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MOFFETT FIELD
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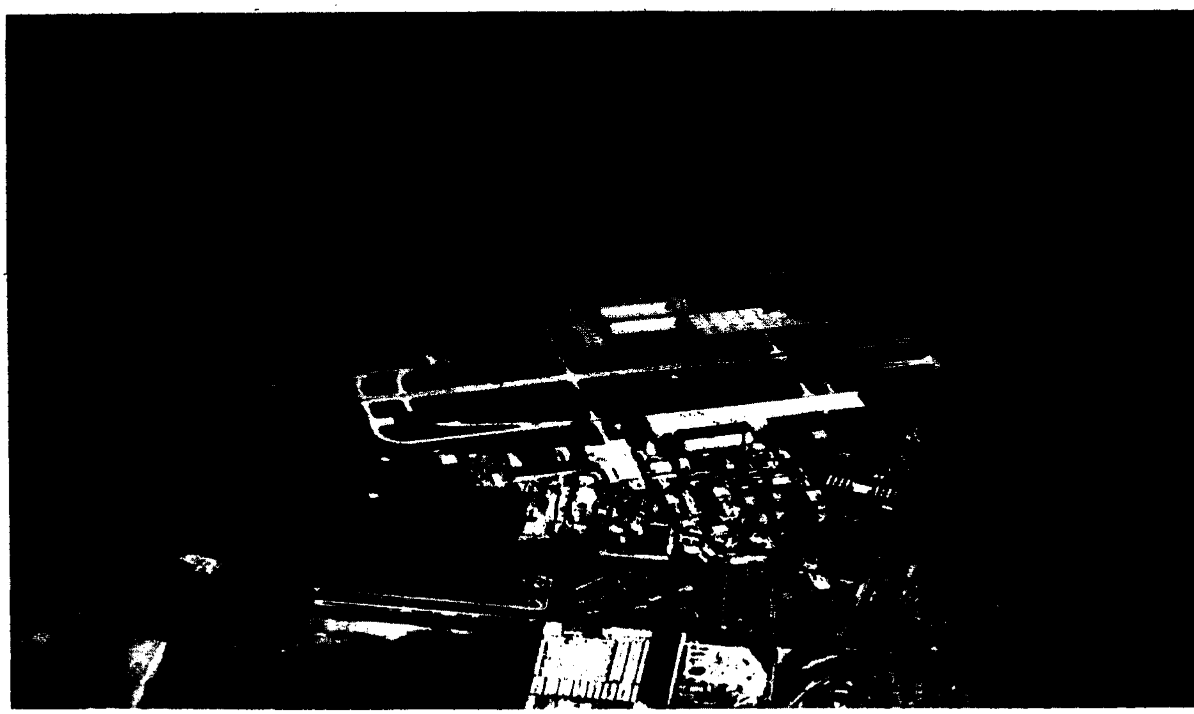
CONFIRMATION STUDY (VERIFICATION STEP)

MOFFETT FIELD NAVAL AIR STATION

VOLUME I



for

Department of the Navy
Western Division
Naval Facilities Engineering Command
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April 1986

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CONFIRMATION STUDY
(VERIFICATION STEP)

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NAVAL AIR STATION

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ESA Project 3110D

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NAVAL AIR STATION

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LIST OF APPENDICES

1. INTRODUCTION

This report presents the results of a Confirmation (Verification Step) Study of the Naval Air Station, Moffett Field, California, performed by Earth Sciences Associates, Inc. and James M. Montgomery, Consulting Engineers for the Western Division, NAVFACENGCOM. This work was authorized under contract number N62474-84-C-5089. The original contract to perform the field investigation (excluding groundwater sampling) was authorized on June 14, 1985. A contract modification to perform groundwater sampling, chemical analyses and reports preparation was negotiated on August 19, 1985. The studies carried out were performed in accordance with the work plan prepared for the U.S. Navy by the Earth Sciences team and reviewed by the various regulatory agencies.

The report is subdivided into two separate volumes:

Volume 1 - Main Report

Volume 2 - Field Investigations (Appendices)

The results of laboratory analyses on soil and groundwater samples are presented in four separate volumes which have previously been submitted to the Navy.

The main purpose of the Verification Step Study (Step I) is to establish the presence of contamination at each of the ten study sites. Previous studies had already established the presence of certain chemical compounds at several of the sites in the vicinity of Hangars 2 and 3, so that at these locations some characterization work was also included as part of the overall study.

This report contains detailed information on the geology and geohydrology of the Moffett Field NAS and includes the results of laboratory analyses on representative soil samples, and on groundwater samples from new and existing wells located within the study area. The soil samples selected for analyses were obtained during the field drilling operations. The groundwater samples were taken approximately one month apart for a period of three months. Information on the level and extent of contamination at each of the ten sites investigated as part of the overall study is also presented. The following information is included as part of this report:

1. Map of Moffett Field showing all on-site well locations.

2. Boring logs for all wells and shallow auger borings drilled as part of this investigation.

3. Well construction diagrams.

4. Geophysical logs and interpretation for all "B" and "C" wells.

5. Groundwater level readings and elevations of all wells.

6. Geologic cross sections showing subsurface geology.

7. Contours of groundwater levels in "A" and "B" aquifers.

8. Discussion of regional hydrogeologic conditions.

9. Discussion of groundwater geology, subsurface geology and groundwater at Moffett Field.

10. Summary of results of laboratory chemical analyses.

11. Discussion of level and extent of contamination at each of the ten sites investigated.

12. Concentration contours for various compounds within the "A" aquifer.

13. Survey of private wells located within Moffett Field.

14. Discussion of field investigations including drilling, soil sampling, well installation and development, health and safety procedures and groundwater sampling.

2. REGIONAL HYDROGEOLOGIC CONDITIONS

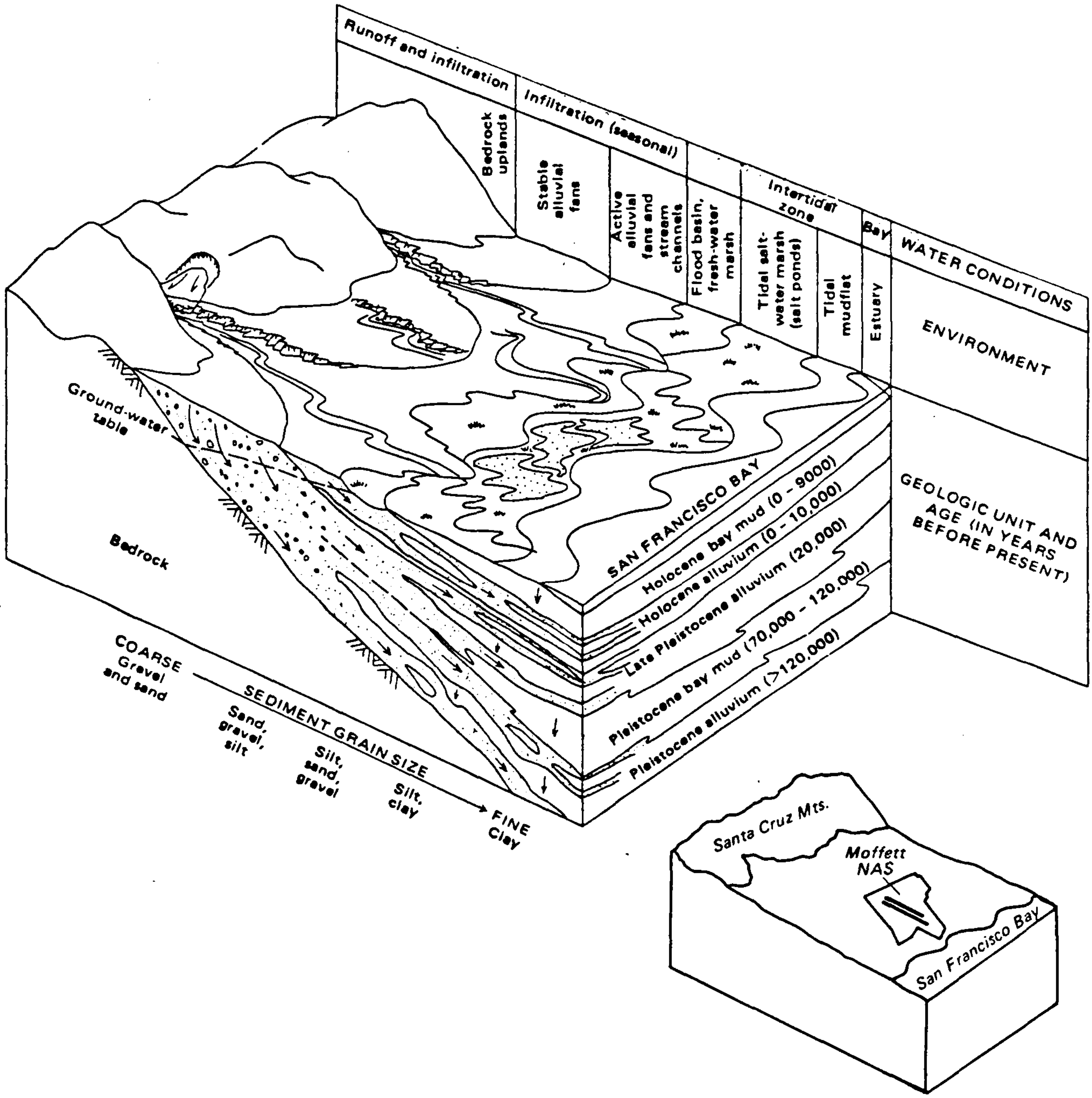
NAS Moffett Field is located in the Santa Clara Valley groundwater basin, which occupies one of several large northwest-trending valleys in the Coast Ranges of California. The Santa Clara Valley is a gently northward-sloping trough cut into bedrock and filled with unconsolidated to semiconsolidated sediments as much as 1500 feet thick near the center (Iwamura, 1980), then thinning to feather edges along the margins. The Santa Cruz Mountains form the western boundary of the valley and its corresponding groundwater basin and the Diablo Range lies to the east. The northwestern part of the trough has been intermittantly inundated by the Pacific Ocean since about one million years ago (Helley and others, 1979) to form the southern arm of San Francisco Bay. This inundation has been periodic as sea level rose and fell in response to climatic fluctuations; during warm periods the basin was partially flooded and marine sediments accumulated in the bay; during colder, glacial periods, sea level was lowered as much as 300-400 feet below its present elevation and alluvial and lacustrine sediments would slowly accumulate in the basin. The maximum average rate of alluvial deposition near Sunnyvale, for example, was less than 5 inches per 1000 years (Meade, 1967). About 10,000-11,000 years ago, the sea entered the Golden Gate once again, gradually spreading to its present elevation by 5,000-6,000 years ago.

The unconsolidated basin-fill deposits consist of interbedded layers, tongues, and lenses of gravel, sand, silt, and clay as depicted on Figure 2-1. The coarser-grained sands and gravels that readily transmit water (aquifers) were deposited on the flood plains of streams by relatively fast-moving water. The finer-grained clays and silts that restrain or restrict groundwater flow (aquitards) were deposited in slow-moving or still water in and along the Bay as well as in relatively flat interfluvial marsh areas. Individual beds generally are thin and of limited areal extent as a result of transgressions and regressions of San Francisco Bay and because of lateral shifts of stream channels on the alluvial fans of the bay margins.

The natural pattern of groundwater flow in the Santa Clara Valley prior to groundwater development during historic times was generally parallel to the slope of the land surface. Groundwater commonly flows directly from the foothills towards the Bay, but surface water channels also influence directions of groundwater flow both laterally and vertically. Groundwater recharge along the margins of the basin has components of flow both downward and away from the streams. In areas of natural groundwater discharge, the components of flow are upward and toward the streams. This pattern of groundwater movement still exists locally in aquifers less than about 100 feet deep.

During the past several decades the flow regime in deeper aquifers, particularly those more than 250 feet deep, has been affected markedly by intensive groundwater extraction. Groundwater was first used in the early 1900's chiefly for irrigation, but more recently municipal and industrial use has become dominant. Groundwater levels originally were within a few feet of the ground surface with the piezometric head locally above the land surface (artesian). Currently in much of the basin, water levels in wells that tap deeper aquifers are more than 100 feet below sea level. The potentiometric head in wells that tap shallow aquifers (a few tens of feet deep), particularly at points within several miles of the Bay, generally is above sea level. The difference in water levels in wells of varying depths is the result of separation of aquifers at varying depths by extensive clay and silt layers plus differences in extraction and recharge.

Many regional groundwater investigations have been conducted in the Santa Clara Valley basin area that includes the site (see Clark, 1924; Tolman and Poland, 1940; California State Water Resources Board, 1955; Poland and Green, 1962; Poland, 1971). The most comprehensive studies were by DWR (1967; 1975) and by Iwamura (1980). These studies were concerned chiefly with the zones more than 100 feet deep that have been extensively developed for groundwater supplies. An ever increasing number of local studies are being made of the groundwater in zones less than 50 feet deep, primarily for hazardous waste investigations (see Goldman, 1969; Howland, 1976; Brown, 1978; EMCON Associates, 1983a, 1983b; Canonie Environmental, 1983; Canonie Engineers, 1985a, 1985b; ESA, 1985, 1985b; Hamlin, 1985). These studies are concentrated in the industrialized areas of the Santa Clara Valley. Several investigations are being conducted in the Mountain View area, up-gradient of Moffett Field.



Notes:

1) Modified from Helley and others (1979).

2) Arrows indicate direction of ground water movement.

Earth Sciences Associates
Palo Alto, California

CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
BLOCK DIAGRAM SHOWING HYDROGEOLOGIC FEATURES OF THE SAN FRANCISCO BAY PLAIN

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3. GROUNDWATER GEOLOGY IN THE VICINITY OF MOFFETT FIELD

Since NAS Moffett Field is located near sea level, the deposits that underlie it are largely water saturated. The occurrence and flow of groundwater plus any water-soluble contaminant within these deposits is dependent upon the nature of material it is in, particularly the porosity and permeability of the material, and on differential pressures gradients which cause groundwater movement. Therefore an understanding of the nature of underlying geologic deposits and the sources of groundwater infiltration and extraction or effluent flow is necessary to achieve the objectives of this investigation.

3.1 Nature and Extent of Geologic Units

NAS Moffett Field lies on flat, gently north-sloping (about 25 feet per mile) terrain near the south end of San Francisco Bay. The Station's northern boundary is near or at the salt evaporators or marshlands that limit the present extent of the Bay although in the mid-1800's the Bay margin extended further inland to the vicinity of the northern end of the runways (Nichols and Wright, 1971). The present, straightened channel of Stevens Creek has been cut due-north through the site west of Ames Research Center. Other abandoned distributory channels of the Stevens Creek drainage can be identified on topographic maps as very low ridges and are shown on Figure 2 as northward-pointing fingers of medium-grained alluvium. The source area of this alluvium and all alluvial sediments beneath the site is the Santa Cruz Mountains lying several miles to the south and west.

Figure 3-1 shows the geologic units exposed at the ground surface in the site area. All of these units consist of geologically young sediments less than about 2 m.y. old. They are mapped on the basis of age, predominant grain size, and physiography.

The Santa Clara Formation underlies the Santa Cruz Mountains foothills near Los Altos southwest of Moffett Field. Alluvial fan deposits of conglomerate or gravel predominate in much of the formation but interbedded sandstone, siltstone and clay is common. Lake beds as thick as 150 feet have been reported by Dibblee (1966) at the base of the unit near Stevens Creek Reservoir. Due to lithologic similarities with overlying younger alluvium, the top of the Santa Clara Formation has not been identified beneath Moffett Field. The base of the formation rests unconformably on Franciscan bedrock and lies at depths greater than 1500 feet in the central part of the valley. The age of this weakly to moderately indurated formation is early Pleistocene (0.7-1.6 m.y.), and possibly in part late Pliocene (less than 3.4 m.y.).

Late Pleistocene alluvium underlies the gently sloping apron that forms the transition from the Santa Cruz Mountains upland to the of Santa Clara Valley floor. Weakly consolidated, interbedded gravel, sand, silt, and clay grades progressively more fine-grained with increasing distance from the mountain front. The alluvium was deposited by streams graded to much lower stands of sea level than now exist. The age of these deposits is at least 10,000 years and may reach as much as 70,000 years (Helley and others, 1979). From the irregular band outcropping near Los Altos, late Pleistocene alluvium extends at depth northward beneath Moffett Field. The top of the unit is at about -160 feet elevation at Dumbarton Strait (Atwater and others, 1977), -140 feet elevation at Palo Alto baylands (Howland, 1976), and probably near -150 feet elevation at Moffett Field although nothing distinctive has been found in exploration at the site to confirm this generalization. The base of the unit rests with angular unconformity over the Santa Clara Formation and lies at depths of about 540 to 650 feet in the site area (Bishop and Williams, 1974).

