American Institute of
Aeronautics and Astronautics

# Historic Aerospace Site

## *Honeysuckle Creek, Tidbinbilla, and Orroral Valley Tracking Stations*

*Australia*

AIAA

*The World's Forum for Aerospace Leadership*

*Invited guests are dwarfed by the 85 foot Honeysuckle antenna at the offical opening, 17 March 1967.*

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HISTORIC AEROSPACE SITE

# Honeysuckle Creek, Tidbinbilla, and Orroral Valley Tracking Stations

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*A general view of the opening ceremony under the antenna.*

The International Geophysical Year (IGY) was a cooperative international enterprise created to advance the state of scientific knowledge about the Earth and its environment. The year started in July, 1957. That October, the Russians launched the world's first earth-orbiting satellite, Sputnik, as their contribution to IGY activities. A month later they launched a larger version of Sputnik containing a dog named Laika, in a high elliptical orbit around the earth.

It was an amazing achievement, and one that shocked and embarrassed the American government. In addition, it raised security concerns because it proved that the Russians now had operational Intercontinental Ballistic Missile (ICBM) capabilities that the U.S. did not. The Americans quickly scrambled to get their own successful launch, and used the Navy Vanguard project in a sadly unsuccessful attempt in December 1951. However, an Army-based program, originally called Orbiter but changed to Explorer, successfully lifted off the Cape Canaveral, Florida launch pad on 31 January 1958.

The small scientific payload it carried included a radiation-measuring instrument designed by Dr. James A. Van Allen of the University of Iowa. In order to receive the telemetry from this instrument, the Jet Propulsion Laboratory (JPL) at this time a contractor with the Army, expanded its Microlock ground-based tracking facilities to include stations at Cape Canaveral, Singapore, Nigeria, and San Diego, California. This was JPL's first look at worldwide network development and operations. The Microlock stations received telemetry from the Van Allen Geiger counters that revealed the presence of a high altitude band of radiation encircling the earth. Eventually named for Van Allen, this was one of the most important discoveries of the IGY.

The launch of Explorer I led to the announcement in March of 1958 of the approval of a U.S. lunar space program, named Pioneer. This consisted of three launches by the U.S. Air Force and two by the U.S. Army to measure cosmic radiation in the region between Earth and the moon. To track the findings, JPL created the Tracking and Data Acquisition Office, headed by Eberhardt Rechtin. As space launches in Russia and the U.S. increased, Rechtin realized the need to have tracking stations around the world, and helped establish such a network.

The first antenna and tracking station was established in 1958 in Goldstone, California, and became part of the newly created National Aeronautics and Space Administration. Rechtin suggested that there should be three areas around the world, approximately 120 degrees apart, to cover the entire earth. This would be known as the Deep Space Network. In addition to Goldstone, the other areas would be Madrid, Spain, and Canberra, Australia.

The first Deep Space Tracking Station opened at Tidbinbilla to the south-west of Canberra. A second station, at Orroral Valley, was opened in 1966, and a third, at Honeysuckle Creek, in 1967.

The Australian Capital Territory (ACT) was selected as the best site in southeastern Australia for these facilities because of the availability of a quiet environment for receiving radio signals from space, the closeness of sites to an urban area offering accommodation for personnel and backup services, and the relative geological stability of the region.

## The Australian/American Agreement

In 1960, Australia entered into a ten-year agreement with the U.S. to support the expanding program of the newly formed civil space agency, NASA. The Australian operating agency was originally the Department of Supply, but responsibility was transferred to the Department of Science in 1976.

After the Explorer and Vanguard projects, Australia supported NASA's manned Mercury missions. In 1960 a tracking station was established at Muchea, near Perth, and the Woomera radar at Red Lake, South Australia, was adapted for use. Both stations supported NASA's first manned orbital flight by astronaut John Glenn in 1962 and the next three Mercury flights.

At about the same time, NASA started preparing for a program of deep space exploration which led to the establishment of a station at Island Lagoon, near Woomera, specially designed for very long-range communication. This station supported NASA's Mariner project, which provided the first deep space probe that flew close to Venus in 1962. It continued in operation until 1972 in support of the variety of NASA deep space probes that followed the Venus project.

