDSCC, including the Apollo Site, is located within an area that has recently been reclassified from Seismic Zone 3 to Seismic Zone 4 (Uniform Building Code, 1988, International Conference of Building Officials, Earthquake Regulations, Chapter 23). A Seismic Zone 4 is defined as a zone close to major fault zones and is within an area susceptible to damage corresponding to a Modified Mercalli Scale Intensity VIII or greater earthquake. (The Mercalli Scale is an arbitrary scale of earthquake intensity, ranging from I for an earthquake detectable only with instruments, to XII for an earthquake resulting in total destruction.)

Two intersecting faults are located within 0.25 miles of the Apollo Site. An east-west trending fault has been mapped approximately 500 feet south of the operations building at the Apollo Site. A north-south trending fault is truncated by the east-west fault, and the intersection of the faults is approximately 1,000 feet southwest of the operations building at the Apollo Site. The structure of the north-south trending ridge located to the west of the Apollo site appears to have been controlled by faulting along the north-south trending fault (CDMG, 1963).

It appears likely that the Apollo Site could be exposed to seismic shaking during an earthquake event. The potential exists for structural damage to occur at the site from an earthquake. The extent of damage would be a function of soil composition, design of the structures, and their joint response to seismic shaking (Engineering-Science, 1987).

D. LITHOLOGY

Table 3 describes a generalized stratigraphic sequence of the Mojave Desert Province in the Goldstone area, giving maximum thickness of each of the units and a brief lithologic description. It should be noted that this is a generalized sequence and that at any given site some of the units may or may not be present or may or may not be present in the given thickness. The general stratigraphic data in Table 3 were constructed from information obtained from Kieffer (1961).

E. GEOLOGICAL HISTORY OF THE GDSCC AREA

The following is a brief summary of the currently accepted interpretation of the geologic history of the Goldstone area (Kieffer, 1961, and Fife and Brown, 1980):

(1) The Precambrian crystalline basement was formed through the accumulation of extrusive and intrusive igneous units and subsequent sedimentation on an evolving continental crustal plate. During late Precambrian and Paleozoic times, these rocks underwent folding, faulting and metamorphic recrystallization, and were later intruded by granitic (pegmatite) dikes (thin injections of molten rock).

Table 3. Generalized Stratigraphic Sequence in the Goldstone Area (after Kieffer, 1961)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Quaternary (Pleistocene)[a]	Alluvial fan and channel gravels; lag gravels; and lacustrine deposits	300+	Composed of sand, cobbles, and boulders derived from intrusive and extrusive igneous rocks; alluvial fan and lag gravels moderately cemented in a caliche matrix. Lacustrine (playa lake) deposits are primarily silt and clay.
Quaternary (Pleistocene)[a]	Basalt Flow	b	Vesicular olivine basalt; resistant to erosion, caps several ridges, dips gently north; offset by faults only in the southeast part of area.
Quaternary to Tertiary	Conglomeratic Sandstone	b	Overlies andesite southeast of Pink Canyon.
Quaternary to Tertiary	Black Glass Dikes	c	General trend N70E, intruded andesite flows only; assumed they occurred near end of andesite extrusion.
Tertiary	Andesite Flows	1000+	Thick sequence of lava flows; composed of andesite, with porphyritic hornblende and plagioclase; flowed from several volcanic vents; very resistant to erosion.
Tertiary	Andesite Breccia	600+ (with Tuff)	Angular blocks of volcanic rock, set in a matrix of volcanic ash; variably resistant to erosion.
Tertiary	Andesite Tuff	600+ (with Breccia)	Volcanic ash that is welded to loose; some pyroclasts; variable resistance to erosion.

Table 3 (Cont'd). Generalized Stratigraphic Sequence in the Goldstone Area (after Kieffer, 1961)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Cretaceous	Jack Spring Quartz Monzonite	c	Quartz monzonite pluton that extends over 85 square miles; relatively homogeneous; has an orthogonal fracture system and parallel jointing; resistant to erosion.
Paleozoic	Rustic Formation	b	Sedimentary and meta-sedimentary units derived from fine-grained marine sediments; foliated and moderately fractured; containing occasional quartz veins with gold and tungsten.
Paleozoic to Precambrian	Granitic Complex	c	Metamorphic and intrusive crystalline rocks; schists, gneisses, and granites highly fractured, low to moderate resistance to erosion.

[a] Deposition of alluvial and lag gravels and lacustrine deposits is believed to have begun during the Pleistocene Age. The olivine basalt is considered to be Pleistocene Age, but isotope dating to confirm the age of the basalt has not been conducted.

[b] Maximum thickness was not reported in available source literature.

[c] Thickness cannot be determined for this type of rock body.

(2) Sedimentary units of the Rustic Formation were deposited within the Cordilleran geosyncline which had formed at the western boundary of the North American continental plate. The Cordilleran geosyncline was a complex of marginal and shallow marine depositional environments, along with island-arc volcanic terrains.

(3) Sedimentary units of the Rustic Formation and older Precambrian basement units were metamorphosed (subjected to high pressures and temperatures) during the late Paleozoic and Mesozoic eras. East-west compression of the Cordilleran geosyncline produced metamorphism, folding, and thrust-faulting (displacement of older rock units on top of younger rock units) within sedimentary units deposited within the geosyncline. Although thrust-faulting appears to have been most intense during the late Paleozoic and early Mesozoic eras, the juxtaposition of Precambrian units over Tertiary terrestrial sediments indicates that thrust-faulting occurred as late as Tertiary time (Fife and Brown, 1980).

(4) Magma (molten rock) of the Jack Spring Quartz Monzonite intruded the existing older rocks probably during Cretaceous time.

(5) Uplift and erosion of the area occurred, and most Paleozoic and Precambrian rocks were eroded away.

(6) A broad basin formed in Tertiary (probably Miocene) time. Volcanic deposits composed of ash tuffs and andesite breccias covered the basin floor in layers up to 600 ft thick. Up to 1,000 ft of andesite lava flows originating from several volcanic vents covered the ash flow and breccia deposits. Black glass dikes intruded into the andesite flows.

(7) Conglomeratic sandstone containing clasts weathered from the surrounding mountains was deposited discontinuously on the andesite lava beds during Tertiary and Quaternary times.

(8) The region was uplifted and extensively faulted in Late Tertiary and Quaternary times. Faulting during Late Tertiary and Quaternary times was primarily normal. Transverse faulting was associated with the development of the San Andreas and Garlock fault zones.

(9) Olivine basaltic flows covered parts of the region during the Pleistocene era. Since deposition of the basalt, the area has been tilted slightly to the north and extensively faulted in the southern part of the region.

(10) Alluvium was deposited during Quaternary time, including: dry lake bed sediments; low lying sand and gravel alluvium in the main valleys; gravel and boulder alluvial fans, lag gravels, and debris slope deposits; unconsolidated sand, gravel and boulders in stream channels; and windblown sand. The thickness of alluvial cover ranges from 0 feet on ridge crests and rock outcrops to 1,000 feet within the valleys.

F. TYPES OF SOILS AT THE GDSCC

The following four soil types described in accordance with the Unified Soil Classification System (USCS) occur at the GDSCC:

(1) Poorly to Well-Graded Gravels (GP to GW) with variable silt, and sand derived from granitic rocks;

(2) Poorly to Well-Graded Gravels (GP to GW) with variable silt, and sand derived from decomposing volcanic rocks;

(3) Poorly Graded Gravels (GP) derived from earlier, dissected alluvial deposits and terrace gravels (includes lag deposits); and

(4) Clayey Silt (ML) to Clay (CL) deposited in lacustrine (playa lake) environments.