Four unconsolidated Holocene (10,000 years or younger) alluvial units are indicated on Figure 3-1. These units are differentiated on the basis of predominant grain size, and therefore depositional origin, with finer material occuring to the north with increased distance from the source. The oldest of these sediments are 5,000 to 7,000 years in age (Helley and others, 1979) and are presently being deposited except where the source channels have been altered by flood control measures. Since the Holocene alluvial units were (and still are) deposited with sea level essentially at its present elevation, these units occur at the ground surface and are generally less than 10 feet thick. Coarse-grained alluvium (Qhac on Figure 3-1) consisting of sand and silt with gravel becoming more abundant in the south is present south of the Bayshore Freeway, where it forms the distal end of an alluvial fan developed by Stevens and Permanente Creeks. An irregular band of fine sand, silt, and clayey silt (Qham on Figure 3-1) parallels the hillfront between El Camino Real and the Bayshore Freeway and extends northward to the Bay's edge as narrow natural levees. Three of these medium-grained levee deposits extend onto Moffett

Field but only the levee bordering the present channel of Stevens Creek is now active. A silt and clay unit (Qhaf on Figure 3-1) rich in organic material, is represented by the fine-grained interfluvial basin deposits that cover much of the ground surface at Moffett Field and to the east and west. These materials were deposited from slow flowing floodwaters that periodically inundated the area and formed ephemeral marshes. Where fine-grained alluvium has come in contact with Bay waters, a transition zone of salt-affected material is produced. This unit (Qhafs on Figure 3-1) was identified as "older San Francisco Bay mud" by Helley and Brabb (1971, sheet 1) but has since been determined to be of alluvial origin (Helley and others, 1979).

Unconsolidated, organic-rich, Bay mud underlies portions of the north end of the runway and is presently being deposited north of Moffett Field. Although Bay mud may be as thick as 120 feet beneath the central part of the bay, the margins thin to less than 1 foot and the thickest deposits beneath Moffett Field are about 5 feet (Bishop and Williams, 1974).

3.2 Geohydrology

All of the sediments that now fill the San Francisco Bay/Santa Clara Valley basin originated in the surrounding highlands or were deposited either by streams flowing across the bay and valley margin, or from still waters in the central part of the depression. These sedimentary processes resulted in an original depositional slope away from the surrounding hills, decreasing in gradient toward the center of the basin as shown on Figure 2-1. Grain size also tends to decrease with increasing distance from the source. Groundwater flowing through the resultant sedimentary sequence follows the same general paths as the surface waters that deposited them. Near the hillfront where deposits of sand and gravel predominate, unconfined groundwater accumulates in essentially one aquifer on the bedrock surface; but near the Bay, where gently dipping sand and gravel aquifers are separated by nearly impermeable aquitards, groundwater is typically confined and under pressure, due to transmission of hydrostatic head from upgradient parts of the aquifers.

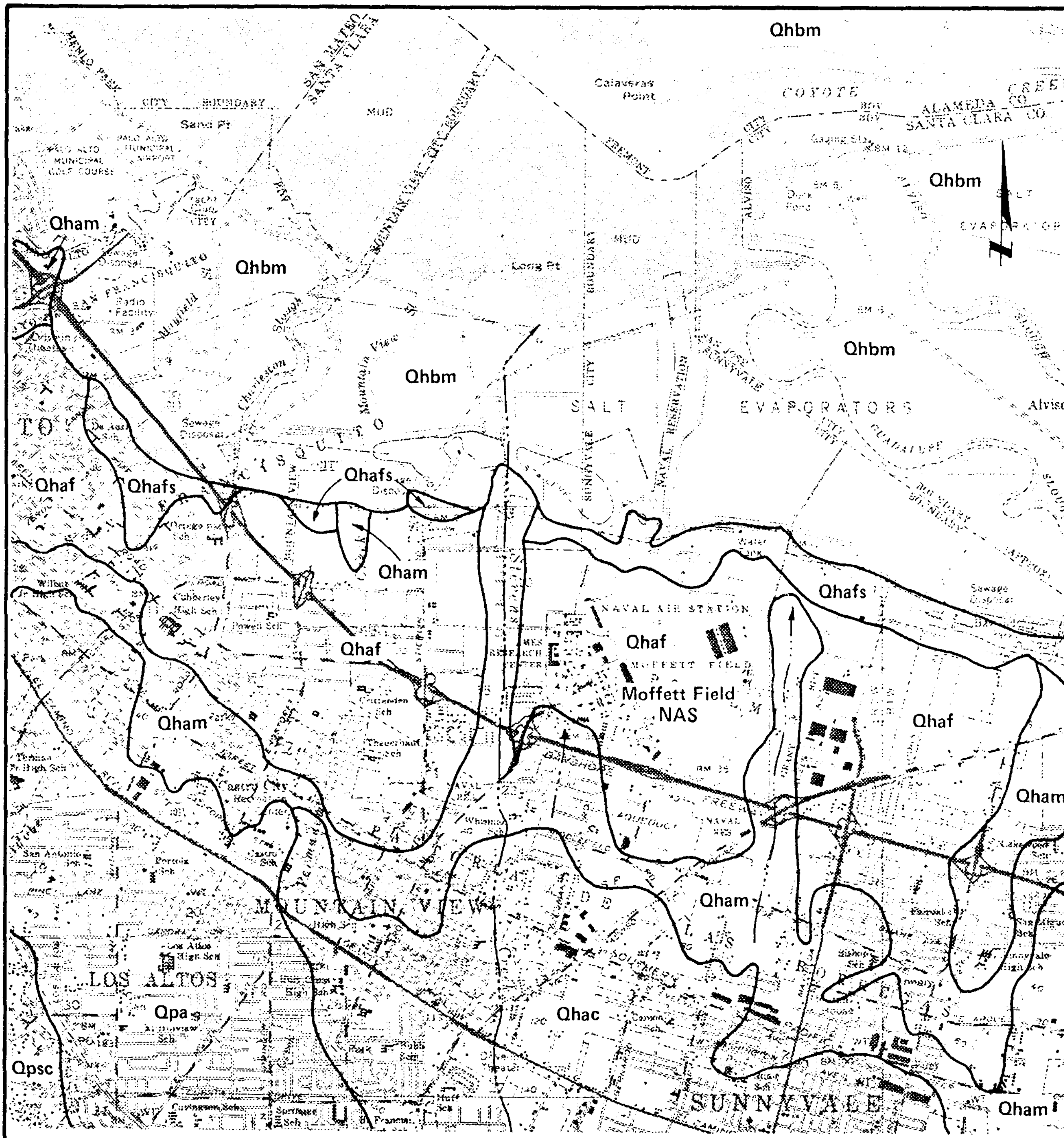
Aquifers of the south Bay plain have recently been divided into two broad units, a deep and a shallow zone, based on the occurrence of confined aquifers in the deep zone and both confined and unconfined aquifers in the shallow zone (see Howland, 1976; Iwamura, 1980; Hamlin, 1985). These zones are separated by a laterally extensive clay aquitard which is generally at depths of 150 to 250 feet in the mid to lower fan area and at 100 to 150 feet in the baylands area (Iwamura, 1980).

The deep aquifer zone comprises many fully confined sand and gravel aquifers that may be either continuous or discontinuous. Most production wells of the area tap the generally fresh water of this zone because of the high yield that can be attained. During the 1970's, the elevation of the piezometric surface associated with the deep aquifer zone in the baylands area ranged from 25 to 97 feet below sea level (Howland, 1976), although seasonal fluctuations in elevation due to pumping vary widely (Iwamura, 1980).

Shallow zone aquifers in the south Bay region may be either confined or unconfined, and perched or semiperched. In the Palo Alto Baylands northwest of Moffett Field, an upper and lower aquifer have been identified within the shallow zone at depths of 20 and 45 feet respectively (Howland, 1976; Hamlin, 1985). These aquifers are separated by a leaky clay aquitard. Groundwater levels in the shallow zone are within a few feet of the ground surface (Howland, 1976) and show very small seasonal fluctuations (Iwamura, 1980).

Prior to extensive groundwater use, water levels throughout the south Bay area were shallow and the piezometric head within most of the confined aquifers in the central part of the basin was above the ground surface. Lawson and others (1908, p. 408) describe artesian wells along Jagel Landing Road which crossed the land that was to become Moffett Field. By 1924 the area of artesian flow had decreased, retreating northward by 0.1 to 0.5 miles to a location near Middlefield Road in the vicinity of Moffett Field (Clark, 1924, Plate XV) due to increased groundwater use. At present, no wells at Moffett Field flow continuously under artesian pressure although the water level in 3 deep wells periodically rises to the ground surface. Well 14M1, drilled to a depth of 1000 feet but presently inactive, has been fitted with an overflow pipe located about 2 feet below the ground surface to control flooding of the pump house. Well 14M2, drilled to a depth of 1020 feet, is also presently inactive and shows signs of artesian pressures. The water levels in both of these wells apparently rise during the winter and fall in the summer. Water flowed from monitoring well W3-1C after its construction but has since stabilized at about 1 foot in depth.

Saltwater intrusion has occurred at various places around the perimeter of the south San Francisco Bay. The source of this contamination is either saline Bay water which has migrated into the aquifers through natural permeable zones and poorly constructed wells, or saline connate water. The very high chloride concentrations (higher even than seawater) from shallow zone aquifers at the Palo Alto bayfront, 3 miles northwest of Moffett Field, are believed to represent connate water trapped during original deposition in an evaporative marsh environment (Iwamura, 1980; Hamlin, 1985). Elsewhere around the bay, including at Moffett Field, saltwater intrusion of the shallow aquifer has been induced when pumping reversed the original bayward hydraulic gradient and allowed seawater into the aquifer. As of September 1980, saline water had intruded into the shallow aquifer southward to an area beneath the Moffett golf course and a diffusion aureole of decreasing chloride content extends further to an area near the Bayshore Freeway (Iwamura, 1980, Plate 3). The deep aquifer generally yields fresh water and is only locally contaminated with seawater from improper well construction or abandonment procedures coupled with heavy pumping (Hamlin, 1985). No excessive chloride concentrations have been detected near Moffett Field as of September 1980 in the deep aquifer in an area between Stevens and Guadalupe Creeks (Iwamura, 1980, Plate 8).



EXPLANATION

Map Units

Quaternary — Holocene:

Qhbm	Bay Mud.
Qhafs	Fine-grained salt-affected alluvium.
Qhaf	Fine-grained alluvium.
Qham	Medium-grained alluvium.
Qhac	Coarse-grained alluvium.

Quaternary — Pleistocene:

Qpa	Late Pleistocene alluvium.
Qpsc	Santa Clara Formation.

Map Symbols

Geologic contact.

Stream channel; arrow points in direction of flow.

Note: Geology compiled from Diblee (1966), Helley and Brabb (1971), and Helley and others (1979).

0 1 2 Miles

Scale: 1:62,000

Base Map: USGS 15' Palo Alto, Calif. Quadrangle.

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Palo Alto, California

CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
SURFICIAL GEOLOGY MAP OF MOFFETT FIELD AND VICINITY

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4. SUBSURFACE GEOLOGY AT MOFFETT FIELD

Information on the deeper, saturated sediments underlying NAS Moffett Field is provided by three deep wells drilled on the base (see Appendix G). The U.S. Geological Survey participated in an exploratory boring drilled at Ames Research Center in early 1973. This borehole was completed in bedrock at a total depth of 1426 feet. A bulk density log of the hole indicates the base of the sedimentary section lies at elevation -1380 feet. Two currently unused water wells (M1 and M2) were developed in the central part of the base near the intersection of McCord Avenue and Wescoat Road. Although only drillers logs of these borings are available, the logs appear to be conscientiously made and show an interbedded sequence of clay and gravel with minor sand lenses to depths of 1000 and 1020 feet, the total depth of each well. The probable top of the Santa Clara Formation is interpreted as the "cemented gravel" at 637 feet depth in M2 and as "hard gravel" at 621 feet depth in M1. No distinguishing characteristics separate the sediments above and below this contact. An increase in the overall amount of gravel occurs below a depth of 303 feet in well M1 and below 272 feet in well M2. The occurrence of yellow clay below this depth in well M1 suggests a change in depositional environment at this horizon from more oxidizing below to reducing above.

Drilling for this step of the Confirmation study has yielded detailed lithologic and geophysical logs to a maximum depth of 250.5 feet. Interpretation of these logs shows the strata underlying Moffett Field to be composed of alternating layers of clay, silt, and sand, with minor thin beds of gravel. Table 4-1 shows the relative distribution by sediment type in each of the rotary wash boreholes. This summary indicates three fourths of these sediments are clay (67%) or silt (6%) aquitards, and one fourth are aquifers of sand (26%) or gravel (1%).

Because of the interlensing nature of the alluvial sediments underlying Moffett Field, the generally widely spaced boreholes, and differences in logging, correlations between various intercepted strata are difficult. Where correlations can be made, stratification is found to dip very gently in a northward direction parallel to the slope of the land surface. This slight inclination is due to the original depositional slope and is modified locally by land subsidence. The greatest amount of subsidence, more than 7 feet during the 1934 to 1967 interval (Iwamura,

Table 4-1

LITHOLOGY OF MOFFETT FIELD SEDIMENTS

Well No.	Gravel	Sand	Silt	Clay
W3-1B		38%	3%	59%
W3-1C		29%	4%	67%
W3-2B		28%	14%	59%
W3-3B		16%	2%	82%
W4-1B	4%	25%	2%	69%
W6-1B		38%	8%	55%
W7-3B		19%	8%	73%
W10-1B		23%		77%
W10-2B	3%	24%	11%	62%
overall	1%	26%	6%	67%

1980, Plate 2), occurred in the southeastern part of the NAS. The pattern of subsidence there would tend to locally warp the strata to a slightly lower than original gradient.

4.1 Site 1: Runway Landfill

The Runway Landfill is located within the boundary of the City of Sunnyvale between Zook Road and the Leslie Salt Company evaporation ponds at the north end of the runways. The history of development of this site can be seen on a thirty-year series of aerial photographs dating from 1947. The earliest photographs show the area with an east-west-trending dike constructed between the present pistol range and Zook Road, and separating a salt evaporator to the north from a marshland crossed by Jagel Slough, a canal, and dirt roads to the south. Historically, the entire site was part of the San Francisco marshland (Nichols and Wright, 1971). By 1956 runway construction was extending bayward and by 1960 the entire site area was diked off and Jagel Slough diverted to the east. Photographs of 1967 show the ground generally west of auger hole A1-2 on Figure 4-1 as grass-covered and little changed since 1960; the area of the "pistol range", though, was receiving fill. The 1977 and later photographs show the site much as it is today.

Three stratigraphic units were encountered in the exploratory borings augered in the Runway Landfill site: fine-grained alluvium, Bay Mud, and fill. Holocene age alluvium, consisting of bluish-gray to light olive-brown sandy clay and locally clayey sand, is the lowermost unit of the penetrated section. The saturated, fine-grained sediments of this unit, as penetrated at the base of borings W1-1A, W1-2A, W1-3A, A1-2, A1-3, and A1-4, are dense and stiff, requiring 7 to 32 blows/foot in the Standard Penetration Test. Borings W1-1A, W1-2A, W1-4A, A1-1, and A1-2 penetrated medium dark gray to black, saturated, sticky, organic clay containing thin peat lenses; this material locally overlies the fine-grained alluvium and constitutes the Bay Mud unit at this site. Standard Penetration Tests in this soft to very soft unit require only 2 to 6 blows/foot. Two types of fill are present at this site (see Figure 4-1). The uppermost fill is a yellowish-brown to black, clayey or gravelly soil that covers the entire site. This material probably originated as spoil from local grading operations. Beneath this throughout much of the interior of the site lies refuse fill debris including cans, plastics, wood, concrete, asphalt, paper, and rags. Methane has locally accumulated to dangerous levels within this fill material and caused boreholes A1-5 and W1-4A to be abandoned and redrilled nearby. Auger boring A1-4 was terminated short of its anticipated depth due to high methane levels. A measurement of 100% LEL at a depth of 6 feet was recorded in the abandoned W1-4A borehole (see Appendix F).