President Kennedy's announcement in 1961 of the goal of landing men on the moon and returning them safely to earth increased NASA's need for support from Australia. A large sophisticated station was established at Carnarvon, Western Australia, in 1963 to replace the Muchea station. It supported NASA's second manned spaceflight project, Gemini, and it went on to support the Apollo program which achieved President Kennedy's goal in 1969.

NASA expressed a need for a site in southeastern Australia, with four or five new stations to support its program. The first requirement was for a second deep space station. It was expected that this would be followed by a second manned spaceflight station and also special stations for the support of unmanned scientific and experimental satellites. This initiated the progressive building of the tracking station complex in the ACT.

## Management of the Stations

The establishment and management of the station in Australia was assigned to the Weapons Research Establishment (WRE) at Salisbury, SA, which operated the Woomera Rocket Range, where it all started in 1957. The American Projects Division, later the American Projects Branch and eventually the Space Projects Branch, was established for the task.

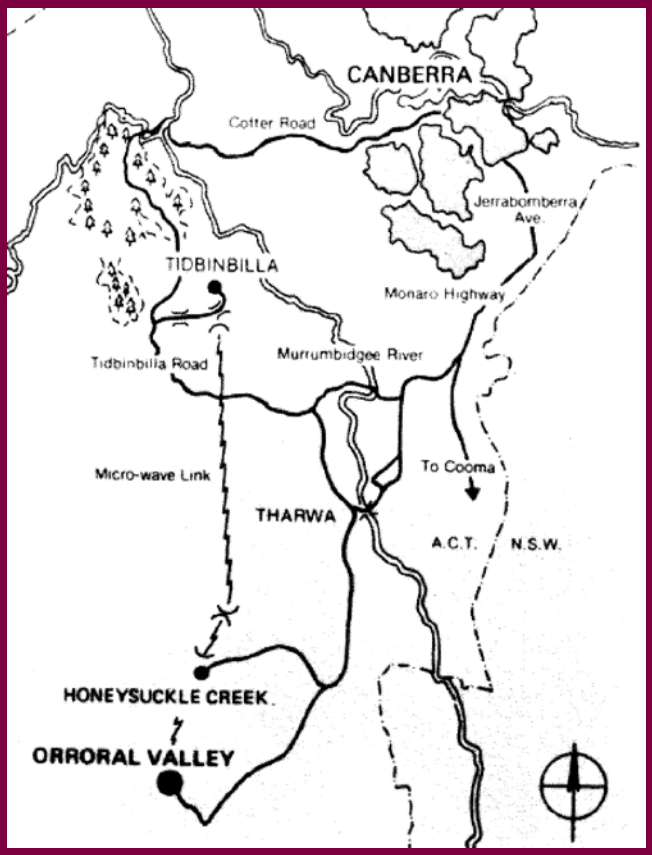
## Site Selection

The research for a site in southeast Australia began in September 1962. The general region for the site, in terms of latitude and longitude was dictated by the need for continuous communication with deep space probes from at least one of three sites around the globe. The location of the keystone station in the Deep Space Network had already been chosen, in Goldstone, California, so the first requirement was for a site about 120 degrees west from there, and at about an equal but opposite latitude, i.e., southeast Australia. Similar arguments applied to optimizing coverage for satellites in high earth orbit and to a lesser extent even for low earth orbiters.

The choice within this region was made on the best balance between a quiet environment for receiving very faint radio signals and the distance from a town or city that could provide sound support to an activity involving several hundred people. Very remote sites such as Woomera, while excellent from the point of view of freedom from interfering radio noise, are very costly considering the need for housing, high staff turnover, etc., and the distance from industrial support.