Unconsolidated volcanic and granitic soils have medium to high porosity and permeability. Development of caliche layers (calcium carbonate cementing of soil layers), however, can greatly decrease the permeability of the soil.

Desert pavement (a residual layer of large soil particles left on the ground surface after the finer particles have been carried off by wind and water) has developed over virtually all soil surfaces. This layer is made up of lag gravels that protect the surface against further erosion. These gravels are often coated with oxides of iron and manganese, known as desert varnish, that give the surface a shiny appearance.

A study to define the engineering properties of the soils at the proposed project location at the Apollo Site has not yet been undertaken, but will be completed prior to final site selection and foundation design. Soil properties at the Apollo Site are likely to be similar to those at the Venus Site, where a 34-meter antenna is currently under construction. In July, 1973, a geological, geophysical, and foundation-engineering survey of the Venus Site was conducted to determine the feasibility of constructing the 34-meter antenna (Pacific Soils Engineering, Inc., 1973). The study concluded that good foundation support exists at the Venus Site, with bedrock within reach (approximately 20 feet below the surface) of the pedestal and instrument tower foundations for the subject design.

In addition, JPL has studied the foundation designs of existing structures at the Mars Site that are similar to the one proposed for the Apollo Site. Based on these studies, it is assumed that soils at the Apollo Site are suitable for construction of the proposed 34-meter antenna.

G. WATER RESOURCES AND FLOODPLAINS

1. Water Resources

There are no permanent streams at the GDSCC. Surface water flow occurs only after intense rainfall periods, and the water quickly infiltrates into the dry desert soils or evaporates. During heavy rainfall, water reaches Goldstone Lake, which becomes inundated for short periods. This intermittent water supply is inappropriate for domestic and other planned uses due to its high levels of suspended and dissolved solids and very short-term availability.

The entire Mojave River Basin (which includes the GDSCC) draws its water supply from the Mojave River groundwater basin, which in turn is recharged by only two sources: rainfall and the Mojave River (Department of the Army, 1979).

The GDSCC receives potable water from a group of six wells located within the vicinity of Fort Irwin. These wells draw from the Bicycle Lake groundwater basin and from the Fort Irwin groundwater basin, which are subunits of the Mojave River Groundwater Basin. About 1,000,000 gallons of water are pumped monthly from Fort Irwin to the GDSCC.

2. Floodplains

The Federal Emergency Management Agency (FEMA) has not mapped floodplains for the Fort Irwin Reservation, including the GDSCC. Ninety percent of the area in the southeast desert of California, however, is classified as Zone D, in accordance with FEMA definitions (A. Russell 1987). Therefore, the GDSCC is most likely to be classified as Zone D, an area of undetermined but possible flood hazard. In the desert environment, in general, high-intensity storms may produce flash flooding. The GDSCC, however, has not experienced flood-related problems in the past.

Two intermittent streambeds (dry washes) are located near the Apollo Site: a wash located several hundred feet to the north of the buildings at the site, and a much smaller wash located immediately south of the site proposed for the new antenna. The wash located north of the Apollo Site provides drainage for most of the area upslope from the site, and appears to provide adequate diversion of drainage away from the operational areas. The small wash located to the south of the proposed project site appears to provide adequate drainage diversion of a small area upslope of the location proposed for the new antenna. Since the initiation of operations at the GDSCC, damage to structures due to flooding has not been reported.

H. BIOTIC RESOURCES, ENDANGERED SPECIES, AND WETLANDS

1. Biotic Resources

The biotic composition at the site of the proposed new Apollo Site DSS-18 34-meter antenna was determined from information compiled through field reconnaissance, supplemented by information obtained from the existing literature. The site was surveyed on foot by the MBGA project team on April 24, 1989. Weather at the time of the survey was cool, with temperatures of 74°F and moderately strong winds of 10 to 20 miles per hour.

The physical nature of the proposed antenna site permitted a direct systematic examination of all terrain within its confines. Floral constituents encountered were recorded in terms of relative abundance and habitat type. Faunal constituents were determined through the use of field identification, combined with documented habitat preferences of regional wildlife species that, whether or not detected during the survey, are thought to include the site within their range. The overall biotic composition of the site was derived from this information.

2. Vegetation

The vegetation of the project site is typical of a diverse mid-elevation Mojave Desert creosote bush scrub community. The dominant plant species are creosote bush (Larrea tridentata), burrow-weed (Ambrosia dumosa), goldenhead (Acamptopappus sphaerocephalus), cheese-bush (Hymenoclea Salsola), and brittlebush (Encelia farinosa). Other perennial plants which were present in high abundance included Nevada ephedra (Ephedra nevadensis), winter fat (Ceratiodes lanata), bladder sage (Salazaria mexicana), Anderson's thornbush (Lycium Andersonii), desert trumpet (Eriogonum inflatum), California buckwheat (E. fasciculatum), and Mojave indigo bush (Psorothamnus arborescens). Some Joshua trees (Yucca brevifolia), jumping cholla (Opuntia Bigelovii) and beavertail cactus (Opuntia basilaris) were also present. Annual species present at the time of the survey included pincushion flower (Chaenactis carphoclinia), desert aster (Machaeranthera tortifolia), fiddleneck (Amsinckia tessellata), red-stemmed filare (Erodium cicutarium), and coreopsis (Coreopsis Bigelovii). Grasses present included arabian schismus (Schismus arabicus), Indian ricegrass (Oryzopsis hymenoides), and galleta grass (Hilaria rigida).

3. Wildlife

Based on field observations and literature search, the varieties of wildlife expected or observed to regularly occur in the habitats of the projected project site are described below. A complete list of expected and observed fauna is available from the GDSCC.

a. Amphibians and Reptiles. No amphibians have been observed or are expected, due to the absence of surface water at the proposed project site or in its vicinity. A variety of lizards and snakes are expected to occur in the project vicinity. Common lizards include the western whiptail (Cnemidophorus tigris), zebra-tailed lizard (Callisaurus draconoides), and side-blotched lizard (Uta stansburiana). Other reptile species found with some frequency throughout the creosote bush scrub community are desert iguana (Dipsosaurus dorsalis), desert tortoise (Gopherus agassizi), common leopard lizard (Gambelia wislizenii), coachwhip (Masticophis flagellum), gopher snake (Pituophis melanoleucus), sidewinder (Crotalus cerastes), and Mojave green rattlesnake (Crotalus scutulatus).

Due to the low ambient temperatures at the time of the survey, no reptiles were observed on the site.

b. Birds. A number of bird species are expected to breed in the creosote bush scrub community within the vicinity of the proposed project. These include the black-throated sparrow (Amphispiza bilineata), Say's phoebe (Sayornis saya), Le Conte's thrasher (Toxostoma lecontei), mourning dove (Zenaida macroura), loggerhead shrike (Lanius ludovicianus), and horned lark (Eremophila alpestris). No breeding activity was observed, however, on the proposed project site.