Figure 4-1 shows the subsurface distribution of both earthfill and refuse fill at the Runway Landfill site based on exploratory borings and aerial photograph interpretation. Contours are drawn on the contact separating either earthfill or refuse fill from Holocene deposits of Bay Mud or fine-grained alluvium. The irregular basal contact of the fill follows the original contours of the salt pond and extends as deep as 12.7 feet below sea level.

4.2 Site 2: Golf Course Landfill

The Golf Course Landfill lies between Marriage and Zook Roads, adjacent to a salt evaporation pond. The dike separating salt water from land as shown on our earliest aerial photographs of 1947 was constructed along the historical Bay margin (Nichols and Wright, 1971). These photographs and the series of 1950 show a loop road crossing the site providing access to several firing ranges and bordered locally by what appears to be trailers or large crates. Several areas had been disturbed apparently by spreading thin layers of soil, but no large mounds or depressions can be seen. By 1956, Macon Road had been constructed through the site, debris adjacent to the loop road and all but one of the firing ranges had been removed, several buildings were constructed adjacent to the loop road, and most of the fields at the site were under cultivation. From 1956 to 1963 the site remained unchanged except for the construction of a few structures near the salt pond boundary. The existing golf course was under construction in the 1967 photographs. This involved removal of all but one section of the loop road turning northeast from Macon Road near building 253, removal of the firing range and most of the peripheral buildings, construction of water hazards and low landscape berms for the golf course. This was the last period of grading at the site.

Fine-grained yellowish-brown to olive-gray alluvial sediments underlie the Golf Course Landfill. These sediments are described as being salt-affected by Helley and others (1979) although no signs of this were observed in our exploration of the site. Borings W2-1A, W2-2A, and W2-3A penetrated sandy clay to a total depth of 25 feet. This low to high plasticity clay contains 20%-40% fine- to coarse-grained sand. A 3- to 12-foot-thick clayey sand layer divides the sandy clay into 2 units as shown on Cross Section A-A' (Figure 4-2). The fine- to-coarse-grained sand contains 30% to 40% low plastic fines and constitutes the "A" aquifer at this site.

Black sandy clay topsoil forms the uppermost 3.5 to 4 feet of section at each drill site except that of A2-1. This soil probably developed in place based on its lithologic similarity to underlying material but may also be partly imported fill.

No debris-type fill similar to that encountered at the Runway Landfill was penetrated by any of the 6 auger borings drilled at the site. The uppermost 4.5 feet in boring A2-1 was identified as fill and consisted of brown gravelly sand composed of less than 20% fines, about 50% fine- to coarse-grained sand, and about 30% gravel. Similar material was found in boring A2-2 at depths of 6.5 to 7.5 feet and is believed to be fill based on similarities to the fill in A2-1 and dissimilarities to the fine-grained alluvium in the area. Well W2-1A is also probably located on fill soil based on its elevation (2.7 feet) above the surrounding terrain.

4.3 Site 3: Marriage Road Ditch

The Marriage Road Ditch drains surface waters and any intersected ground-water northward from the intersection of Marriage and Macon Roads across the flat alluvial plain to the northern boundary of Moffett Field. From this point the water is pumped into a perimeter canal south of the salt evaporation ponds, eventually flowing into the Guadalupe Slough through Moffett Channel. The ditch was constructed adjacent to the east side of Marriage Road prior to the 1947 aerial photographs and originally extended across Macon Road to the Hangars 2 and 3 aprons. Boreholes MW-17A, MW-17B, MW-18, and MW-19 were drilled at Site 3 in 1983 by EMCON (1983b). A gamma ray log of the deepest hole, MW-17B, was made during this investigation (see Appendix B4).

A total of 7 boreholes were drilled at this site ranging in depth from 20 to 250.8 feet. The "B" and "C" series borings were drilled with rotary wash methods and downhole geophysical logs were made to supplement the drilling and sampling logs (see Appendix B2). The interpretation of the resistivity logs is complicated by saltwater intrusion into the upper sedimentary layers. Saltwater, being a better conductor of electricity than fresh water, is indicated by low resistivity (curve scribed to the left of graph), as shown on the upper part of the 6-foot lateral curves of borings W3-1B, W3-2B, and W3-3B. Since all rotary-wash borings were drilled using fresh water, invasion of the drilling fluid into the formation would create a zone of higher resistivity adjacent to a well bore drilled into saline waters. Therefore, the short normal curve, which measures resistivity within a closer distance to the borehole than the long normal curve, will be traced to the right of the long normal curve under these conditions. This reversal can be seen in logs of the upper 60 feet of borings W3-1B and W3-2B and in the upper 30 feet of W3-3B. The presence of saline water in the upper sections of these boreholes is further suggested by high conductance values (see Section 6) for adjacent "A" aquifer wells. Interpretation of these logs (see Figures 4-3, 4-4, 4-5, and 4-6) indicates the site is underlain by an interbedded sequence of fine-grained alluvial sediments. Sandy aquifers constitute 16% to 38% of the materials penetrated (see Table 4-1) with silt or clay aquitards composing the remainder.

Borehole W3-1C, the deepest drilled during this phase of investigation, penetrated three permeable units that correspond to divisions identified during research in the surrounding region (e.g. Iwamura, 1980; Canonie Engineers, 1985; Hamlin, 1985) (see Figure 4-6). The uppermost unit includes the "A" aquifer and here extends from the ground surface to a depth of 12 feet (elev. -12). This is separated from the middle unit by a 28 foot thick clay aquitard. The middle unit of boring W3-1C includes 6 distinct sand layers that together account for 53% of the unit and constitute the "B" aquifer. These silty sand beds reach as much as 17 feet in thickness and extend from depths of 40 to 127 feet (elev. -40 to -127). The lowermost unit is dominantly gray silty clay but contains 4 silty or clayey sand layers that here form the "C" aquifer. A subtle color change at 150 feet depth (elev. -150) from olive-gray above to gray below suggests the lower unit was deposited in a slightly different environment (more reducing) than the units above.

Correlations between borings at the Marriage Road Ditch site are illustrated on a fence diagram, Figure 4-7. This illustration presents an oblique 3 dimensional view of a block of ground beneath the site. As can be seen, borehole intercepts of various sand layers indicate generally horizontal stratification but interlensing and pinching out is very common. In fact, only the "B1" aquifer can be traced through all borings and is divided into an upper and lower member ("B1a" and "B1b") in 3 of the 5 borings.

4.4 Site 4: Former Industrial Wastewater Holding Pond

A former Industrial Wastewater Holding Pond was located north of Hangar 3 and west of the existing ponds (see Plate 1). Monitoring wells MW-7, MW-8, and MW-14 were installed south of the pond and wells MW-9, MW-10, MW-11 installed to the north in May of 1983 (EMCON, 1983a). Well MW-15 was added between MW-8 and MW-14 in November 1983 (EMCON, 1983b). Three down-gradient monitoring wells were installed north of the pond during this investigation.

Borehole W4-1B, drilled immediately north of the former pond, penetrated 200 feet of olive-gray to brown fine-grained alluvium (see Figure 4-8). This boring contained the least amount (13%) of sand or gravel aquifers of any of the "B" or "C" series boreholes drilled for this investigation. Sand aquifers were encountered at depths of 35 to 44 feet (elev. -30 to -39), 120 to 124 feet (elev. -115 to -119), 129 to 131 feet (elev. -124 to -126), and 193 to 196 feet (elev. -188 to -191); a silty gravel aquifer was penetrated between depths 174 and 182 feet (elev. -169 to -177). Several silt beds of low permeability were found between depths of 66 to 155 feet (elev. -61 to -150).

Stratigraphic correlations of sediments beneath the site are indicated on Figures 4-2 and 4-9. These cross sections show the "A" aquifer pinching out on either side of the former pond and the highest continuous aquifer beneath the site being the "B1" at a depth of about 35 feet.

4.5 Site 5: Fuel Farm French Drains

The Fuel Farm French Drain site is located in the triangular area bordered by Macon Road, Patrol Road and the golf course (see Plate 1). This area was developed in the interval between air photo flights of 1950 and 1956 and appears unchanged since that time although fuel dumping there was stopped in the 1960's.

Since the expected contaminant at this site is lighter than water, only shallow borings were completed in the area. A total of 6 boreholes were augered. Each penetrated 3 to 5½ feet of expansive black silty clay topsoil, overlying olive- to yellowish-brown sandy clay extending to depths of 30 feet. The sandy clay contains 10% to 40% fine- to medium-grained sand and low to medium plastic fines. A 7-foot-thick layer of silty clay was penetrated in boring W5-3A and lenses of clayey or silty sand were encountered at depths of 12 to 14½ feet (elev. 1½ to -4) and 16½ to 18 feet (elev. -6 to -8½) in borehole W5-1A. These sand lenses which constitute the "A" aquifer are not continuous across the site (see Figure 4-10).

4.6 Site 6: Runway Apron

The Runway Apron disposal site was located in the area adjacent to the former aprons north and east of Hanger 3. This site was paved over in 1979 during enlargement of the apron. EMCON (1983a; 1983b) installed monitoring wells MW-6, MW-7, MW-8, MW-14, and MW-15 at the site in 1983. Wells W6-1A and W6-1B were installed here during this investigation (see Plate 1).

Typical fine-grained alluvial soils were found to underlie the site (see Figures 4-2, 4-9, and 4-10). As shown on Figure 4-11, boring W6-1B penetrated 5 silty sand aquifers comprising 38% of the borehole, and separated by silty and sandy clay aquitards of fairly uniform thickness (5 to 11 feet). The sand layers are olive-gray to olive-brown in color, containing fine- to coarse-grained sand and commonly 10% to 15% fine gravel.

4.7 Site 7: Hangars 2 and 3

Hazardous waste accumulated in the unpaved area surrounding Hangars 2 and 3 and flowed in deck drains to the Marriage Road Ditch (ESA, 1985). Nine monitoring wells (MW-1 through MW-5, MW-12A and B, MW-13, and MW-20A and B) have been established by EMCON (1983a; 1983b) at this site; 4 additional wells (W7-1A, W7-2A, W7-3A, and W7-3B) were developed during this investigation (see Plate 2); gamma ray logs were also made of 2 existing wells, MW-12B and MW-20B (see Appendix B4).

Logs of borehole W7-3B (see Figure 4-12) reveal a silty clay sequence with minor thin interbeds of silty sand and silt to a depth of 80.8 feet (elev. -70.5). The olive-brown clays have low to medium plasticity and contain 5% to 10% fine- to medium-grained sand. Sandy aquifers range from 2 to 5 in feet thickness and constitute only 14% of the material penetrated. The 5 foot in thickness silt bed at 20 ft. depth (elev. -7 to -12) may also be an aquifer of low permeability. Two black silty clay layers in the uppermost 7 feet of the borehole are similar to topsoil found elsewhere at Moffett Field and indicate this area has been disturbed by past grading.

A thick bed of gravelly sand encountered at 5.5 feet depth (elev. -6) in boring W7-1A, extended to 30 feet (elev. -19), the total depth of the borehole (see Figure 4-10). This yellowish-brown aquifer is composed of about 70% fine- to coarse-grained sand, about 20% fine gravel, and about 10% silt and low plasticity fines. A few one-foot thick silty and clayey sand lenses were encountered below 17 feet depth. Gravel beds were also logged in borehole MW-12A and MW-12B between depths of 15 and 43 feet (elev. -5 to -33 feet) (EMCON, 1983a) and in W10-2B at depths of 29 to 35 feet (elev. -13 to -19 feet). These sediments probably originated in a Holocene distributary channel. The localized occurrence of the river gravels suggests a north-trending channel of limited areal extent that diagonally traverses the Hangar 2 and 3 area.

4.8 Site 8: Waste Oil Transfer Area

The Waste Oil Transfer Area, located between Zook Road and McCord Avenue (see Plate 2) is underlain by fine-grained Holocene alluvium. Borehole W8-1A penetrated 30 feet of this material including an uppermost 21 feet of sandy clay underlain by a sandy aquifer to the total depth of the boring (elev. -23). This "A1" aquifer is composed of moderate yellowish-brown fine to coarse-grained sands, silty in the upper 5 feet, then becoming clayey and containing less than 10% gravel below. The overlying sandy clay aquitard contains about 20% fine to coarse-grained sand and grades downward from black to moderate yellowish-brown. Six auger holes drilled to two feet depth along the drainage ditch for soil samples show the surficial materials range from clayey gravel to silty clay, generally decreasing in grain size to the east.

4.9 Site 9: Old Fuel Farm

The Old Fuel Farm is located in the block formed by Bushnell Road, Severyns Avenue, North Akron Road, and McCord Avenue (see Plate 2). The site was developed on fine-grained Holocene alluvium and is now essentially covered with buildings and paved parking lots. Eight exploratory auger borings were drilled on this site: six for soil samples, and two for monitoring wells.

Sediments underlying the Old Fuel Farm, as shown on Figure 4-13, are dominantly gray to brown clays to a minimum depth of 11 feet (elev. 8). Below this depth, and to the total depth of exploration (30 feet or elev. -11), thin sand layers ranging from 1 to 2 feet in thickness become common. Good correlations can be drawn between silty clay units, containing 10% or less fine-grained sand, and sandy clay layers with 10% to 40% fine- to coarse-grained sand. The silty sand layers that comprise 39% of the materials between depths of 11 and 30 feet in well W9-1A and 46% of those between depths of 18 and 31 feet in well W9-2A form the "A" aquifer in this location.

4.10 Site 10: Chase Park Investigation

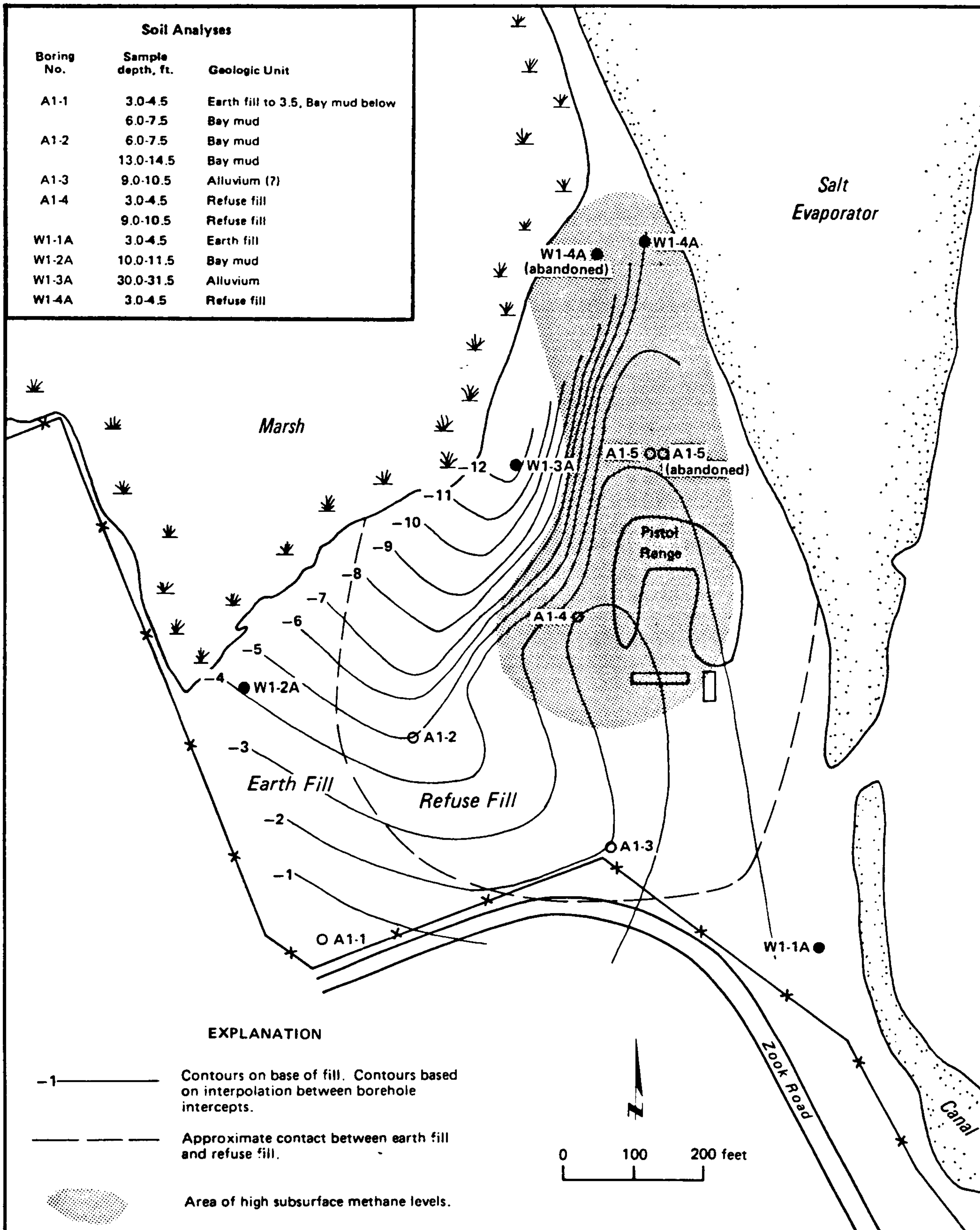
Volatile organic chemicals have been identified in monitoring wells (see Plate 2) installed in the course of an industry-sponsored effort to define a contaminant plume that apparently has migrated northward into the Chase Park area from one or more sources south of Bayshore Freeway (Canonie Environmental, 1983; Canonie Engineers, 1985). No source of contaminants is known in the Chase Park area or along any on-base groundwater flowline upgradient of the Chase Park monitoring wells. Hydrologic and chemical data also indicate an off-site source to the south. Contaminant levels are higher in the "B" than in the "A" aquifer. The piezometric head in the "B" aquifer monitoring wells is higher than the water level in the "A" aquifer, indicating that any contaminant migration between these aquifers is upward. Four boreholes were drilled during this investigation on the runway apron between Chase Park and Hangars 2 and 3 (see Plate 1) to determine if contaminants from the Hangars 2 and 3 area are contributing to the plume at Chase Park.