Other factors were also weighed in the balance such as relative freedom from earthquakes or violent storms and firm soils or shallow bedrock, considering the large but fragile antenna structures required and the need for great stability and precision. Natural shielding of stations one from another, and from the nearest town or city, by a series of hills and valleys was also important. Thought was given to avoiding airlanes, at least those in heavy use, because of the possibility of blanking even for a fleeting second, at just the wrong time, and of possible radio interference between aircraft and the tracking stations.

All but one of the stations that NASA wished to build in the ACT were accepted. The exception was a temporary station operating in the frequency band already assigned to the Melbourne-Canberra-Sydney radio relay link. That station was established instead at Cooby Creek near Toowoomba in 1966. It was part of a network of stations to support NASA in pioneering efforts in the development of communication and weather satellites, and, being transportable, moved from Australia in 1970 to meet changing requirements. It made history by providing Australians with the first live TV programs from overseas.




*A map of the locations of the three stations.*

*A view of the Tidbinbilla station in 1965.*
*Photo by Les Whaley.*

## Tidbinbilla

The site for the first station, at Tidbinbilla, was located on the Oakey Creek Station of Mr. N. Reid. The design of the facilities for the station was undertaken by the ACT Regional Office of the Commonwealth Department of Works, and the buildings were completed within a year. The driving force for the rapid establishment of the Tidbinbilla Station was the need to support NASA's rapidly expanding deep space program. In particular, NASA needed support from this area for the first probe to Mars, Mariner 4, in late 1964, while still supporting the Ranger lunar exploration project from the Island Lagoon Station at Woomera.

The Tidbinbilla Station, known then as Deep Space Instrumentation Facility 42 (DSIF 42), consisted of a 25.9-meter-diameter parabaloid antenna on a polar mount, driven in hour-angle and declination, as for astronomical telescopes.

Information from the spacecraft, comprising data from instruments such as TV cameras and other sensors, and data on the spacecraft itself such as temperature, attitude, etc. was superimposed on the transmission from the spacecraft and extracted at the station. Digital systems for transmission of data were relatively new in 1964, but digital systems were used by the first spacecraft supported by Tidbinbilla. A fine balance had to be preserved in the energy in the spacecraft signal devoted to information (the sidebands) as distinct from energy in the basic signal itself (the carrier) which was required for navigation, to ensure that both systems would continue to operate at the same distance from the earth.

Information collected by the station was transmitted to the network control

center in the U.S. by means of teletype transmission, with magnetic tape recordings air freighted later. Voice circuits were provided for coordination and for some oral reports of spacecraft or station parameters.

Tidbinbilla came on the air in December 1964 to support Mariner 4, which was launched on its way to Mars in November of that year. One week later, the Woomera Station was taken down to be converted for support of the Ranger lunar probe. The Tidbinbilla station had a staff of about sixty people at that time, which provided tracking about 11 hours a day, 7 days a week, until Mariner 4 flew by Mars in July 1965. The pictures of Mars revealed the startling fact that the planet was covered with large craters and it seemed at that time that Mars was more like the moon than the earth.

The first launch of a deep space probe supported by Tidbinbilla was Pioneer 6, which was put into an orbit around the Sun in January 1965, to report on particles and fields in space. Although Mariner 4 was the main reason for haste in establishing Tidbinbilla, the Surveyor project was a very close runner-up. Surveyor, a forerunner of manned space exploration of the moon, was required to make preliminary surveys of possible landing sites for astronauts. In particular, it was to investigate the landing properties of the lunar surface before landing humans on what otherwise might have been a sea of dust.

The goal of Surveyor was to make soft landings at various prospective sites for manned landings, to test the strength of the soil and to survey the surroundings by means of television cameras, and to make other observations. The Surveyor project required specialists at the tracking stations to assist in controlling the spacecraft, based on the data received. At that time, in 1966, there was no way of transmitting live television from Australia to the U.S.

The next major change at Tidbinbilla concerned support for NASA's Apollo project involving manned exploration of the moon, and included constructing a new wing on the operations building to house the Apollo equipment. Regular deep space work continued in non-Apollo periods.

A new 64-meter-diameter antenna was built at Tidbinbilla in 1973, allowing support of deep space probes at greater range, or more complex missions transmitting higher data rates at the same range. It was later expanded to 70 meters.