Four species of raptors (birds of prey) may breed in the vicinity of the proposed project site, and may utilize the site for forage. Common barn owls (Tyto alba) nest in the crevices and caves found in butte faces and canyons. Red-tailed hawks (Buteo jamaicensis), which are more frequent in winter, may breed locally. Prairie falcons (Falco mexicanus) are an uncommon breeding resident in the area, nesting primarily on steep cliff faces, which are more frequent in the northern portion of the GDSCC. Golden eagles (Aquila chrysaetos) may also inhabit the area.

c. Mammals. Small mammals, most of them nocturnal, are common in the Mojave Desert. The long-tailed pocket mouse (Perognathus formosa), the deer mouse (Peromyscus maniculatus), Mojave ground squirrel (Sphermophilus mohavensis), and desert wood rat (Neotoma lepida) are expected in the vicinity of the proposed project. Merriam's kangaroo rats (Dipodomys merriami) are likely the most abundant and widespread small mammal within the project area. Black-tailed jackrabbit (Lepus californicus) and desert cottontails (Sylvilagus audubonii) are also common throughout the area.

Predators expected in the proposed project area include the coyote (Canis latrans), kit fox (Vulpes macrotis), ringtail (Brassariscus astutus) and bobcat (Felix rufus).

4. Impacts Upon the Biotic Resources of the Proposed Project Site and Their Mitigations

Impacts to the biotic resources of the proposed project site and its vicinity are expected to be minimal due to the small size of the area to be altered by the proposed project and its proximity to existing roads. Project implementation may result in the removal of several mature Joshua trees, which may be too large to be transplanted, and one to several individual Mojave indigo bushes. Wildlife, for the most part in the form of small rodents, would be permanently displaced from the area of construction, and population numbers would likely continue to be lower in the immediate vicinity of the project. This decline in rodent numbers may have a minor effect on predators presently foraging in the area. None of these biological impacts would be significant.

During construction of the new 34-meter antenna, efforts will be made to disturb as small an area of vegetation as possible. The desert flora recovers very slowly, and unnecessary clearing would be visible for many decades.

5. Endangered Species

Several species present in the vicinity of the proposed project have been given special recognition by Federal, state, or local, resource-conservation agencies and organizations due to declining, limited, or threatened populations, resulting in most cases from habitat reduction (see Tables 4 and 5). Sources used for determination of sensitive biological resources are as follows:

(1) Wildlife: U.S. Fish and Wildlife Service (FWS) (1986), California Natural Diversity Data Base (CNDDB) (1987), California Department of Fish and Game (CDFG) (1980, 1986), Remsen (1978), National Audubon Society (NAS) (Tate and Tate 1986), and Bureau of Land Management (BLM) (1980).

(2) Plants: FWS (1986), CDFG (1985), CNDDB (1987), and Smith and York (1984).

Table 4. Sensitive Plant Species that Potentially Could Occur at the GDSCC[a]

Species	Status: FWS	Status: CNPS	Habitat
Androstephium breviflorum Small-flowered androstephium	--	2[b]	Gravelly to rocky soils below 7,000 ft
Astragalus jaegerianus[c] Jaeger's locoweed	C2[c]	1B[d]	Sandy to gravelly soils below 4,000 ft
Chorizanthe spinosa Mojave spiny-herb	C3[e]	4[f]	Same
Cymopterus deserticolus Desert cymopterus	C2	1B	Same
Dudleya saxosa ssp. saxosa Panamint dudleya	C2	4	Same
Eriophyllum mohavense Mojave eriophyllum	C2	1B	Same
Linanthus arenicola Sand linanthus	C3[c]	2	Deep sandy soils
Psorothamnus arborescens Mojave indigo bush var. arborescens (Dalea a.)	C3[c]	4	Same
Sclerocactus polyancistrus Mojave fish-hook cactus	C2	4	Rocky soils

[a] Listing agencies/organizations:
FWS: U.S. Fish and Wildlife Service (USFWS, 1986).
CNPS: California Native Plant Society.
Note: The California Fish and Game Department has no listing for this area.

[b] Rare or endangered in California, but more common elsewhere.

[c] Federal Category 2 candidate in which a decline of the species is suspected. Insufficient data exist, however, to support a proposed listing.

[d] Considered rare and endangered throughout its range.

[e] Species is too widespread to warrant listing.

[f] Species has limited distribution.

Table 5. Sensitive Wildlife Species Known From the Vicinity of the GDSCC[a]

Species	Status[b] FWS	CDF	GPS	NAS	Habitat
Gopherus agassizii Desert tortoise	C2[c]	--	S[d]	--	Creosote bush scrub
Aquila chrysaetos Golden Eagle	--	SC3[e]	PS[f]	--	Nests in cliffs; forages over creosote bush scrub
Falco mexicanus Prairie falcon	--	SC3	--	--	Same
Athene cunicularia Burrowing Owl	--	SC2[g]	--	2[h]	Nests in banks of washes and road cuts
Spermophilus mohavensis Mojave ground squirrel	--	T[i]	--	--	Creosote bush scrub

[a] None of the listed species actually were identified at the project site during the MBGA survey.

[b] Listing agencies:
FWS: U.S. Fish and Wildlife Service (USFWS, 1986).
CDFG: California Department of Fish and Game (CDFG 1980, 1985, 1986).
BLM: Bureau of Land Management (BLM, 1980).
NAS: National Audubon Society (NAS, 1986).

[c] Federal Category 2 candidate in which sufficient data exist to propose species for listing as threatened or endangered.

[d] BLM considers this species to be sensitive due to small population size, limited distribution, or threat from human activities.

[e] State Species of Special Concern, List 3: species not in immediate danger of extinction. Small population sizes, however, warrant observation.

[f] BLM-proposed sensitive species, pending the accumulation of sufficient data to support concern.

[g] State Species of Special Concern, List 2: Species warrants active monitoring due to population decline.

[h] NAS second priority species: Special concern due to observed decline in population.

[i] State-listed as threatened.

Species considered sensitive in other parts of their range but not in the California deserts are not included in this discussion. No federally-listed threatened or endangered species were located on the proposed site, nor are any expected to occur. Thus, no effects to federally-protected rare, threatened or endangered species would occur as a result of implementation of the proposed project.

The desert tortoise is a BLM "sensitive" species. The U.S. Fish and Wildlife Service (FWS) has categorized the desert tortoise as a Category II species (Federal Register January 6, 1989:554) (i.e., a species for which sufficient data are available to suggest that "Threatened" or "Endangered" status may be warranted), but listing has been precluded by other priorities (Federal Register December 5, 1985:49868). The desert tortoise has been petitioned for candidacy for state "Threatened" status in California, and the petition has been accepted by the California Fish and Game Commission (FCG-670.1 January, 1986); it has not yet been determined, however, whether listing is warranted. Tortoise density in the GDSCC area is expected to be 0 to 20 per square mile (Berry et al., 1987). No sightings or sign (such as scat or burrows) of the desert tortoise were observed at the time of the MBGA site survey.

No significant impacts to California-listed sensitive, rare, threatened, or endangered plant species are expected to result from project implementation. The Mojave indigo bush has been listed by the California Native Plant Society (CNPS) as being of limited distribution; it is a Federal category III species (considered too widespread to warrant Federal listing). Several Mojave indigo bushes may be removed as a result of project implementation; the loss of these few individual plants, however, is not significant.

No significant impacts to State-listed sensitive, rare, threatened, or endangered wildlife species are expected to occur as a result of implementation of the project. The CDGF has listed the Mojave ground squirrel as threatened, and this species is known to occur at the GDSCC.