Borehole W10-2B, drilled to a depth of 200 feet (elev. -184), penetrated the greatest stratigraphic thickness of this area of investigation (see Figure 4-14). About 62% of this boring was drilled in a low to medium plasticity olive-brown to bluish-gray silty clay containing 10% to 30% sand and fine gravel. Several sand interbeds ranging from 2 to 10 feet in thickness occur generally below 85 feet depth (elev. -69). These thin aquifers are composed of about 50% fine-grained sand, 40% to 50% silt to low plasticity fines and less than 10% coarse-grained sand and fine gravel. A gravelly bed in the upper 15 feet of the borehole (elev. +1 to -2) is apparently part of the channel gravels identified in the Hangars 2 and 3 area (see Figure 4-10). A lower clayey gravel at depths of 30 to 35 feet (elev. -14 to -19) may be part of an older channel system in the area.

Borehole W10-1B, drilled 142 feet north-northwest of W10-2B, penetrated similar materials but contained more silty clay (77%) and none of the gravelly sediments (see Figure 4-15). Correlations between the 2 boreholes are poor but suggest a general dip from W10-2B to W10-1B of 2° (see Figure 4-9).

Soil Analyses

Boring No.	Sample depth, ft.	Geologic Unit
A1-1	3.0-4.5	Earth fill to 3.5, Bay mud below
	6.0-7.5	Bay mud
A1-2	6.0-7.5	Bay mud
	13.0-14.5	Bay mud
A1-3	9.0-10.5	Alluvium (?)
A1-4	3.0-4.5	Refuse fill
	9.0-10.5	Refuse fill
W1-1A	3.0-4.5	Earth fill
W1-2A	10.0-11.5	Bay mud
W1-3A	30.0-31.5	Alluvium
W1-4A	3.0-4.5	Refuse fill



EXPLANATION

–1—— Contours on base of fill. Contours based on interpolation between borehole intercepts.

— — — Approximate contact between earth fill and refuse fill.

(stippled area) Area of high subsurface methane levels.

W1-2A ● Monitoring well location; see Appendix B1.

A1-3 ○ Shallow auger boring; see Appendix B3.

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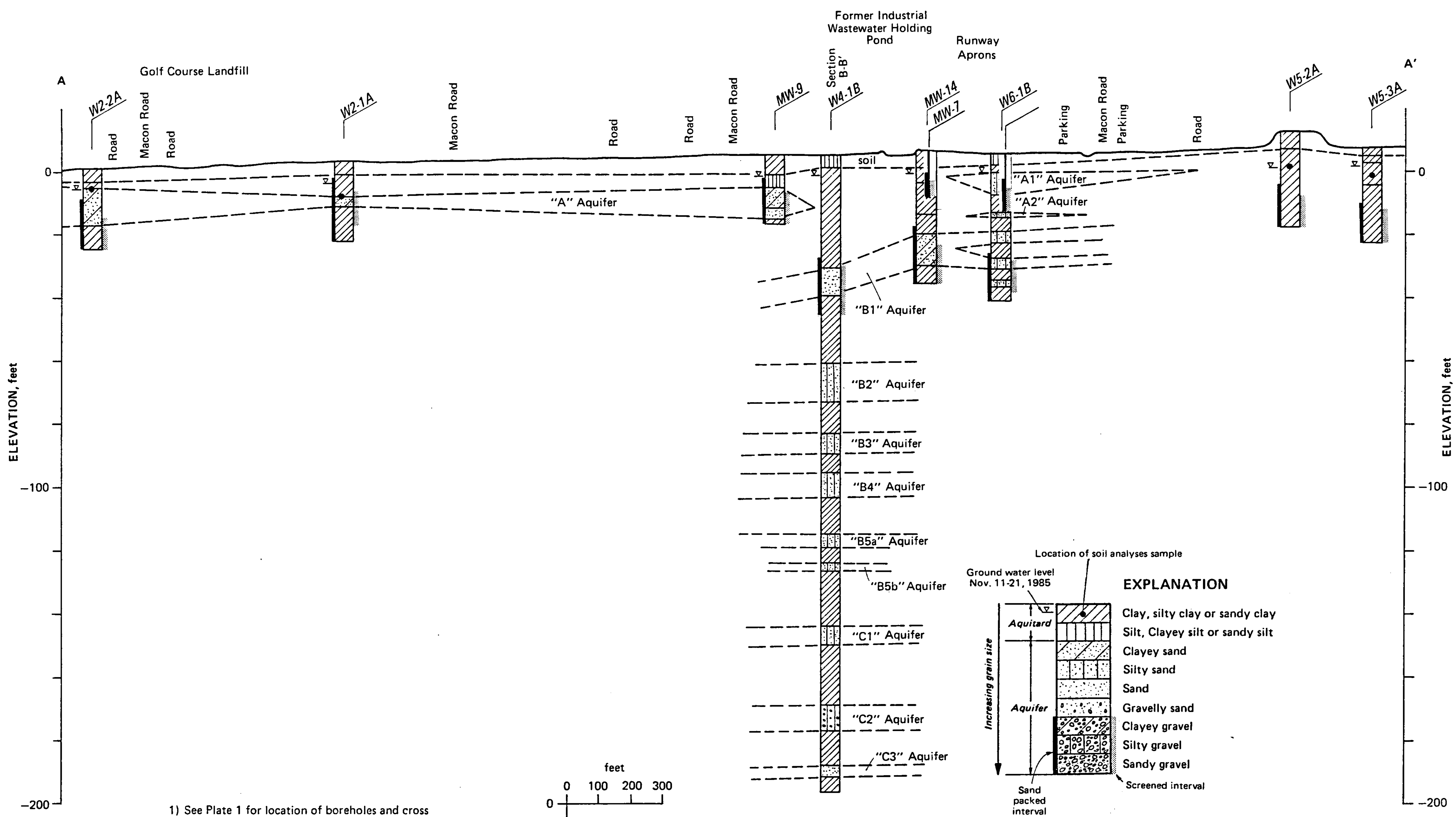
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
CONTOURS OF BASE OF RUNWAY LANDFILL

Checked by / Approved by	Date	Project No.	Figure No.
Checked by L.A. Fry	Date 4/10/86	3110D	4-1
Approved by J.E. Valera	Date 4/10/86		



1) See Plate 1 for location of boreholes and cross section.

2) Subsurface geology is based on borehole intercepts Contacts between strata in widely spaced borings are tentative and meant to show correlations rather than actual conditions.

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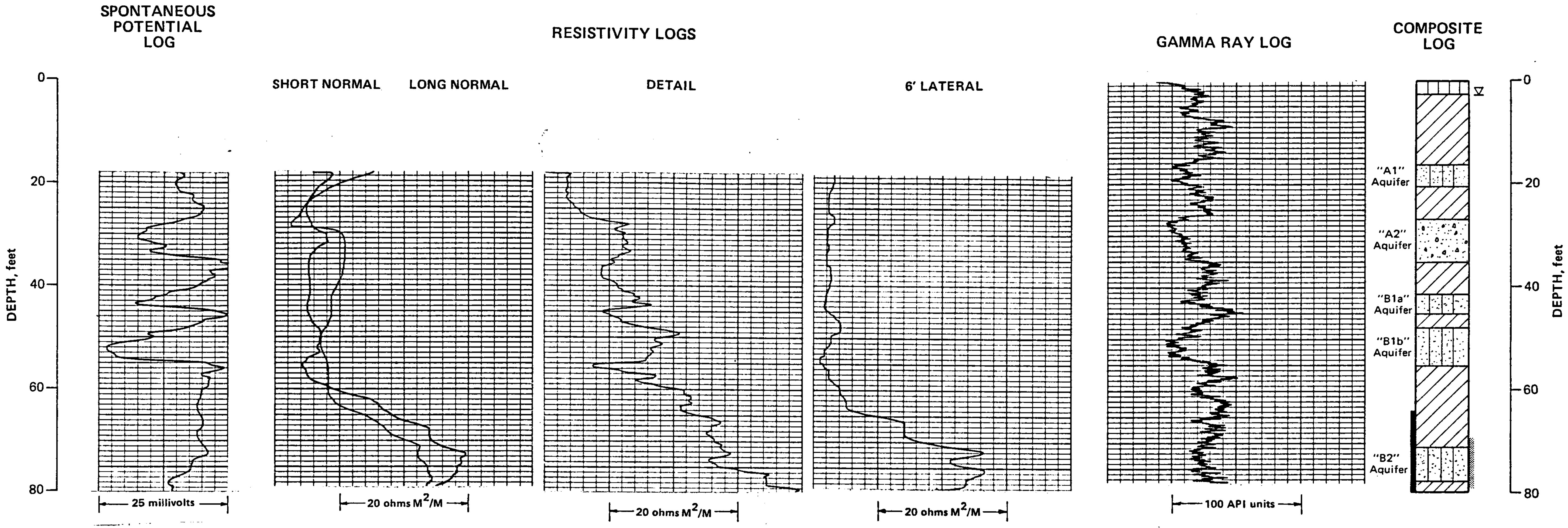
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
GEOLOGIC CROSS SECTION A-A'

Checked by [signature] Date 4/10/86	Project No.	Figure No.
Approved by J.C. Tarera Date 4/10/86	3110D	4-2



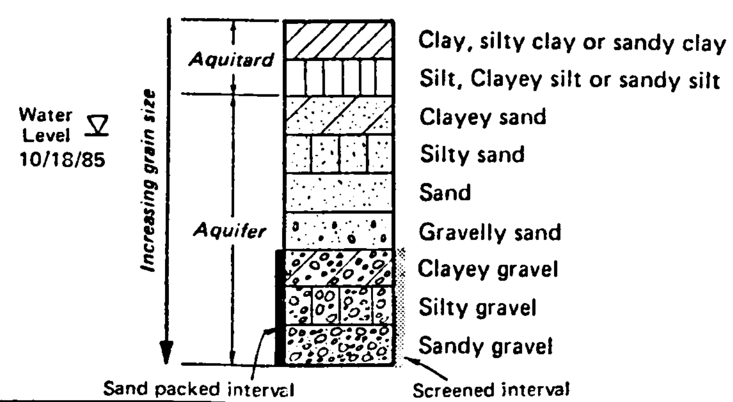
Notes:

1) Well location shown on Plate 1.

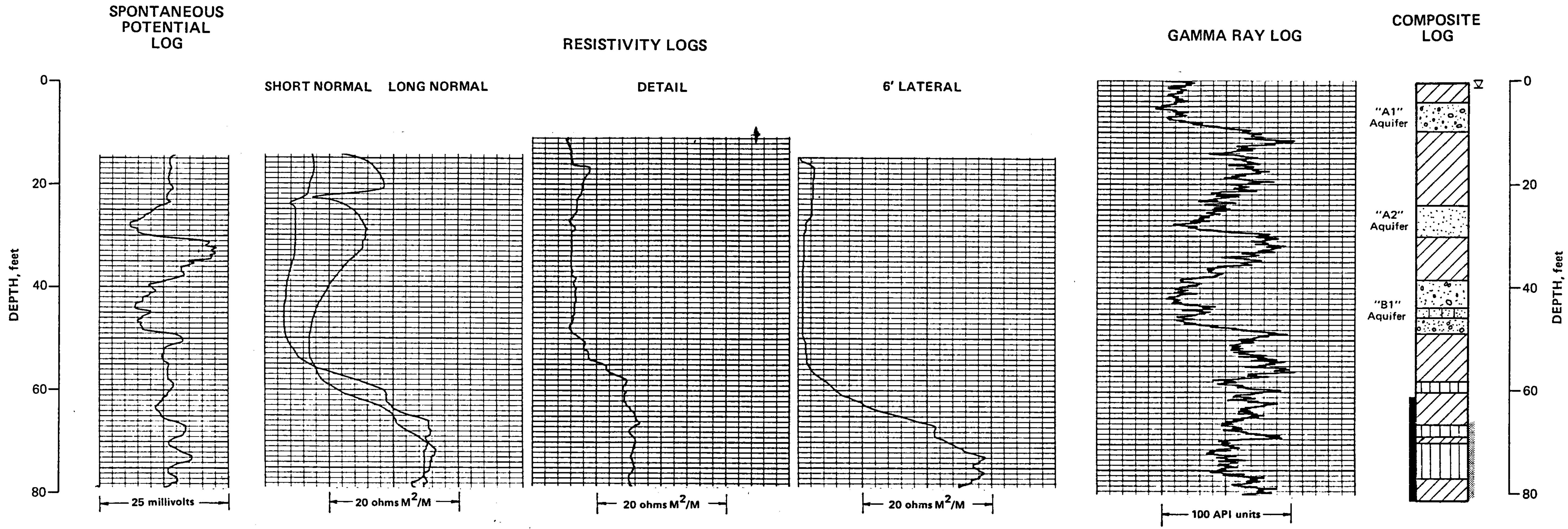
2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



Earth Sciences Associates Palo Alto, California		
CONFIRMATION STUDY (VERIFICATION STEP) MOFFETT FIELD NAS INTERPRETATION DIAGRAM OF MONITORING WELL W3-1B BOREHOLE LOGS		
Checked by [signature] Date 4/10/86 Approved by J. E. Valera Date 4/10/86	Project No. 3110D	Figure No. 4-3



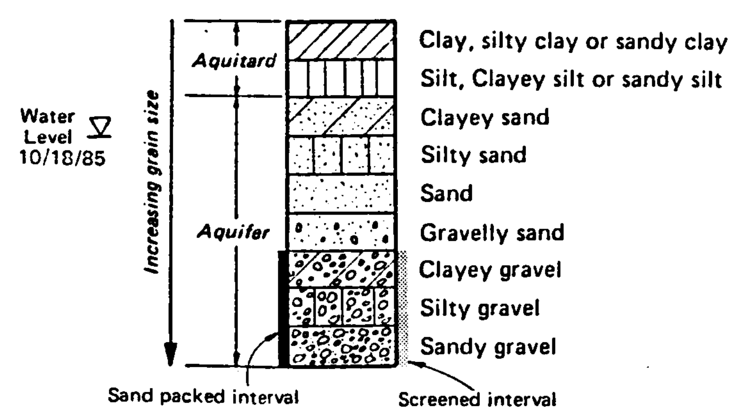
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