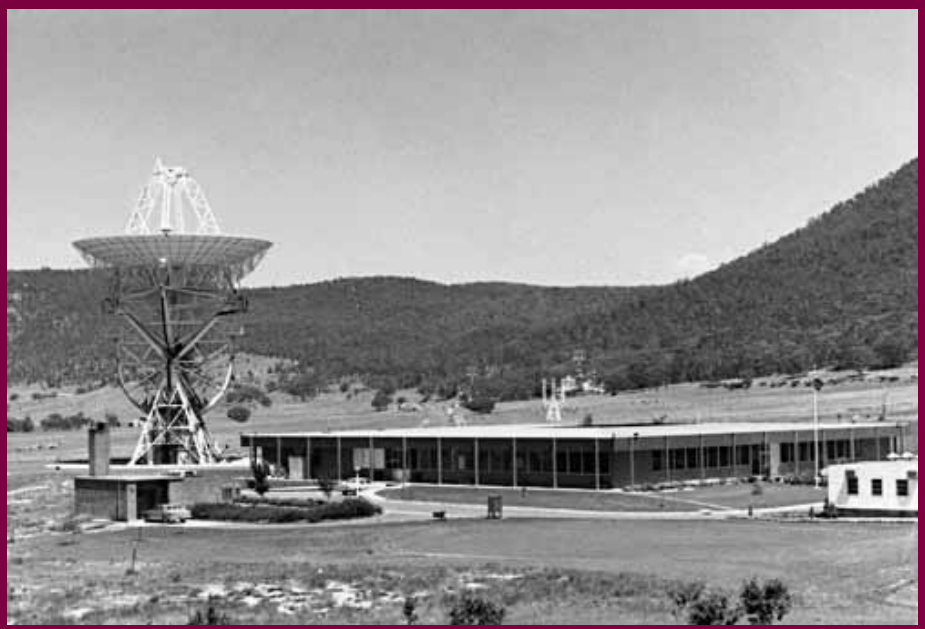
The station went on to support a variety of deep space missions such as the Mariner 10 flyby of Mercury in 1974, the Viking orbiters and landers launched on their way to Mars in 1975, the Pioneer 10 and 11 flybys of Jupiter in 1973 and 1974 and the Pioneer 11 flyby of Saturn in 1978, and NASA's Voyager I to Saturn in 1980.

The station has been updated continuously with new equipment to improve the data gathering capability and to automate many of the operations. This complex is the only NASA tracking station still operational in Australia today.

*Australian Minister for Supply, Mr. (later Sir) Allen Fairhall (left); Australian Prime Minister, Sir Robert Menzies (center) with Station Director Bob Leslie (right),19 March 1965.* *Photo by Clive Jones.*

*John Weatherley at the Surveyor Command Console.* *Photo by Les Whaley.*

*Dr. William Pickering, Director of the Jet Propulsion Laboratory (front) and Dr. George E. Mueller, NASA Associate Administrator for Manned Space Flight (left), with the plaque at the start of the construction of the new antenna in 1969. The Australian Minister for Supply, Ken Anderson, is in the background.*



*A photograph of the Orroral Valley Station, 1969.*
*Photo by Ted Barnes.*

## Orroral Valley

The Orroral Valley site for a tracking station to support earth orbiting satellites was selected in late 1963 and the construction work and installation of equipment were completed in 1965. The main requirement of this station, as distinct from the long-range communication task of Tidbinbilla, was to be able to switch quickly from supporting one satellite to another, often with quite different characteristics.

The signals received from satellites in earth orbit are relatively strong but view periods are short, a few minutes being typical. Many of the supported satellites used different systems for transmitting data, or for receiving commands so the station had to cope with a variety of equipment for support of the individual satellites. Data from the satellites were recorded on magnetic tape and air-freighted to the U.S. for study.

Shortly after the dedication of the station, additional equipment was installed to provide for the support of up to four satellites simultaneously. The later antennas were less sensitive than the original 26-meter-diameter receiving antenna, which was then used mainly for the reception of relatively weak signals from satellites in high earth orbit.