6. Wetlands

No wetlands in the form of springs, seeps, or streams are found in the vicinity of the proposed project. No playas (dry lakes) or areas where standing water may accumulate during or after a storm are evident on or in the immediate vicinity of the proposed project site.

I. AIR RESOURCES

1. Meteorology

Climatic conditions at the GDSCC are those typical of high desert. Summers are hot and arid while winters are relatively cool with little precipitation and frequent strong westerly winds. Occasionally there are summer showers and thunderstorms that result in flash flooding. During the winter months, strong winds may occur and local dust storms often accompany the strong winds.

2. Air Quality

The project site is located in the Southeast Desert Air Basin (SEDAB), an area that complies with environmental limits for all primary air pollutants except ozone. Air pollutant emissions from the GDSCC are primarily from storage and use of hydrocarbon fuels, a spray booth and degreaser, Diesel-engine generators, and wipe-solvents.

The proposed project will not substantially increase fuel consumption for heating purposes. An air-conditioning unit, to cool specific antenna equipment, will be installed at the proposed project location. There are no plans to increase fuel consumption for other purposes or to add new equipment that would increase the present level of emissions. Thus, it is not anticipated that the proposed project will result in any significant impact on basin air quality from stationary sources.

There will be no substantial increase in mobile-source emissions as a result of the proposed project, since daily vehicle usage is not anticipated to increase as compared to current usage.

Emissions generated during site preparation and construction of the proposed antenna and support structures would be primarily from exhaust emissions from construction equipment and fugitive dust generated as a result of soil movement. These emissions would be of short-term duration, and, for the most part would be confined to the Apollo Site, resulting in an insignificant impact on local air quality.

J. HUMAN ENVIRONMENT

1. Land Use and Socioeconomics

The GDSCC is located within the Fort Irwin Military Reservation, a U.S. Army installation under the control of the U.S. Armed Forces. The GDSCC is a 52-square-mile complex with an extremely low-density development. Because of its mission, the GDSCC is highly sensitive to physical and electromagnetic interference and thus requires large surrounding areas with minimal activity and development.

With Fort Irwin bordering the GDSCC on the north, east, and southeast, the potential for incompatible activities and actions exists unless both facilities operate in a cooperative manner. Of primary concern are the 20 to 25 "critical" and 35-40 "semi-critical" days per year when GDSCC transmissions require absolute freedom from physical and electromagnetic interference. While critical-day activities have not been violated up to this time, this is still an area of concern. Memoranda of understanding have been signed addressing the responsibilities of both Fort Irwin and the GDSCC.

The GDSCC, including the Apollo site, is designated as Rural Conservation (RCN) in the County of San Bernardino General Plan (San Bernardino County, 1986). The RCN designation permits a variety of low-intensity land uses such as agricultural croplands, mining areas, national forest, wilderness, and residential units on minimum lot sizes of 40 acres. The area is zoned DL-40, restricting subdivisions to no less than 40 acres. The proposed 34-meter antenna at the Apollo Site is included in the GDSCC development plans. The proposed antenna project is consistent with the County's General Plan.

The proposed DSS-18 34-meter antenna will be compatible with existing uses at the GDSCC and will complement and support the existing Deep Space Network. The antenna will be constructed in two phases. The foundation will be constructed over a 6-month time period span during the first phase; the antenna then will be erected over a 9-month span during the second phase. The existing DSS-12 34-meter antenna at the Echo Site will be dismantled and removed from the GDSCC within approximately one year from completion of the new antenna.

The existing Apollo Station has 42 full-time employees who exclusively support operation of the existing Apollo DSS-16 26-meter and DSS-17 9-meter antenna. The proposed DSS-18 34-meter antenna and associated facilities will require the transfer of employees from the Echo Site to the Apollo Site. The number of employees that will be involved in this transfer is not known at this time. No new employees will be required for the proposed project. Therefore, no long term socioeconomic impact from the proposed project on GDSCC or regional demographics is expected.

2. Vehicular Traffic and Circulation

Vehicular access to the Apollo Site at the GDSCC is provided via Covington Road, a two-lane, paved surface road. Covington Road intersects Goddard Road and runs south-southeast approximately one mile to the Apollo Site.

The employment level at the Apollo Site will increase when the new DSS-18 34-meter antenna is placed in operation. Total employment level at the GDSCC, however, will not change as a result of the proposed project. Changes in traffic patterns, therefore, will occur but there will be no increases to total local traffic. The proposed antenna will be located close to the existing infrastructures, and thus will only require construction of about 400 feet of additional access road.

Some temporary construction traffic will occur. The small number of trips, relatively short duration of construction activity, and low level of roadway usage, however, will preclude any significant impacts to local roadways.

3. Noise

The GDSCC noise environment is typical of quiet desert locations. The sparsely developed complex and restricted airspace, which are required to minimize interference with communications, serve to promote a quiet environment.

Noise sources originating from the GDSCC include minor, intermittent surface traffic, occasional aircraft operations, and activities at other remote GDSCC operating sites. Surface traffic and its associated noise impact is at a relatively low level with a total staff of only about 217 people at the GDSCC. Air traffic at the airport at Goldstone Dry Lake is limited to propeller-driven aircraft. Flights include three scheduled NASA flights per week and infrequent flights of military administrative personnel. Mechanical equipment in use at the

GDSCC also contributes to the overall noise environment. Even the loudest of generators, pumps and other types of mechanical equipment present at any particular site produces a highly localized noise impact, however, that does not extend more than a few hundred feet from its source.

Off-site noise sources include some minimal occasional disturbance by Fort Irwin military training exercises and military aircraft sonic booms. Since antenna operations are restricted during hours when troop maneuvers and military aircraft have scheduled operations, these noise sources should not have an adverse impact on the various NASA missions.

Over the short term, noise impacts at the proposed project site will involve additional construction traffic noise and noise from site preparation (earth moving and excavation), materials handling, fabrication, and erection of facilities. Since the project location is in a remote area with no noise-sensitive land uses within miles, short-term noise impacts are expected to be insignificant. Long-term noise generation can be expected from the antenna mechanical system, engineering shop activities, cooling/ventilation systems, generators, and motor vehicles. Since the proposed project is replacing existing comparable facilities and a staff of approximately the same size, no significant change to the existing noise environment is expected.

4. Cultural Resources

An abundance of archaeologic and historic resources exists in the Mojave Desert, and especially within the boundary of Fort Irwin and the GDSCC. Since access to these installations is controlled, only a few archaeologic sites have been discovered and recorded. Fort Irwin has employed a resident archaeologist who has documented areas of archaeologic, prehistoric, and historic interest as well as fossil areas within the Fort Irwin and GDSCC boundaries. A large area within the GDSCC has been designated as an area of archaeologic and historic interest. This site is located in the northern portion of the GDSCC, in and around Goldstone Lake, approximately 1 mile north of the Apollo Site. The Fort Irwin archaeologist has been requested to conduct a survey of the Apollo Site to verify that no archaeologic or historic resources exist at the site.