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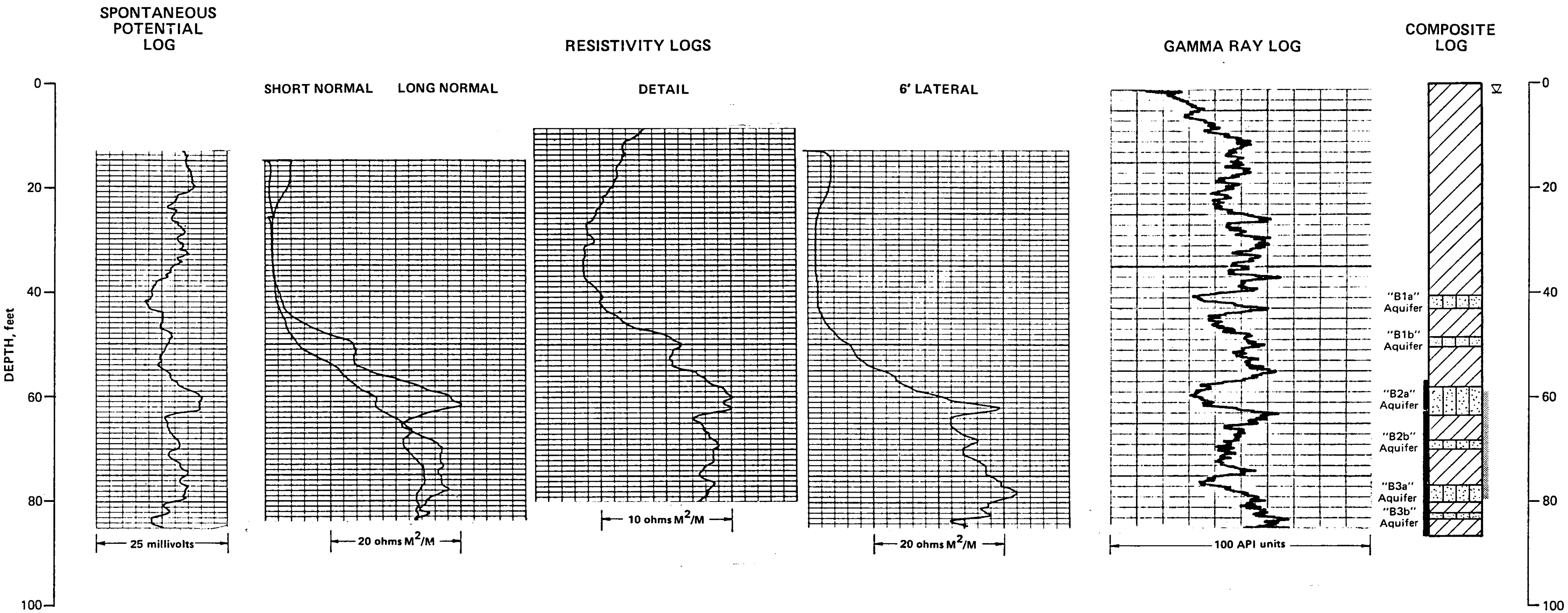
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W3-2B BOREHOLE LOGS

Checked by / Approved by	Date	Project No.	Figure No.
Checked by [signature]	Date 4/10/86	3110D	4-4
Approved by [signature]	Date 4/10/86		



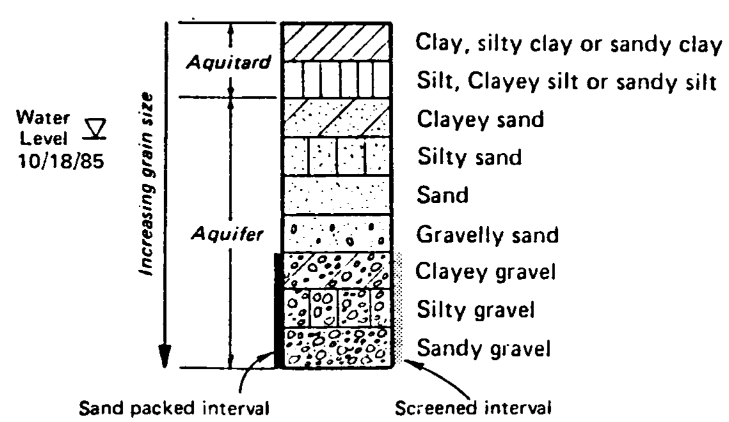
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



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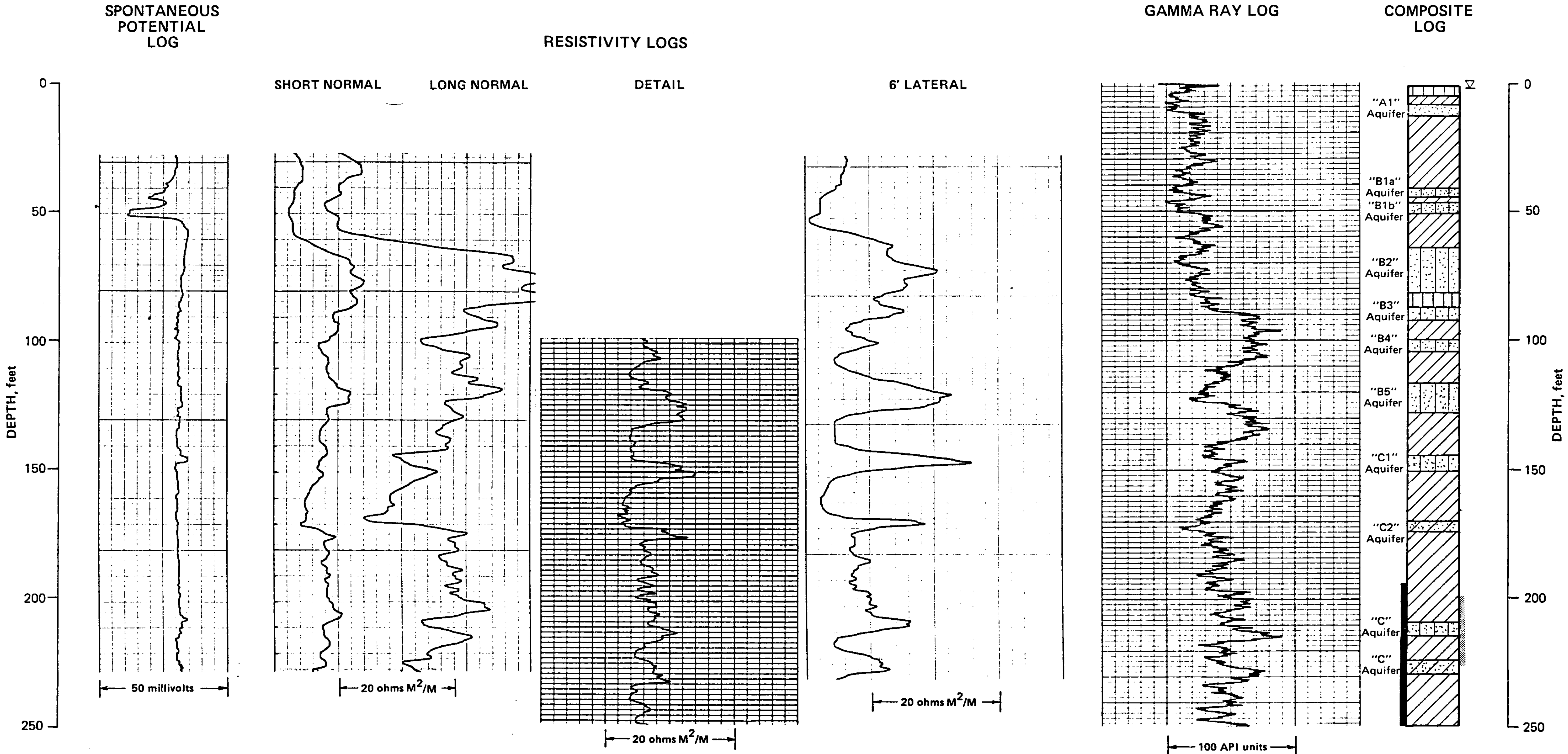
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W3-3B BOREHOLE LOGS

Checked by / Approved by	Date	Project No.	Figure No.
Checked by [signature]	4/10/86	3110D	4-5
Approved by J. E. Valera	4/10/86		



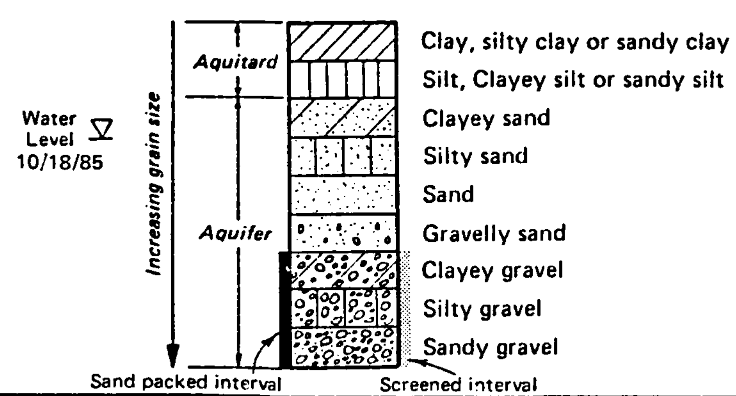
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



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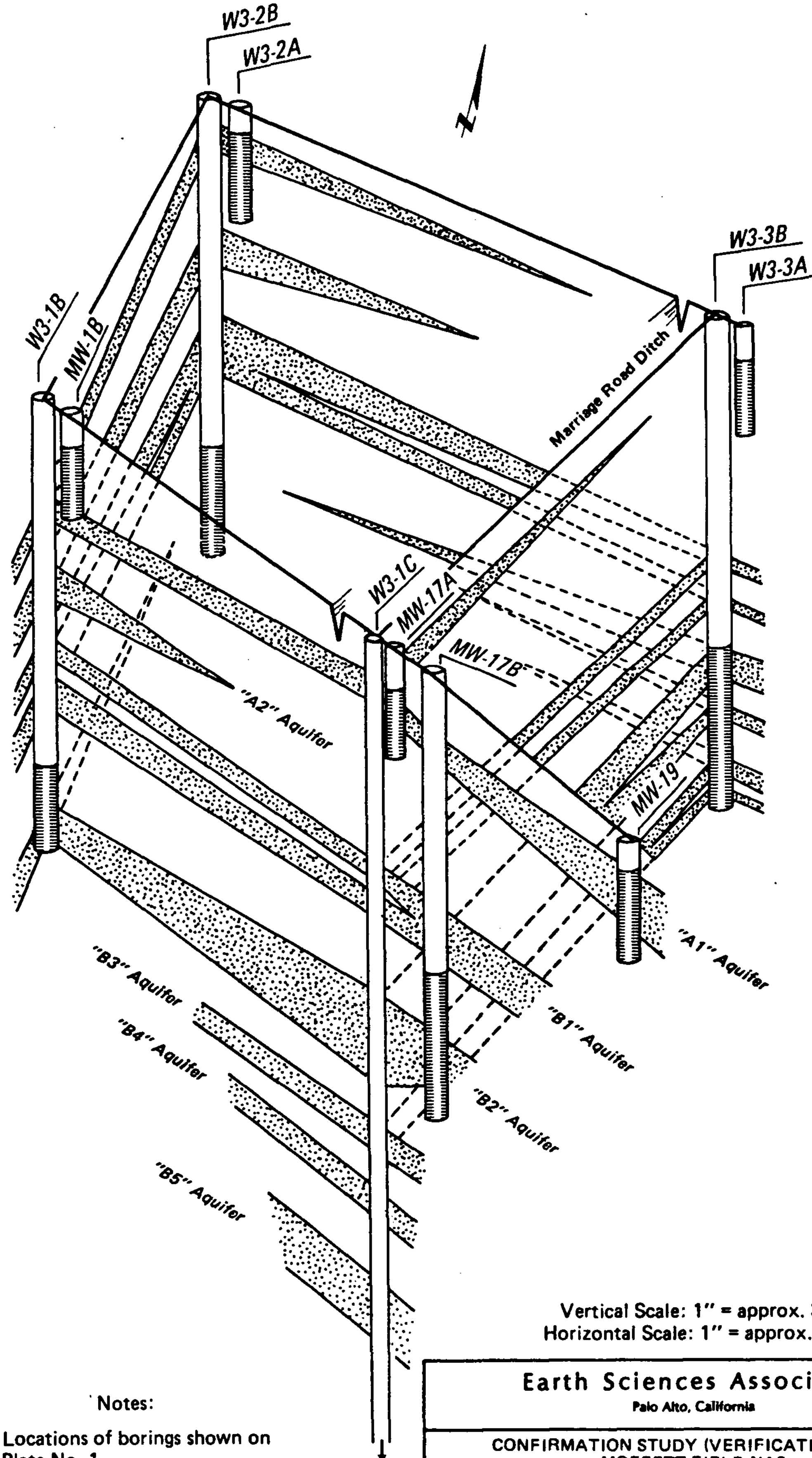
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W3-1C BOREHOLE LOGS

Checked by [signature]	Date 4/10/86	Project No. 3110D	Figure No. 4-6
Approved by J.E. Valera	Date 4/10/86		



Vertical Scale: 1" = approx. 30'
Horizontal Scale: 1" = approx. 200'

Notes:

1) Locations of borings shown on Plate No. 1.

2) Correlations, especially between thin sand layers, are diagrammatic.

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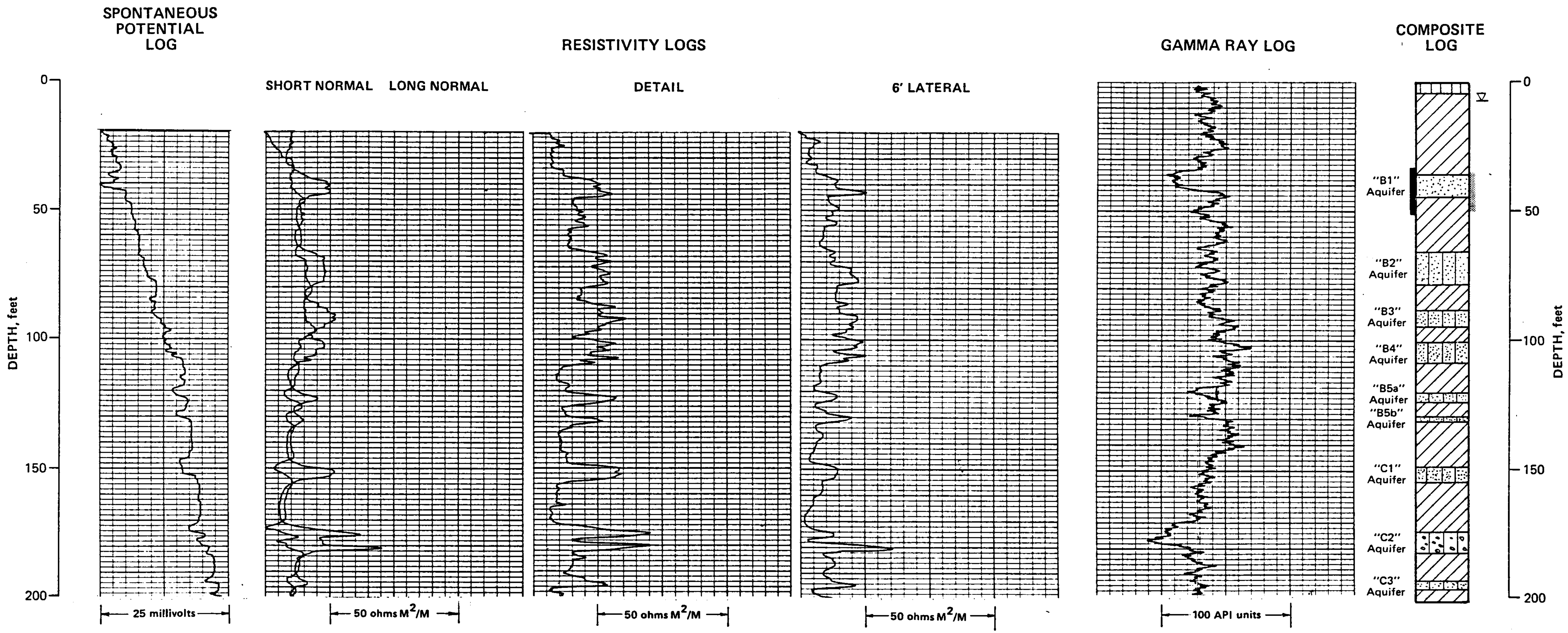
CONFIRMATION STUDY (VERIFICATION STEP) MOFFETT FIELD NAS FENCE DIAGRAM OF MARRIAGE ROAD DITCH AREA		
Checked by [signature] Date 4/10/86 Approved by Julio Valera Date 4/10/86	Project No. 3110D	Figure No. 4-7