In the 1970s, satellites started to use a higher frequency band for their transmissions, similar to that used for deep space probes (known as S-band) and the 26-meter antenna at Orroral was consequently modified to accept that frequency band in addition to those used by earlier satellites. Other antennas were installed later to reflect changes in program support and new developments in technology.

The station supported the cooperative U.S./Soviet Apollo-Soyuz project in

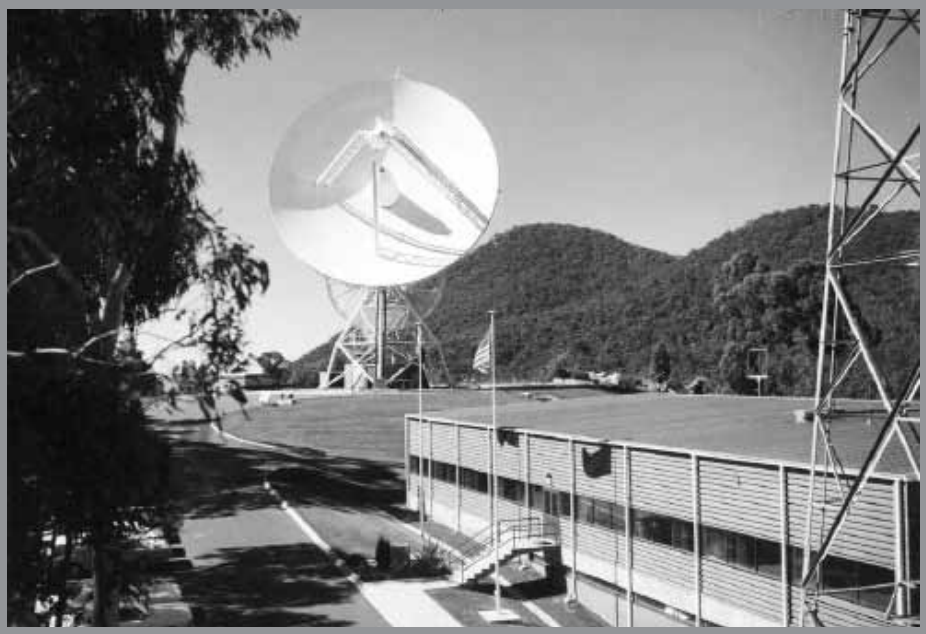
1974 in which American and Russian astronauts linked up vehicles in earth orbit and carried out joint experiments in space. Later, Orroral supported the Space Shuttle, which undertook its first orbital flight early in 1981.

## Honeysuckle Creek

The Honeysuckle Creek site for a tracking station, designed specially to support the lunar phase of NASA's Apollo project for manned exploration of the moon, was selected in 1965 by a joint team from NASA and the Australian Weapons Research Establishment. The station was dedicated by Prime Minister Harold Holt on 17 March 1967. The first Apollo mission supported was the unmanned test flight Apollo 4 in November 1967 and the first manned space flight mission supported was Apollo 7 in October 1968.

The main requirement of this station, as distinct from the sensitivity of Tidbinbilla and the flexibility of Orroral, was reliability coupled with sufficient sensitivity to handle communications with astronauts at the moon and receive their television and other transmissions. The station had the capability to handle simultaneous communications with astronauts on the moon and with an astronaut in orbit around the moon, together with command, data reception, and range and velocity measurement for two spacecraft. The moon diameter as seen from earth is about 0.3 degrees, which was also the width of the Honeysuckle antenna beam, so that it could handle both the orbiter and the lander.