5. Radio Interference, Electromagnetic Radiation, and Microwaves

The GDSCC operates several large, high-powered, microwave, ground transmitters used in deep space communications. These transmitters are capable of transmitting radiation ranging in frequency from 10 megahertz to 100 gigahertz. Transmission in this frequency range produces radiation potentially hazardous to persons working nearby. The power density in the direct beam may cause severe biological damage. The energy density in the feeding system is considered potentially lethal. Currently, DSS-14 (Mars Station) is the only GDSCC antenna station that radiates high-power on a routine basis. The proposed new DSS-18 34-meter antenna, to be located at the Apollo Site, will duplicate the electromagnetic functions of the existing DSS-12 antenna at the Echo Site: reception in both S- and X-bands, and transmission in the S-bands.

The Jet Propulsion Laboratory (JPL) has issued Safety Practice Bulletin 12-4-6 that sets standards for safely operating antennas during transmissions. The bulletin addresses exposure hazards, exposure limits, and procedures for ensuring that all safety precautions are taken prior to and during a transmission event. In addition, the bulletin contains a requirement that JPL Form 0284-S, Optional Safety Review, be completed prior to modification of an existing antenna or construction of a new radio frequency transmitter. This bulletin is included in this Environmental Assessment Document as Appendix D. Although this review has not as yet been conducted for the proposed antenna, it will be performed prior to construction and will ensure that the facility meets safety standards.

High-power microwave transmissions also can generate effects at greater distances, potentially exposing aircraft to radiation. In accordance with standard practice, procedures will be established with neighboring military installations and the Federal Aviation Administration (FAA) to prevent exposure of aircraft to radiation levels greater than 10 mW/cm. These procedures include restricting the permissible angles of radiation and avoidance of the supersonic corridor, establishing a prearranged schedule for transmissions, and providing airspace avoidance contour plots to cognizant external agencies. By following prescribed policies and procedures for existing antennas, the GDSCC has maintained a record of safe transmissions since it began high-power transmissions in 1981.

During the project-planning phase for the proposed 34-meter Apollo antenna, specific requirements will be negotiated and coordinated with nearby military installations and the FAA. It is anticipated that these requirements for operation of the proposed antenna will be much less restrictive than those already in place for similar antennas at the GDSCC, because no transmissions are expected for the proposed new DSS-18 34-meter antenna at the Apollo Site.

The radiation issue remains unresolved at this time because of lack of information on health and safety effects from low-power transmissions. This matter will be resolved, prior to final project approval, through the standard procedures of negotiation of transmission restrictions with the military and FAA and completion of the required safety review.

6. Solid and Hazardous Wastes, Toxic Substances, and Pesticides

a. Solid Wastes: Goldstone operates one 10-acre, Class III solid waste landfill. The landfill, which is located at the Echo Site, is properly permitted and has a projected remaining life of four years. Only non-putrescible, non-liquid solid wastes are accepted for burial.

Materials generated by the dismantling of the DSS-12 antenna at the Echo Site would be sold as parts or recycled to the greatest extent possible. Solid waste generated during this dismantling activity would not have a long-term effect on the solid-waste disposal capabilities of the GDSCC. Other adverse impacts from solid waste generation are not anticipated as a result of the proposed project because:

(1) Additional staff will not be required to operate the proposed antenna.

(2) Operation of the proposed antenna will not result in generation of quantities of solid waste that are greater than quantities generated by the existing antenna.

(3) Types of solid waste generated are not expected to change from those generated at the present time.

b. Toxic Substances and Hazardous Wastes: The GDSCC does not store or use large quantities of toxic or hazardous substances. The substances used in greatest quantities are fuels and oils. Purchase of drummed liquids is kept to a minimum.

The GDSCC now operates one main drum storage area at the Apollo Site. This facility which is environmentally substandard consists of drums stored on locked, metal, dispensing racks situated on a concrete pad (Figure 10). The facility is properly equipped with warning signs, fire extinguishers, and materials for spill cleanup. Small quantities of containerized substances are stored throughout the complex in a manner consistent with procedures established by the GDSCC Environmental Office. Storage locations are inspected on a routine basis. Typically, only the quantity of material needed to support operations is distributed for storage at each workplace.

A new storage facility for hazardous materials and wastes is to be constructed at the Apollo Site in 1990. The new facility will be similar to the new facility constructed at the Echo Site as described in Environmental Projects: Volume 9, Construction of Hazardous Materials Storage Facilities, JPL Publication 87-4, November 15, 1989. An illustration of the new, environmentally acceptable storage facilities for hazardous material and wastes, as it now exists at the Echo Site, is depicted in Figure 11.

Bulk products (primarily fuels and oils) are stored in permitted underground tanks in conformance with prevailing underground tank regulations. There currently are 13 underground tanks in use for storage of bulk fuels and oils at the GDSCC. All 13 tanks are of recent installation and are of double-wall construction with leak-detection systems.

Hazardous waste generated at the GDSCC is collected in drums at designated accumulation points throughout the complex. Accumulation points are maintained in conformance with procedures established by the GDSCC Environmental Office, and are inspected on a regular basis. Waste is transported from each accumulation point to a central staging facility located at the Echo Site. At this facility, all hazardous waste containers are readied for off-site transport to a commercial, permitted Hazardous Waste Management Facility for either treatment, recycling, or disposal, as appropriate. GDSCC policy requires minimizing waste generation and supports detoxification, reclamation, and reuse of wastes in preference to their disposal.

Materials to be stored at the Apollo Site to support the proposed operations are not expected to be substantially different in quantity or type from what is stored to support current operations. The waste-generation rate presently is very low (primarily oily waste), and also is not expected to substantially differ if this proposed antenna project is implemented. Furthermore, the GDSCC has an active environmental program that includes routine monitoring of hazardous materials and waste management practices at each antenna station by the GDSCC Environmental Coordinator. Consequently, no adverse effects from hazardous substances are anticipated.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

Figure 10. Apollo Site: Substandard Storage Area for Hazardous Materials and Wastes Will Be Replaced by New, Environmentally Acceptable Storage Facility in 1990.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