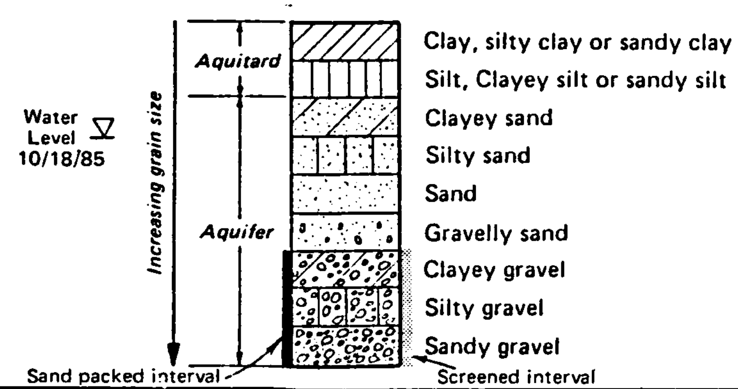
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



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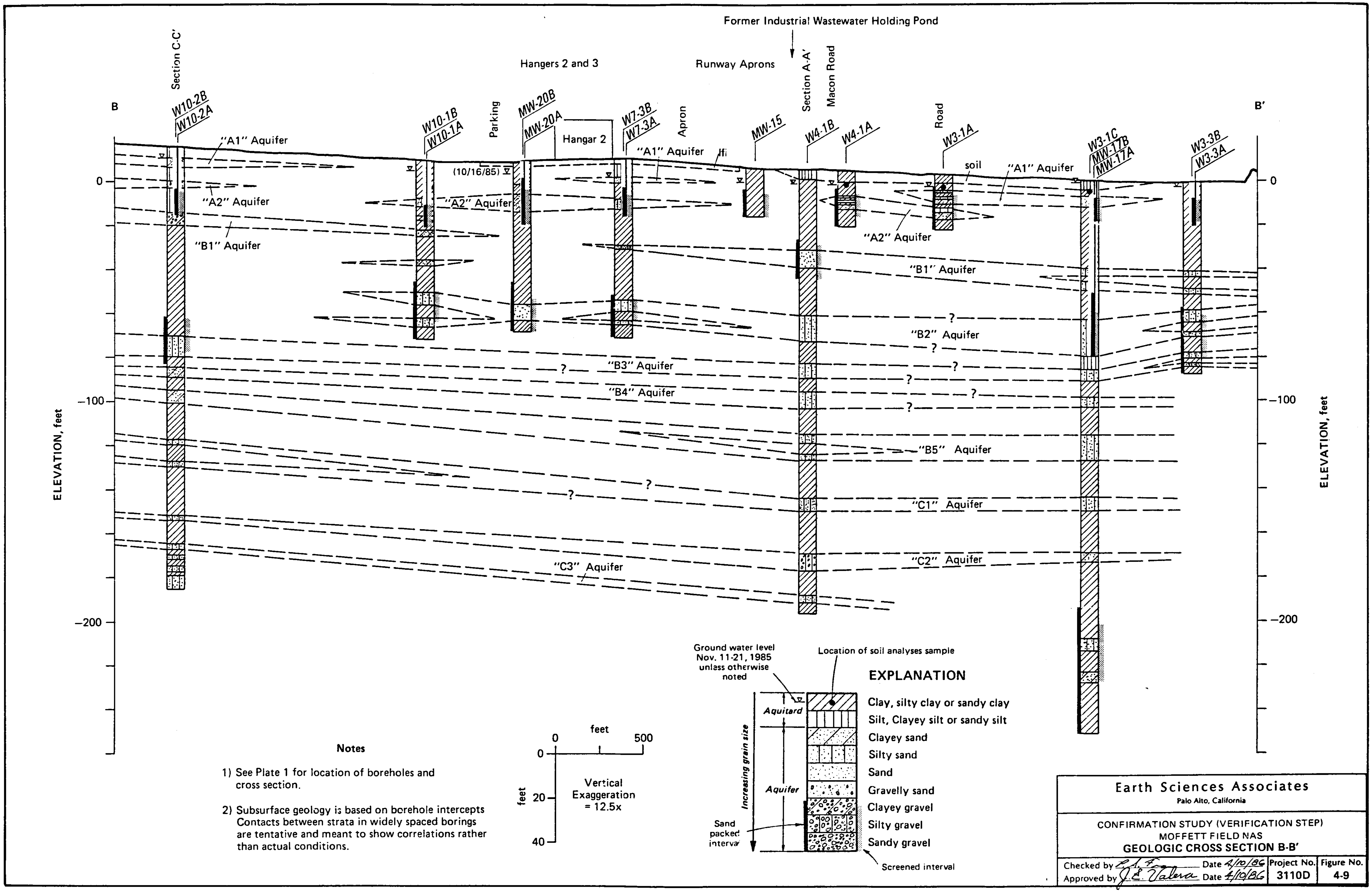
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W4-1B BOREHOLE LOGS

Checked by	Date 4/10/86	Project No. 3110D	Figure No. 4-8
Approved by J. E. Valera	Date 4/10/86		


Former Industrial Wastewater Holding Pond
Section C-C'
Hangers 2 and 3
Runway Aprons
Section A-A'
Macon Road
B
B'
W10-2B
W10-2A
W10-1B
W10-1A
Parking
MW-20B
MW-20A
Hangar 2
W7-3B
W7-3A
Apron
MW-15
W4-1B
W4-1A
Road
W3-1A
W3-1C
MW-17B
MW-17A
W3-3B
W3-3A
soil
(10/16/85)
"A1" Aquifer
"A2" Aquifer
"B1" Aquifer
"B2" Aquifer
"B3" Aquifer
"B4" Aquifer
"B5" Aquifer
"C1" Aquifer
"C2" Aquifer
"C3" Aquifer
0
−100
−200
ELEVATION, feet
feet
0
500
0
20
40
feet
Vertical Exaggeration = 12.5x
Notes
1) See Plate 1 for location of boreholes and cross section.
2) Subsurface geology is based on borehole intercepts Contacts between strata in widely spaced borings are tentative and meant to show correlations rather than actual conditions.
Ground water level Nov. 11-21, 1985 unless otherwise noted
Location of soil analyses sample
EXPLANATION
Aquitard
Aquifer
Increasing grain size
Clay, silty clay or sandy clay
Silt, Clayey silt or sandy silt
Clayey sand
Silty sand
Sand
Gravelly sand
Clayey gravel
Silty gravel
Sandy gravel
Sand packed interval
Screened interval
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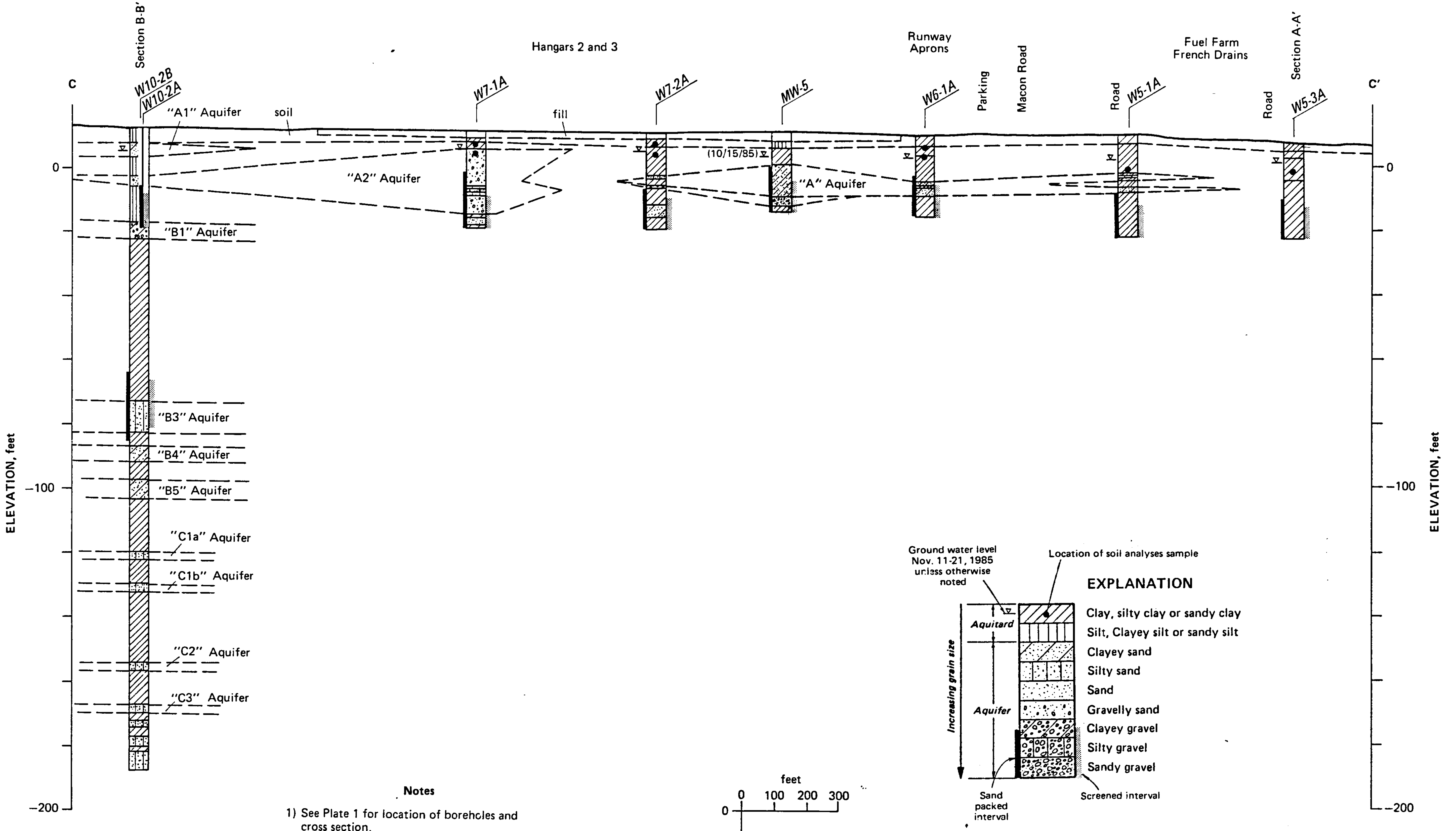
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
GEOLOGIC CROSS SECTION B-B'
Checked by
Date 4/10/86
Approved by J. E. Valera
Date 4/10/86
Project No. 3110D
Figure No. 4-9



Notes

1) See Plate 1 for location of boreholes and cross section.

2) Subsurface geology is based on borehole intercepts Contacts between strata in widely spaced borings are tentative and meant to show correlations rather than actual conditions.

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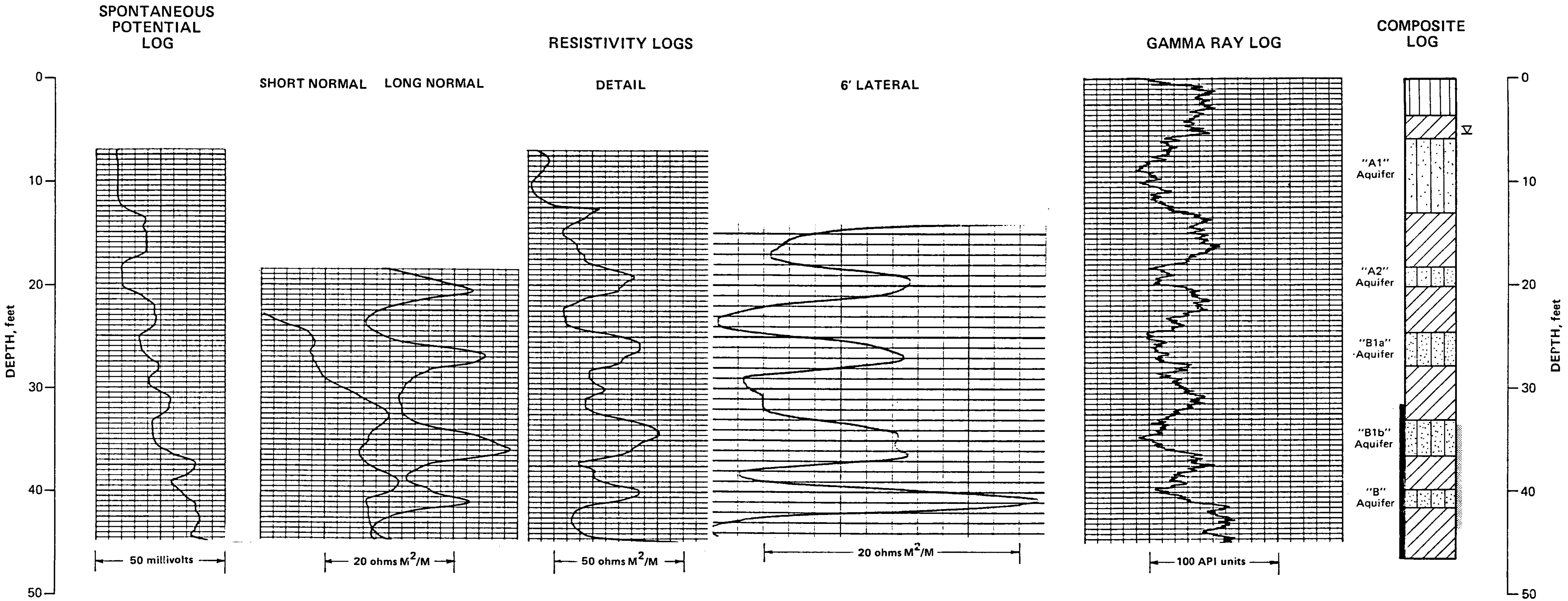
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
GEOLOGIC CROSS SECTION C-C'

Checked by	Date 4/10/86	Project No.	Figure No.
Approved by J.C. Valera	Date 4/10/86	3110D	4-10



Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION

Water Level ∇ 10/18/85

Increasing grain size

- Aquitard
  - Clay, silty clay or sandy clay
  - Silt, Clayey silt or sandy silt
- Aquifer
  - Clayey sand
  - Silty sand
  - Sand
  - Gravelly sand
  - Clayey gravel
  - Silty gravel
  - Sandy gravel

Sand packed interval

Screened interval

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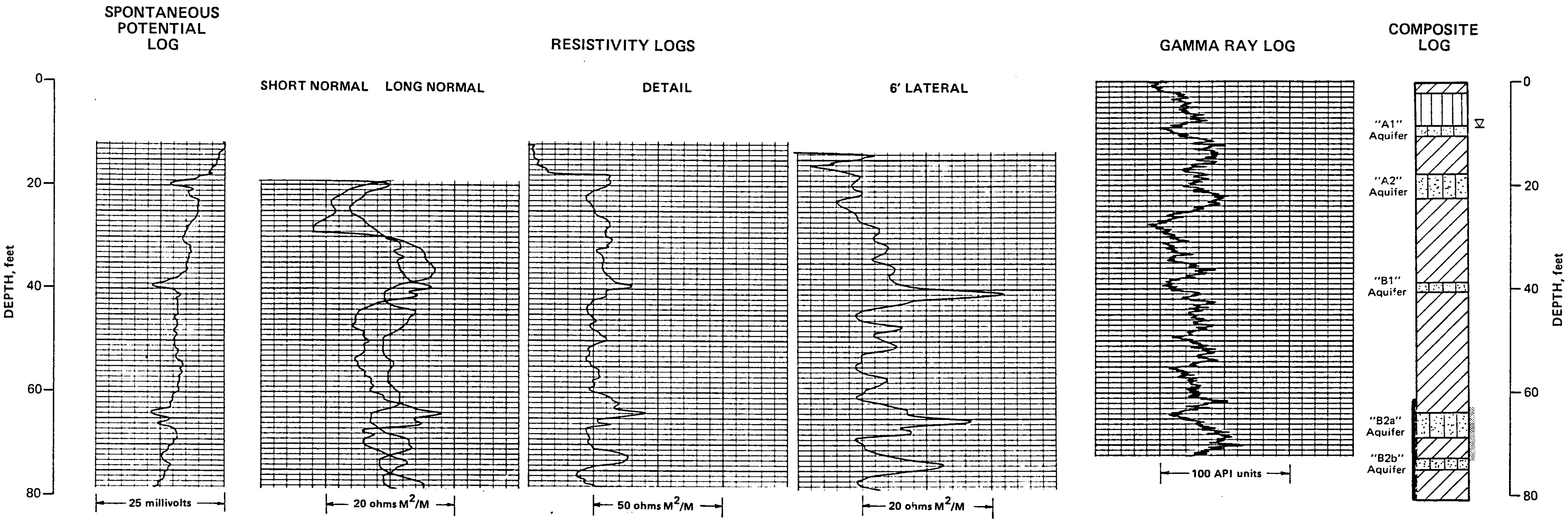
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL W6-1B BOREHOLE LOGS