Although there were three manned space flight network stations, there were also backup stations in Guam, Hawaii, and Carnarvon, Australia, and still more backup at Tidbinbilla. Special



*The Honeysuckle Creek station.* *Photo by Hamish Lindsay.*

*The assembly of the parabolic dish support structure at Honeysuckle Creek.*
*Photo byKen Lee.*

*Sometimes getting to work could be hazardous. An early road washout near the Honeysuckle Creek station.*
*Photo by Hamish Lindsay.*

*Prime Minister Harold Holt addresses the gathering at the dedication of the Honeysuckle Creek site in 1967.*
*Photo by Bruce Withey.*

*Snow and kangaroos at Honeysuckle Creek.*
*Photo by Hamish Lindsay.*

equipment was installed at Tidbinbilla so that the antenna could be switched over at short notice, from its normal deep space role, to support Apollo. This was done just before each manned flight mission to the moon. Honeysuckle and Tidbinbilla were linked by a microwave relay system so that Tidbinbilla became a second receiving and transmitting system for Honeysuckle, which processed data from the spacecraft and commands to the spacecraft.

Shortly before the first moon landing attempt, when it became apparent that that landing would take place towards the end of the view period from Goldstone, and that most of the first moon walk would be in the Australian view, NASA asked for assistance from CSIRO's 64-meter radio telescope at Parkes to further enhance the receiving capability for the most critical period. The successful activities of Apollo 11 were viewed live around the world by the largest television audience in history via the Parkes/Honeysuckle/NASA/INTELSAT system.

Honeysuckle, with the help of Tidbinbilla and Parkes, went on to give reliable support to the following six Apollo missions to the moon. Parkes was called in at very short notice to help communicate with Apollo 13 after an explosion in the spacecraft caused the moon landing to be called off and put the safe return of the astronauts in jeopardy.

The last mission supported by Honeysuckle, as part of NASA's manned space flight network, was Skylab, a huge space station designed to test man's ability to work in space for protracted periods and to make scientific observations from space. The staff of Honeysuckle had to be increased to cover the long mission periods involved in Skylab, even though it was known that this would be the last manned space flight project supported by Honeysuckle.

The station completed its support of Skylab in February 1974 and then started the process of converting to become a part of NASA's deep space network, using equipment from the Woomera station which had already been closed. Special data handling equipment for manned space flight was shifted to Orroral, which took over support for future manned space flight.

These three stations, Tidbinbilla, Honeysuckle Creek, and Orroral Valley, played a crucial role in the Apollo program. Along with their colleagues in far-flung areas of Australia such as Carnarvon, Muchea, Parkes, and Woomera, these facilities maintained vital communication and information-gathering links that supported early human forays into earth and the first human step on the moon, and they continue to provide support for ongoing space exploration.

*Significant portions of the text are from Robert A. Leslie, "Space Tracking Stations" in Canberra's Engineering Heritage. Mr. Leslie was the WRE Tidbinbilla Station Director starting in May, 1963.*

*All photographs are courtesy of Colin Mackeller at www.honeysucklecreek.net.*

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## THE AIAA HISTORIC AEROSPACE SITES PROGRAM

For over 75 years, the American Institute of Aeronautics and Astronautics (AIAA) has served as the principal society of the aerospace engineer and scientist. Formed in 1963 through a merger of two earlier societies, the American Rocket Society (ARS) and the Institute of the Aerospace Sciences (IAS), the purpose was, and still is, "to advance the arts, sciences, and technology of aeronautics and astronautics, and to promote the professionalism of those engaged in these pursuits." Today, AIAA has more than 35,000 members, as well as 90 corporate members.

AIAA sponsors many technical conferences, seminars, and short courses every year, and publishes *Aerospace America,* and seven archival technical journals (including one online journal). The Institute also publishes conference papers and proceedings, technology assessments, position papers, audiovisual information packages, many books, and a variety of career-related educational materials. The Institute conducts a rigorous public policy program and works closely with other societies and governments in broad areas of mutual concern.

AIAA established the Historic Aerospace Sites Program in January 2000 to promote the preservation of, and the dissemination of information about, significant accomplishments made in the aerospace profession. More than 35 sites have been recognized, including the Cincinnati Observatory, Cincinnati, Ohio; the Boeing Red Barn, Seattle, Washington; Kitty Hawk, North Carolina; the site of the first balloon launch, in Annonay, France; and Tranquility Base, on the moon.


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