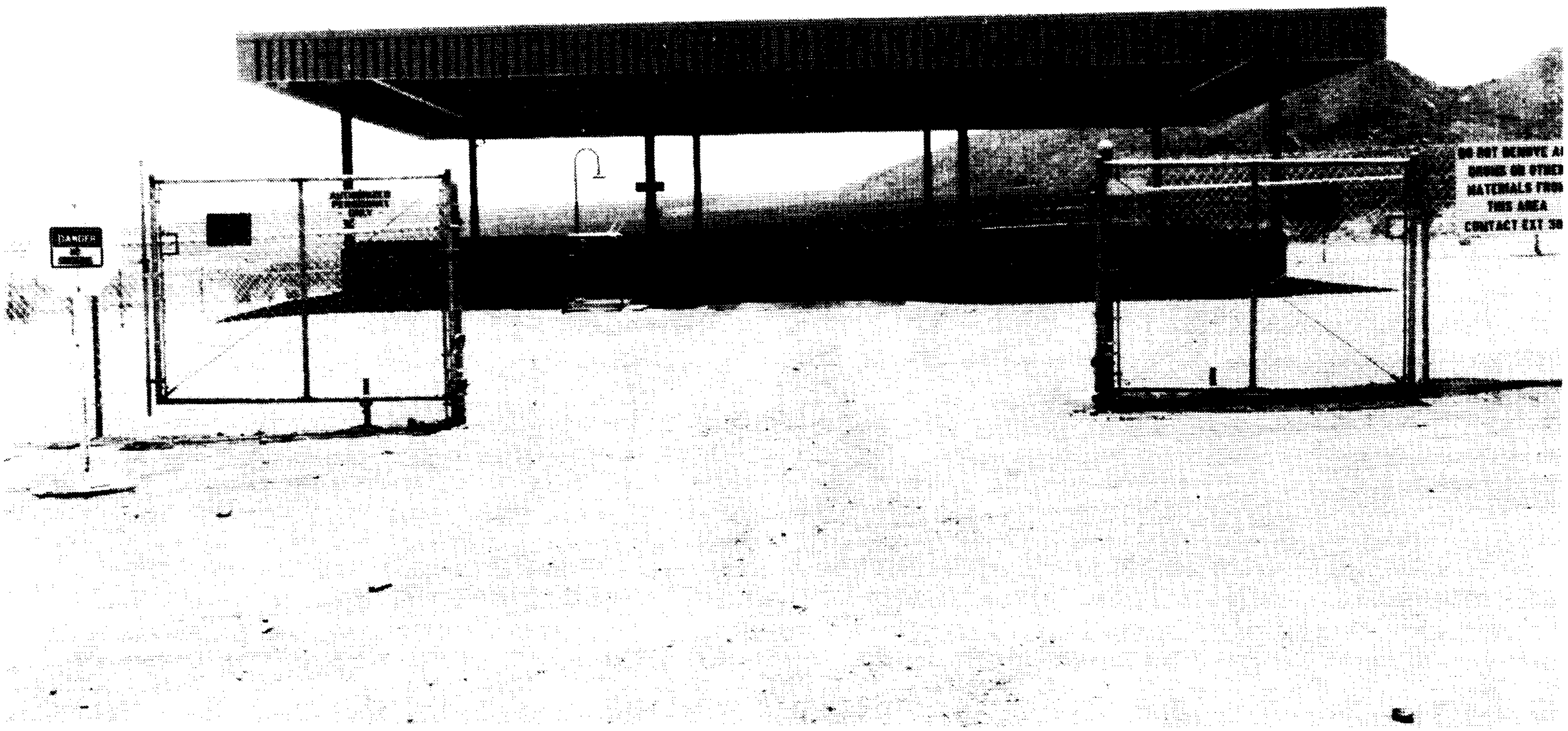


Figure 11. Echo Site: Completed Storage Facility for Hazardous Materials and Wastes. The New Hazardous Materials and Wastes Storage Facility to Be Constructed at the Apollo Site Will Be Similar to This Echo Site Facility.

c. Pesticides: The GDSCC does not directly purchase, store, or use pesticides. All pesticide application is by a licensed contract firm that brings spray applicators containing premixed pesticide to the GDSCC, applies the pesticide under the direction of the GDSCC's Environmental Officer, and leaves the premises with all remaining product and spent canisters. Virtually all pesticide application is to the interior of buildings. In the event that it is necessary to spray outside areas prior to initiating new construction, Natural Resource Management personnel from Fort Irwin or from the private sector are consulted to ensure that spraying will not affect environmental resources.

d. Summary of Hazardous Materials Use, Generation of Solid and Hazardous Wastes, and the Use of Pesticides at the Proposed New DSS-18 34-Meter Antenna at the Apollo Site: The proposed Apollo antenna project will not require expansion over the current level of operations or an increase in manpower. It is not anticipated, therefore, that hazardous materials use, solid waste generation, or hazardous waste generation will increase significantly as a result of implementation of the proposed project.

7. Health and Safety

The DSS-18 34-meter antenna design is required to meet the health and safety standards of prevailing health and safety codes.

According to the Advanced Engineering Study Report for Design and Construction of a Beam Waveguide 34-Meter X-Band AZ-EL Antenna, prepared by TIW Systems, 1986, safety provisions, similar to those that now are required to be provided for the 34-meter antenna now being constructed at the Venus Site, would be provided at the proposed antenna at the Apollo Site. At a minimum, provisions will include the following:

(1) Lighting: Incandescent lighting will be provided to give a minimum of five footcandles in all work areas. Battery-powered emergency lights also will be provided wherever frequent maintenance and service are required.

(2) Grounding: The antenna will be grounded and will have lightning protection. All grounding and bonding shall conform to prevailing codes and good engineering practice.

(3) Travel Limits: Redundant antenna travel limits will be supplied at both limits of travel on each axis. Azimuth bumper contact switches also will be provided on the azimuth access stairway structure to prevent damage around the antenna at ground level. Emergency stop switches will be installed at the following locations:

    (a) Elevation Drives

    (b) Antenna Access Stairway

    (c) Each Azimuth Drive Wheel

    (d) Reflector Surface

    (e) Future Lower Quadripod Leg.

No project-related health and safety impacts are anticipated with implementation of the above and other essential safety measures. A review of safety issues specific to operation of the proposed antenna should, however, be initiated prior to project approval.

8. Aesthetics

Typical views at the Apollo Site can be seen in Figures 12 and 13. The proposed project site is approximately 1 mile south of Goddard Road and thus is not clearly visible to vehicle occupants traveling to the airport. The existing antenna and the location of the proposed antenna are within a natural topographic bowl and thus are shielded from distant viewpoints. Although the proposed DSS-18 antenna facility will be approximately 30 feet taller than the existing Apollo DSS-16 26-meter antenna, no residential, commercial or public uses are located near the site. Therefore, the proposed antenna is not expected to have an effect on area aesthetics.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

Figure 12. Apollo Site: View Towards Goldstone Dry Lake

Figure 13. Apollo Site: View From the West

SECTION VI

CONCLUSIONS OF THE ENVIRONMENTAL ASSESSMENT CONCERNING THE CONSTRUCTION AND OPERATION OF A NEW 34-METER ANTENNA PROPOSED FOR THE APOLLO SITE AT THE GDSCC

The Environmental Assessment (EA) for the proposed 34-meter antenna to be constructed at the Apollo Site has examined the full range of potential environmental effects that may result from implementation of this project. The conclusion of this EA is that the proposed antenna and its operation would not result in significant adverse impacts to the natural, physical or human environment. It will, however, be necessary to manage electromagnetic transmissions from the antenna in such a manner as to ensure safe operation, in accordance with existing JPL standard procedures and external interface agreements.

Thus, in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality implementing regulations, and the NASA implementing provisions, the proposed project is eligible for a Finding of No Significant Impact (FONSI).

SECTION VII

CERTIFICATION

I hereby certify that all work performed by M. B. Gilbert Associates, Long Beach, California, in its environmental assessment of the construction and operation of a new 34-meter antenna proposed for the Apollo Site at the Goldstone Complex of the Fort Irwin Military Reservation, San Bernardino County, California, as described in this report, was performed in compliance with Federal, state, and local regulations, and in accordance with good engineering and investigative practice.