Checked by E.A.F. Date 4/10/86	Project No.	Figure No.
Approved by J.E. Valera Date 4/10/86	3110D	4-11



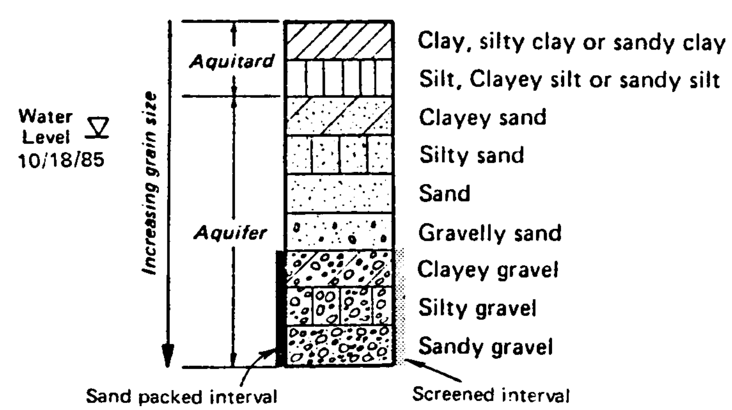
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



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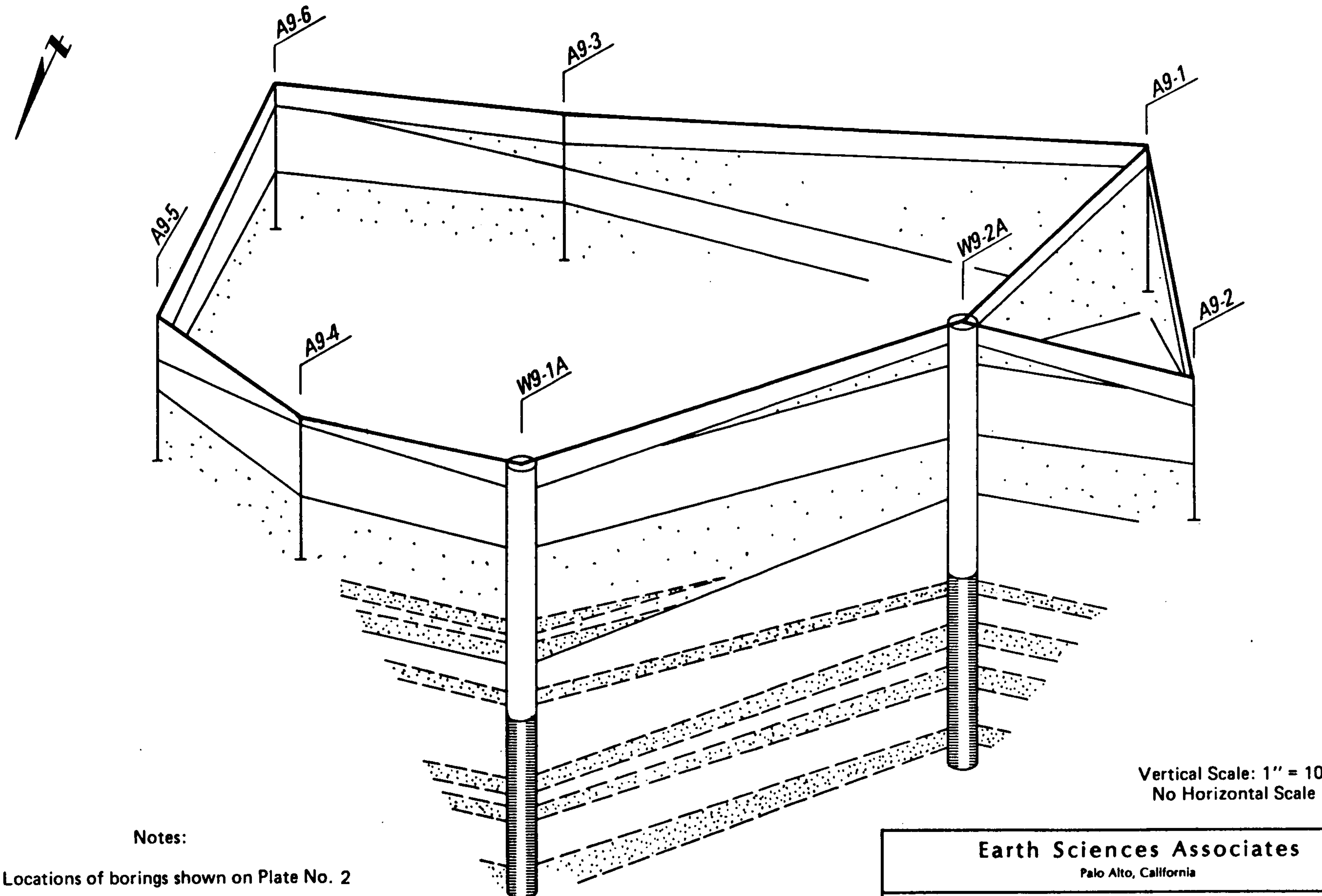
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W7-3B BOREHOLE LOGS

Checked by [signature] Date 4/10/86	Project No.	Figure No.
Approved by J. E. Valera Date 4/10/86	3110D	4-12

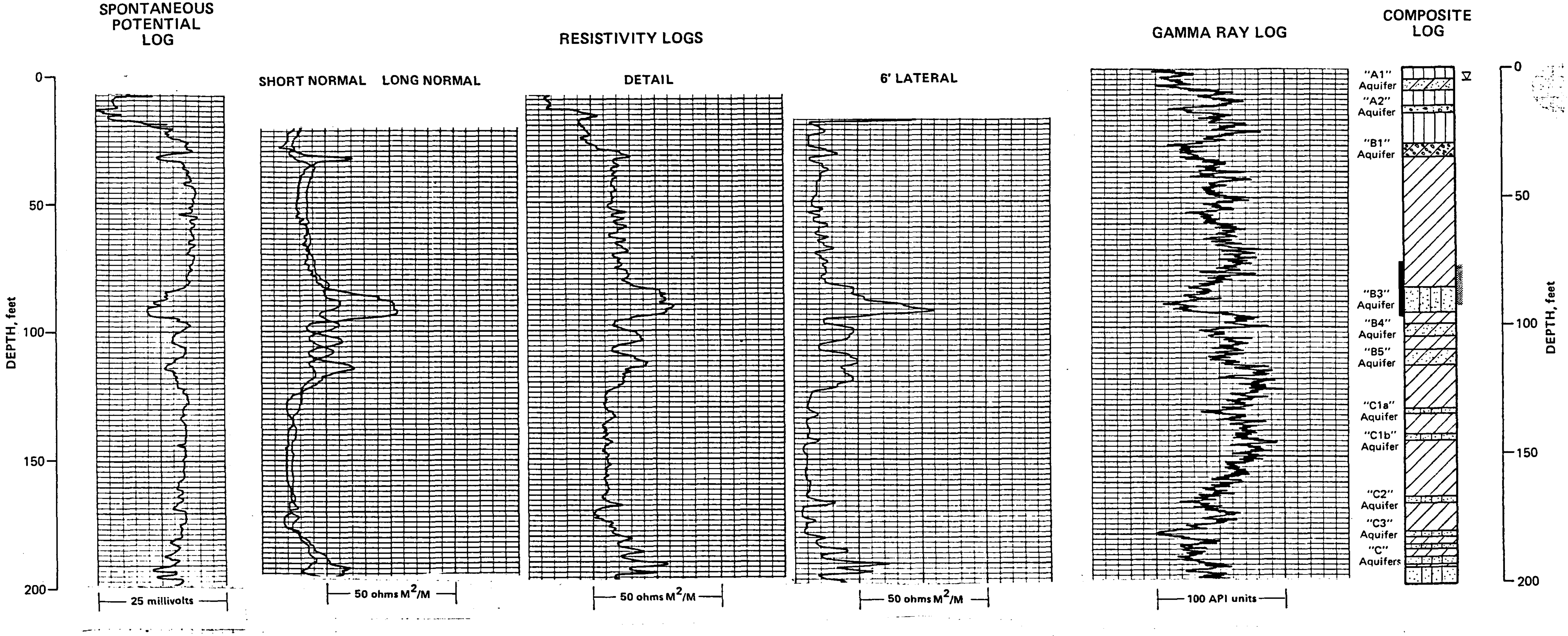


Notes:

1) Locations of borings shown on Plate No. 2

2) Correlations, especially between thin sand layers, are diagrammatic.

Earth Sciences Associates Palo Alto, California		
CONFIRMATION STUDY (VERIFICATION STEP) MOFFETT FIELD NAS **FENCE DIAGRAM OF OLD FUEL FARM SITE**		
Checked by [signature] Date 4/10/86 Approved by J. E. Valera Date 4/10/86	Project No. 3110D	Figure No. 4-13



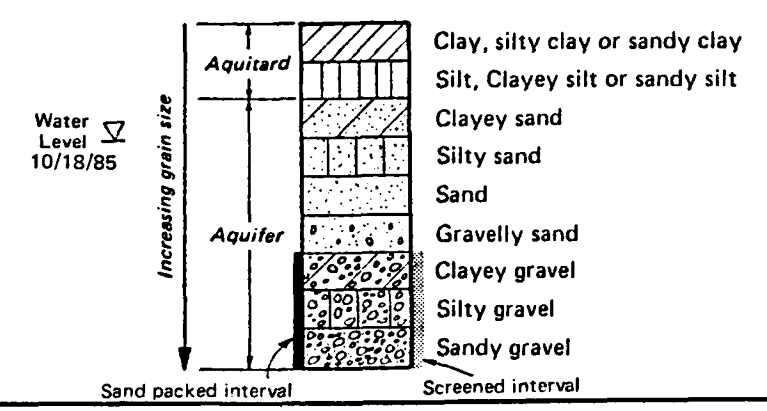
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

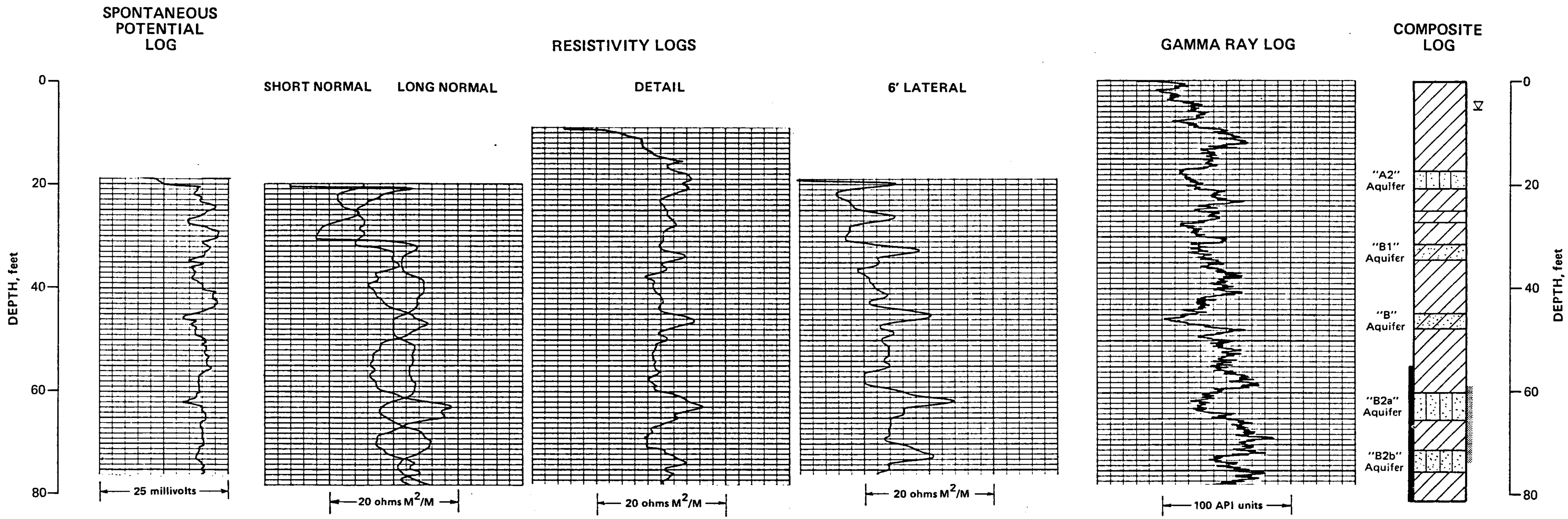
EXPLANATION



Earth Sciences Associates
Palo Alto, California

CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
INTERPRETATION DIAGRAM OF MONITORING WELL
W10-2B BOREHOLE LOGS

Checked by	Date 4/10/86	Project No.	Figure No.
Approved by J.E. Valera	Date 4/10/86	3110D	4-14



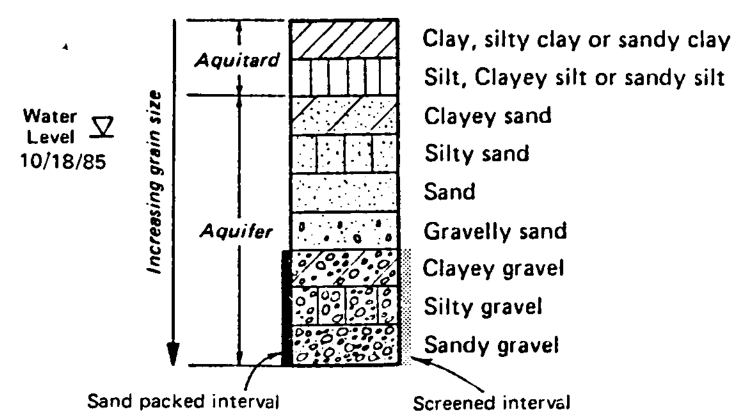
Notes:

1) Well location shown on Plate 1.

2) Drilling logs of borehole in Appendix B2.

3) Composite log drawn from interpretation of geophysical logs and modified with drilling log. The resultant composite borehole log was used to construct cross sections and in the interpretation of the geology of NAS Moffett Field.

EXPLANATION



Earth Sciences Associates Palo Alto, California		
CONFIRMATION STUDY (VERIFICATION STEP) MOFFETT FIELD NAS INTERPRETATION DIAGRAM OF MONITORING WELL W10-1B BOREHOLE LOGS		
Checked by [signature] Date 4/10/86 Approved by J. E. Valera Date 4/10/86	Project No. 3110D	Figure No. 4-15

5. GROUNDWATER AT MOFFETT FIELD

Thirty three new groundwater monitoring wells were developed as part of this investigation. Each borehole was drilled, logged, and wells installed in such a manner as to identify and sample specific aquifers and to seal off others (see Appendices A, B, and C). Monitoring wells were constructed in the 10 waste disposal sites previously described in Section "4" of this report and are summarized in Table 5-1. Results of sampling and chemical analyses of the groundwater from the various wells were used to establish the levels and extent of groundwater contamination at each site.

Additional monitoring wells at Moffett Field supplement the information developed in this phase of investigation. EMCON (1983a; 1983b) established 23 monitoring wells in the area surrounding Hangars 2 and 3 and to the north. Presently 22 monitoring wells have been developed in the area between Chase Park and the runways to investigate groundwater contamination from off-site industrial sources (Canonie Engineers, 1985b). Additional wells will be developed in this area in the future.

Only one private well, No. 24D1, is presently in operation at Moffett Field. This 655-foot-deep well is located in the southeastern corner of the NAS and used for agricultural purposes. Four additional active private wells, as described in Appendix G, are located on lands adjacent to Moffett Field: well 24D3 is located north of the intersection of Highways 101 and 237, opposite well 24D1; wells 10Q* and 10Q03 are located west of Ames Research Center between Stevens Creek and Moffett Boulevard; well 10G1 is located between Whisman Slough and the salt evaporators northwest of Moffett Field. Depths of these irrigation wells range from about 200 to 1423 feet. At least 9 other private wells are known to have been drilled at Moffett Field (see Appendix G) and are now abandoned or inactive. Other early private wells, such as those described by Lawson and others (1908), may have existed at the site and been abandoned without record.