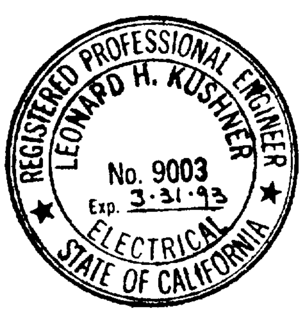
Leonard H. Kushner
Registered Professional Engineer

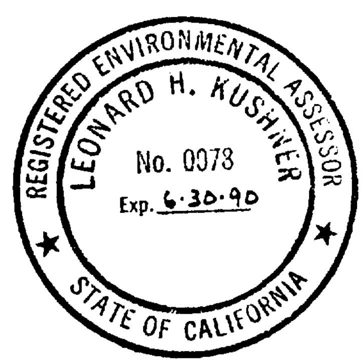
Signature: Len Kushner

Date Signed: January 15, 1990

Registration No.	E9003, Electrical	State:	California
	SF1086, Safety		California
	REA0078 Environmental Assessor		California

Stamp/Seal





APPENDIX A

INDIVIDUALS AND AGENCIES CONSULTED AND CONTACTED IN PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

APPENDIX A

INDIVIDUALS AND AGENCIES CONSULTED
IN PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

PREPARERS OF THE ENVIRONMENTAL ASSESSMENT REPORT

(1) Jet Propulsion Laboratory, California Institute of Technology

Office of Telecommunications and Data Acquisition:

Leonard H. Kushner, P.E., TDA Safety and Environmental Compliance Engineer
Glen G. Kroll, Cognizant Safety and Environmental Compliance Engineer
Ezra Abrahamy, P.E., TDA Safety and Environmental Compliance Engineer

Documentation Section 648:

Irving S. Bengelsdorf, Ph. D., Technical Writer/Specialist

(2) M. B. Gilbert Associates (Contractor):

Marsha B. Gilbert, Principal-in-charge
Susan Reynolds, Ph.D., Environmental Impact Specialist
Robert Coale, P.E., Senior Engineer
Brian Beck, R.G., Senior Scientist
Rob Hartman, Hydrogeologist
Marcia R. Baverman, Health and Safety Specialist
Robert Lunche, P.E., Air Emissions Specialist
Curt Uptain, Biologist
Rachel Fischer, Paleontologist

INDIVIDUALS AND AGENCIES CONTACTED IN PREPARATION OF THE ENVIRONMENTAL ASSESSMENT

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APPENDIX B

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APPENDIX B

ENVIRONMENTAL ASSESSMENT: BIBLIOGRAPHY

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APPENDIX C

ARCHEOLOGICAL APPROVAL FOR INSTALLATION OF UNDERGROUND POWER LINE RUNNING FROM THE ECHO SITE TO THE APOLLO SITE

JET PROPULSION LABORATORY

INTEROFFICE MEMORANDUM

November 15, 1989
FILE: POWEROK.NTC

TO: J. Dorman

FROM: B. A. Gaudian

SUBJECT: Archaeological, Environmental and EOD range clearances for the underground power line route between Echo and Apollo

REFERENCE: My letters to Ft. Irwin requesting Archaeological Environmental and EOD range clearances dated July 11, 1989.

As shown on the attached correspondence from Ft. Irwin we have received Archaeological, Environmental and Explosive Ordnance range clearances for the Echo to Apollo underground power line route.

Please be advised that if at anytime during surveys, digging or construction suspected ordnance is noticed you should contact the Goldstone Safety office. Do not attempt to do anything that will disturb the object and take action to keep personnel well away from the area until proper disposal action has been taken.

cc: H. R. Alderson
L. E. Butcher
P. Glenn
G. G. Kroll
J. E. McPartland
G. A. Morris
A. Price
W. Schnittger
L. Sturgis

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
JPL - Barstow	Underground power line between Echo and Apollo

TO	FROM	DATE	CMT 1
Director, DEH Ft. Irwin Attn: EHP-S Mr. Cassidy Mr. Demars	B. A. Gaudian Jet Propulsion Lab 850 E. Main St. Barstow, CA 92311	July 11, 1989	(619) 386-8218

Goldstone requests archaeological and environmental compliance approval of the route for an underground power line between Echo and Mars sites. The route will depart the Echo site along the road and follow the Southwest side of the road beside the buried communications cables. After the road turns Westward the power line route will continue to follow the buried communications route into the Apollo site.

The location of the route should have no adverse impact to the physical or human environment because most of the area has previously been exposed to trenching for communications cables or for water lines.

cc: Without Attachments

H. Alderson
L. E. Butcher
J. Dorman
P. Glenn
L. Kushner
J. E. McPartland
W. Schnittger
L. Sturgis

AFZJ-EHE-SP

TO B.A. Gaudian
Jet Propulson Lab
850 E. Main St.
Barstow, CA 92311

FROM DEH

DATE November 13, 1989
Cassidy/tl/3737

1. The above proposed project was field checked on 8,9 November 1989 for archaeological and environmental concerns. The underground power line between Echo and Apollo sites will not adversely impact the environment.

2. As proposed, the project may proceed.

Walt Cassidy

Walt Cassidy
NTC Staff Archaeologist

DA FORM 2496 AUG 80 PREVIOUS EDITIONS WILL BE USED

APPENDIX D

JET PROPULSION LABORATORY SAFETY PRACTICE BULLETIN 12-4-6,
EFFECTIVE DATE: JUNE 15, 1978

I. GENERAL

A. Microwave transmitters have extensive application in industry and in the home. They are used for: curing certain adhesives, ionizing gases, treating physical ailments, detecting optically invisible objects, cooking, spacecraft communications, etc.

B. Potential dangers are associated with microwave transmitter operations. High-powered ground transmitters used in spacecraft communications are potentially hazardous to persons working nearby. The power density in the direct beam may cause severe biological damage, and the energy density in the feeding system is considered potentially lethal.

C. Any known accidental exposure must be reported immediately to the First Aid Office.

D. For the purpose of this Safety Practice, the microwave frequency spectrum extends from 10 megahertz to 100 gigahertz.

II. HAZARDS

A. Radio frequency radiation heat affects specific parts of the human body. At a particular frequency, the amount of radiation heating is determined by the power density of the field and duration of exposure. The absorbed energy results in heating the body tissue which induces a temperature rise capable of producing biological damage, while no pain is experienced.

B. Users of radio frequency/microwave transmitters are required to be thoroughly familiar with associated hazards and the safety precautions to be taken. Biological damage occurring to the body, without physical warning, must always be kept in mind.

C. Looking into or standing in front of an antenna, waveguide horn, or open waveguide, while the transmitter is on, is extremely dangerous and can cause biological damage.

III. EXPOSURE LIMITS

A. The power density must not exceed one milliwatt per centimeter squared (1 mw/cm^2) in areas where employees are working eight hours a day or forty hours a week.

B. In areas where the power density exceeds 1 mw/cm^2, but is not more than 10 mw/cm^2, employees are restricted to working for no longer than one hour in any twenty-four hour period.

IV. PROCEDURE

A. All radio frequency/microwave transmitter operation areas must be posted with the necessary warning signs and devices.

B. A Safety Review of New Operation, JPL Form 0284-S, must be completed when a new radio frequency transmitter is installed for operation or an existing one is modified.

C. If at the time of initial operation the calculated power density exceeds 1 mw/cm^2 at 1 meter, a survey must be made of the electromagnetic radiation density. The antenna must be rotated, leaving the survey meter stationary while the side lobes are checked. A copy of this survey report must be sent to the Safety Office.

D. Klystrons and magnetrons are to be monitored for X-rays.

E. Certain pulse and transmit/receive tubes contain small amounts of radioactive material and must be handled carefully if broken.

F. The types of waveguide fill gases should be checked to see if a hazard would be created during arcing or accidental release.

G. High-voltage leads must be properly contained to ensure that they cannot come into direct contact (accidentally) with persons in the area.

H. High-voltage capacitors must be enclosed or covered to prevent accidental contact by persons in the area. They must also be provided with an automatic bleed-off system, to prevent the retention of a charge after the equipment is shut off.

I. Combustible materials may not be kept in areas where electrical or radio frequency arcing can occur.

J. Concentrated microwave beams must never be pointed or aimed where flashbulbs, squibs, or other types of electronic explosive devices are in use.

V. MEDICAL REQUIREMENTS

A. The Laboratory requires that persons, working in areas where exposure to radio frequency energy of 1 mw/cm^2 could occur, have an eye examination when the work assignment is made, and annually thereafter, as long as assigned to this type of work.

B. Annual eye examinations are required of persons working on radio frequency/microwave systems where the total average output power of the transmitter exceeds 500 watts including:

1. Large, microwave tracking antennas during transmission.

2. Antenna testing ranges.

3. Laboratories where transmitters of this output power are being used.

NOTE: Should a break in the waveguide occur with systems of this power level, the resulting leakage could cause damage to the eyes.

Charles H. Terhune, Jr.
Deputy Director

OFFICE OF PRIMARY RESPONSIBILITY

Assistant Laboratory Director for Administrative Divisions

SUPERSEDES

Safety Practice 12-4-6, Microwave Transmitters, dated May 13, 1976.

JPL OPERATIONAL SAFETY REVIEW

NO

TO: Cognizant Section Manager | DATE

FROM: Cognizant Engineer | EXT | SECTION

PROGRAM
☐ R/AD ☐ FLIGHT PROJECT ☐ CIVIL PROGRAMS ☐ DEFENSE PROGRAMS ☐ OTHER

LOCATION
☐ JPL ☐ DSN BLDG ________ OPERATION STARTING DATE ________
☐ TM ☐ EF ☐ OTHER ROOM ________ OPERATION COMPLETION DATE ________

☐ PRE-OPERATIONAL REVIEW ☐ OPERATIONAL REVIEW ☐ ANNUAL REVIEW

NAME OF OPERATION OR PROJECT

NAMES OF QUALIFIED PERSONNEL ASSIGNED TO THE OPERATION

DESCRIPTION OF OPERATION (NUMBER OF RUNS, DURATION OF RUNS, ETC.) Attach block diagrams, layout, etc., if needed for clarity.

OPERATION ☐ ATTENDED ☐ UNATTENDED WHEN

EMERGENCY NOTIFICATION: NAME ________ PHONE ________
ALTERNATE ________ PHONE ________

WILL THIS OPERATION REQUIRE USE OF THE BUDDY SYSTEM OR OTHER SURVEILLANCE (T.V., AUDIO, ETC.)
☐ NO ☐ YES, TYPE ________

IS ADEQUATE WRITTEN INFORMATION (JPL) AVAILABLE TO ASSIST IN SAFELY CARRYING OUT THIS OPERATION
☐ YES ☐ ADDITIONAL INFORMATION REQUIRED AND WILL BE AVAILABLE PRIOR TO OPERATION

LIST HAZARDOUS MATERIALS, PRESSURE, TEMPERATURES, POWER, VOLTAGES, FREQUENCIES, ETC. TO BE USED

MATERIAL – POWER – ETC.	PRESSURE – VOLTAGE – ETC.	TEMPERATURE – FREQUENCY – ETC.	QUANTITY		HAZARD *
			AT SITE	IN RIG	

HAZARD TYPE *

1-TOXIC	4-PYROPHORIC	7-ELECTRICAL	10-PRESSURE	13-CONTAMINATION
2-CORROSIVE	5-RADIATION	8-FIRE	11-LASER	14-
3-EXPLOSIVE	6-ACOUSTIC	9-SUFFOCATION	12-ENERGY SOURCES	

LIST DISCHARGE PRODUCTS AND WASTE FROM OPERATION (FOR BOTH NORMAL AND ABNORMAL CONDITIONS)

MATERIAL	QUANTITY	CONDITION	MEANS OF DISPOSAL	DISCHARGE PRODUCTS
		NORMAL		
		ABNORMAL		
		NORMAL		
		ABNORMAL		
		NORMAL		
		ABNORMAL		

LIST PERSONNEL SAFETY EQUIPMENT REQUIRED FOR THIS OPERATION

LIST OF DOCUMENTS, BY TITLE, THAT PERTAIN TO THIS OPERATION

JPL 0284 S R 3/86

JPL TEST PREPARATION CHECK LIST

YES	NO	N/A	PERSONNEL SAFETY
☐	☐	☐	1. Location of personnel during test and in adjacent areas is safe.
☐	☐	☐	2. Provisions exist to avoid unsafe contamination of materials (spills, hypergolic, catalyst, etc.)
☐	☐	☐	3. Emergency procedures exist for protecting personnel in case of fire, spill, explosion, etc.
☐	☐	☐	4. Pertinent personnel protection exist (protective clothing, breathing apparatus, eye and ear protection, medical check, first aid, etc.)
☐	☐	☐	5. Shielding against high frequency or particle radiation, splash, blast exposure, heat, cold, etc., is provided.
☐	☐	☐	6. Additional training is required for this test.
			TEST OPERATION
☐	☐	☐	7. Operating procedure has been prepared. Existing procedure reviewed/revised.
☐	☐	☐	8. Operating procedure has been reviewed with operating personnel.
☐	☐	☐	9. "Fail safe" means exist in case of power, pressure, combustion or personnel failure.
☐	☐	☐	10. Protective means exist in case of over-temperature, over-pressure, over-speed, explosion, fire, etc.
☐	☐	☐	11. Provisions in case of failure of vessel or system from evacuation or pressure are provided (drains, deluge, ventilation, etc.)
☐	☐	☐	12. Electrical and/or static grounding and bonding is adequate (electrical equipment, test systems, work bench, drums, building grounds, etc.)
☐	☐	☐	13. Live parts are suitably guarded (electrical, belts, vent/burst pipes, bldg. sprinklers).
☐	☐	☐	14. Provisions exist for purging of equipment or area after test (water, nitrogen, freon, etc.)
			TEST FACILITY
☐	☐	☐	15. Sprinklers and/or other fire extinguishing equipment installed and operating.
☐	☐	☐	16. Fire protection valves, detection, and warning devices or switches sealed in operating position.
☐	☐	☐	17. Equipment for detection and monitoring of hazardous conditions installed and operating (radiation, toxicity, insufficient oxygen).
☐	☐	☐	18. Pressure vessel is certified. Pressure Vessel number: ______________.
☐	☐	☐	19. Protection from ignition sources (space heaters, automatic electrical, contamination, etc.) exists.
☐	☐	☐	20. Warning system installed and operational (horn, lights, observer, personnel barriers, signs indicating presence of hazards, etc.)
☐	☐	☐	21. Adequate work area around equipment and electric power panels (aisles, exits, doors, etc.)
☐	☐	☐	22. Adequate ventilation (windows, doors, fans, exhaust systems) provided.

ADDITIONAL ITEMS

☐ Brain Tickler: Consider pressure relief devices, vents, moving equipment, automatic equipment, storage, instrumentation, transportation, sample analysis, material compatibility, proof testing, clean equipment, lifting, tripping hazards, etc.

23. ______________________________

24. ______________________________

CC: Cognizant Engineer
Division Safety Coordinator
Safety Office
Supervisor

____
Cognizant Engineer

____
Group Supervisor

____
Section Safety Coordinator

REVERSE SIDE JPL 0284-S R 3/86