As described in previous sections of this report, aquifers in the uppermost 250 feet of sediments underlying Moffett Field comprise an interlensed sequence of sands separated by clayey material of low permeability. Sand and local gravel aquifers account for about one quarter of these earth materials. Similar materials

Table 5-1

SUMMARY OF MONITORING WELLS INSTALLED FOR MOFFETT FIELD NAS
(All Measurements in Feet)

Aquifer Monitored[1]	Well Number[1]	Date Installed	Ground Surface Elevation[2]	Bottom of Well[3] Depth	Bottom of Well[3] Elevation[2]	Bottom of Well Casing[4] Depth	Bottom of Well Casing[4] Elevation[2]	Top of Well Casing Elevation[5]	Sand Packed Interval[6] Depth	Sand Packed Interval[6] Elevation[2]	Screened Interval[7] Depth	Screened Interval[7] Elevation[2]
A	MW-1	4/13/83	10.8	18.5	-7.7	15.3	-4.46	10.80	8.5 - 18.5	2 - -7.7	10.5 - 18.5	0.5 - -7.5
A	MW-2	4/13/83	10.6	15.0	-4.4	12.3	-1.68	10.60	4 - 15.0	7 - -4.4	9 - 15	1.5 - -4.5
A	MW-3	4/13/83	10.1	18.5	-8.4	16.9	-6.75	9.89	6 - 18.5	4 - -8.4	8.5 - 18.5	1.5 - -8.5
A	MW-4	4/13/83	9.9	16.5	-6.6	15.4	-5.45	9.85	6 - 16.5	4 - -6.6	9.5 - 16.5	0.5 - -6.5
A	MW-5	5/17/83	10.8	25.0	-14.2	24.1	-13.29	10.78	11 - 25.0	0 - -14.2	15 - 25	-4 - -14
A	MW-6	5/17/83	5.6	18.0	-12.4	14.9	-9.26	5.56	8 - 18.0	-2 - -12.4	10 - 18	-4.5 - -12.5
A	MW-7	5/17/83	6.1	14.5	-8.4	14.7	-8.57	6.14	7 - 14.5	-1 - -8.4	9.5 - 14.5	-3.5 - -8.5
A	MW-8	5/17/83	5.9	20.0	-14.1			6.11	8 - 20.0	-2 - -14.1	10 - 20.	-4 - -14
A	MW-9	5/18/83	5.4	21.5	-16.1	19.6	-14.17	5.43	6.5 - 21.5	-1 - -16.1	11.5 - 21.5	-6 - -16
A	MW-10	5/18/83	5.1	21.5	-16.4	14.8	-9.73	5.48	8 - 21.5	-3 - -16.4	11.5 - 21.5	-6.5 - -16.5
A	MW-11	5/18/83	4.0	16.5	-12.5	15.0	-10.96	3.97	7 - 16.5	-3 - -12.5	11.5 - 16.5	-7.5 - -12.5
A	MW-13	5/23/83	9.8	16.5	-6.7	13.9	-4.06	9.55	9 - 16.5	1 - -6.7	11.5 - 16.5	-1.5 - -6.5
A	MW-15	11/2/83	5.7	21.5	-15.8	18.6	-12.92	5.75	8 - 21.5	-2 - -15.8	11.5 - 21.5	-6 - -16
A	MW-16	11/1/83	4.8	21.5	-16.7	19.1	-14.30	4.83	8 - 21.5	-3 - -16.7	11.5 - 21.5	-6.5 - -16.5
A	MW-18	11/1/83	0.4	18.0	-17.6	18.0	-17.65	0.39	6 - 18.0	-6 - -17.6	8 - 18	-7.5 - -17.5
A	MW-20A	11/2/83	8.3	28.0	-19.7	23.8	-15.52	8.21	7.5 - 28.0	1 - -19.7	13 - 28	-4.7 - -19.7
A	W1-1A	8/23/85	2.7	25.7	-23.0	25.7	-23.0	2.88	13.0 - 25.7	-10.3 - -23.0	15.5 - 25.7	-12.8 - -23.0
A	W1-2A	8/23/85	4.4	25.9	-21.5	25.9	-21.5	4.58	13.0 - 25.9	-8.6 - -21.5	15.7 - 25.9	-11.3 - -21.5
A	W1-3A	8/22/85	17.3	36.2	-18.9	36.2	-18.9	17.27	24.0 - 36.2	-6.7 - -18.9	26.0 - 36.2	-8.7 - -18.9
A	W1-4A	8/29/85	2.8	15.8	-13.0	15.8	-13.0	2.43	7.0 - 15.8	-4.2 - -13.0	9.6 - 15.8	-3.8 - -13.0
A	W2-1A	8/21/85	2.7	25.0	-22.3	20.8	-18.12	2.63	5.0 - 25.0	-2.3 - -22.3	9.4 - 19.6	-7.9 - -18.12
A	W2-2A	8/15/85	0.6	25.8	-25.2	25.4	-24.78	0.82	10.0 - 25.8	-9.4 - -25.2	15.5 - 25.8	-14.5 - -24.78
A	W2-3A	8/22/85	0.2	25.0	-24.8	20.7	-20.51	0.26	8.0 - 25.0	-7.8 - -24.8	10.1 - 20.4	-10.2 - -20.51
A	W3-1A	8/14/85	3.2	25.0	-21.8	20.7	-17.52	2.91	5.0 - 25.0	-1.8 - -21.8	10.0 - 19.6	-7.9 - -17.52
A	W3-3A	8/14/85	-0.7	20.0	-20.7	18.1	-18.83	-0.75	7.0 - 20.0	-7.7 - -20.7	8.0 - 18.1	-8.7 - -18.83
A	W4-2A	8/16/85	4.6	25.0	-20.4	20.6	-15.97	4.33	8.0 - 25.0	-3.4 - -20.4	10.0 - 20.2	-5.8 - -15.97

Table 5-1 (Continued)

Aquifer Monitored[1]	Well Number[1]	Date Installed	Ground Surface Elevation[2]	Bottom of Well[3]		Bottom of Well Casing[4]		Top of Well Casing Elevation[5]	Sand Packed Interval[6]		Screened Interval[7]	
				Depth	Elevation[2]	Depth	Elevation[2]		Depth	Elevation[2]	Depth	Elevation[2]
A	W5-1A	8/16/85	10.3	32.2	-21.9	32.3	-22.01	10.27	18.0 - 32.2	-7.7 - -21.9	22.0 - 32.2	-11.8 - -22.01
A	W5-2A	8/19/85	12.8	31.0	-18.2	30.7	-17.93	12.78	17.0 - 31.0	-4.2 - -18.2	20.4 - 30.7	-7.6 - -17.93
A	W5-3A	8/19/85	7.8	30.4	-22.6	30.7	-22.94	7.84	18.0 - 30.4	-10.2 - -22.6	20.2 - 30.4	-12.7 - -22.94
A	W6-1A	8/20/85	9.8	26.0	-16.2	25.7	-15.93	9.78	13.0 - 26.0	-3.2 - -16.2	14.8 - 25.0	-5.7 - -15.93
A	W7-2A	8/28/85	10.9	31.0	-20.1	31.1	-20.22	10.77	18.0 - 31.0	-7.1 - -20.1	20.8 - 31.0	-10.0 - -20.22
A	W7-3A	8/21/85	10.4	26.0	-15.6	26.2	-15.84	10.16	13.0 - 26.0	-2.6 - -15.6	16.0 - 26.0	-5.8 - -15.84
A	W8-1A	8/27/85	7.4	30.0	-22.6	30.0	-22.61	7.39	18.0 - 30.0	-10.6 - -22.6	19.8 - 30.0	-12.4 - -22.61
A	W9-1A	8/29/85	18.9	30.0	-11.1	31.3	-12.42	18.78	18.0 - 30.0	0.9 - -11.1	19.8 - 30.0	-2.2 - -12.42
A	W9-2A	8/29/85	19.5	31.0	-11.5	31.5	-11.96	19.46	18.0 - 31.0	1.5 - -11.5	20.8 - 31.0	-1.8 - -11.96
A	W10-1A	8/21/85	9.7	30.4	-20.7	29.6	-19.91	9.95	18.0 - 30.4	-8.3 - -20.7	20.0 - 30.3	-9.6 - -19.91
A	W10-2A	8/21/85	15.5	31.0	-15.5	30.2	-14.67	15.71	18.0 - 31.0	-2.5 - -15.5	20.0 - 30.8	-3.9 - -14.67
A1	MW-17A	11/1/85	0.6	18.0	-17.4	14.4	-13.77	0.55	8 - 18.0	-7.4 - -17.4	8 - 18	-7.5 - -17.5
A1	MW-19	11/7/85	-0.2	21.5	-21.7	17.6	-17.79	-0.17	5 - 21.5	-5.2 - -21.7	11.5 - 21.5	-11.5 - -21.5
A1	W3-2A	8/14/85	-2.0	20.0	-22.0	15.8	-17.80	-2.30	3.5 - 20.0	-5.5 - -22.0	5.2 - 15.4	-7.6 - -17.80
A2	W4-1A	8/16/85	4.6	25.0	-20.4	20.8	-16.19	4.31	8.0 - 25.0	-3.4 - -20.4	10.4 - 20.5	-6.1 - -16.19
A2	W7-1A	8/20/85	11.3	31.0	-19.7	31.0	-19.67	11.33	13.0 - 31.0	-1.7 - -19.7	20.6 - 30.6	-9.4 - -19.67
B	MW-12A	5/18/85	10.0	36.5	-26.5	30.8	-20.77	9.73	29 - 36.5	-19 - -26.5	31.5 - 36.5	-21.5 - -26.5
B	MW-12B	5/18/85	10.0	46.0	-36.0	39.8	-29.80	9.73	37.5 - 46.0	-27.5 - -36.0	41 - 46	-31 - -36
B	W3-2B	8/6/85	-2.2	80.4	-82.6	79.8	-81.98	-2.30	61.0 - 80.4	-63.2 - -82.6	65.0 - 80.2	-66.8 - -81.98
B1	MW-14	5/24/85	6.4	41.5	-35.1	38.7	-32.34	6.46	23.5 - 41.5	-17.1 - -35.1	29.5 - 41.5	23 - -35
B1	W4-1B	8/2/85	5.2	50.0	-44.8	49.8	-44.61	5.24	32.3 - 50.0	-27.1 - -44.8	35.0 - 50.0	-29.6 - -44.61
B1	W6-1B	8/9/85	5.5	46.3	-40.8	43.4	-37.91	5.57	31.0 - 46.3	-25.5 - -40.8	33.4 - 43.5	-27.8 - -37.91
B2	W3-1B	8/1/85	0.3	79.5	-79.2	78.8	-78.50	0.29	64.4 - 79.5	-64.1 - -79.2	69.0 - 79.0	-68.5 - -78.50
B2	W7-3B	7/31/85	10.4	80.8	-70.4	73.7	-63.34	10.16	61.0 - 80.8	-50.6 - -70.4	63.0 - 73.0	-53.3 - -63.34
B2	W10-1B	8/9/85	9.8	81.3	-71.5	73.0	-63.21	9.77	55.0 - 81.3	-45.2 - -71.5	59.0 - 73.6	-48.6 - -63.21
B2	MW-17B	11/17/85	0.6	79.0	-78.4	71.7	-71.07	0.55	52.5 - 79.0	-51.9 - -78.4	59 - 79	-59.5 - -79.5
B2	MW-20B	11/4/85	8.3	76.5	-68.2	67.8	-59.45	8.27	53 - 76.5	-45 - -68.2	61.5 - 76.5	-53 - -68

Table 5-1 (Continued)

Aquifer Monitored[1]	Well Number[1]	Date Installed	Ground Surface Elevation[2]	Bottom of Well[3]		Bottom of Well Casing[4]		Top of Well Casing Elevation[5]	Sand Packed Interval[6]		Screened Interval[7]	
				Depth	Elevation[2]	Depth	Elevation[2]		Depth	Elevation[2]	Depth	Elevation[2]
B2, B3	W3-3B	8/2/85	-0.8	86.4	-87.2	79.6	-80.43	-0.76	56.5 - 86.4	-57.3 - -87.2	59.5 - 79.6	-60.3 - -80.43
B3	W10-2B	8/9/85	15.7	97.0	-81.3	93.3	-77.59	15.69	76.0 - 97.0	-60.3 - -81.3	78.0 - 93.2	-62.4 - -77.59
C	W3-1C	8/5/85	-0.2	250.0	-250.2	223.3	-223.51	-0.21	192.5 - 250.0	-192.7 - -250.2	200.0 - 225.0	-198.5 - -223.51

[1]Table is ordered by increasing well number within each aquifer zone. Where known, individual aquifers are numbered. Downhole geophysical logs are included in this report for all "B" and "C" boreholes drilled for this investigation plus gamma ray logs of wells MW-12B, MW-17B, and MW-20B.

[2]Relative to U.S.C. and G.S. Monument D1122-1967 (see Plate 1) having an elevation of +3.448 feet above mean sea level, based on the National Geodetic Vertical Datum of 1929.

[3]Lowermost extent of sand pack as indicated on log or well construction diagram.

[4]As measured February 11, 1986 except wells of Site 1 which were taken from well construction diagrams. May include sediment accumulated in well. Well MW-8 not measured due to jammed cap. All monitoring wells constructed from 2-inch-diameter casing. "MW"-series wells use PVC casing; "W"-series wells use stainless steel casing.

[5]Surveyed by Sandis and Associates, 1985; see also 2. This elevation used to calculate all other elevations.

[6]"MW"-series wells were sealed with a bentonite-concrete mixture from the top of the sand pack to the ground surface. "W"-series wells were sealed with a 1- to 3.5-foot-thick layer of bentonite at the top of the sand pack, then grouted to the ground surface.

[7]Screened intervals of "MW"-series wells (EMCON, 1983a; 1983b) based on assumption that "slotted" length was placed at bottom of sand pack. Values rounded to nearest 0.5 foot.

presumably extend to the bottom of the groundwater basin more than 1000 feet below the NAS. The water-bearing sediments can be arbitrarily divided into 3 aquifer systems as established by other investigations in the vicinity. In the area northeast of the runways, the aquifer systems include: 1) a shallow "A" aquifer which lies at depths less than 35 feet; 2) the "B" aquifer which extends from depths of 25 to 130 feet; and 3) the "C" aquifer which lies below a depth of about 130 feet. Depths of these aquifer systems are similar to those described in the Middlefield-Ellis-Whisman study area to the south. Canonie (1983), for example, describes the "A" zone as generally occurring at depths of 15 to 30 feet, the "B" at 45 to 115 feet, and the "C" below about 200 feet. More recently, Canonie (1985b) lists "A" monitoring wells installed to depths of 45 feet, "B" wells to depths of 101 feet, and "C" wells as shallow as 156 feet to the top of the gravel-packed interval. Harding Lawson (1985) indicates that the "A" aquifer zone occurs above depths of 45 feet, the "B" aquifer zone lies between depths of 50 to 160 feet, and the "C" aquifer zone occurs below 200 feet. Iwamura (1980, p. 11) describes "upper" ("A" and "B") and "lower" ("C") aquifer zone as being ... "separated by an extensive aquitard in the interior portion of the basin at depths of 150 to 250 feet in the mid to lower fan area and 100 to 150 feet in the baylands area." Overlap in the depth (and elevation) of the aquifer systems is an indication of the interfingering nature of the sediments and shows the importance of lateral correlations between the various site areas.

Each aquifer system can be further subdivided into individual permeable units. These are numbered consecutively from top to bottom as shown on Figures 4-2, 4-7, 4-9 and 4-10. The "A" aquifer was divided locally into an "A1" and "A2" unit; the "B" aquifer subdivided into "B1" through "B5" units, and at least 3 units can be subdivided in the upper "C" aquifer. Individual aquifers were further locally subdivided into an upper "a" and lower "b" portion where clay formed an interbed within the aquifer (see for example the "B2" aquifer on Figure 4-9). Aquifer designations in this report are based on the stratigraphy shown on cross sections A-A', B-B', C-C' (see Figures 4-2, 4-9, and 4-10 respectively). Additional borehole data should enable this stratigraphy to be directly correlated with the stratigraph and aquifer designations of the Middlefield-Ellis-Whisman area to the south and southwest.

Aquifer units were used in correlations between borings and to place the Moffett Field stratigraphy into a regional perspective. The dynamic depositional environment in the area accounts for the discontinuous, interlensing nature of aquifers at the site. The actual degree of interlensing is no doubt greater than indicated on profiles of this report, where continuity of aquifers appears proportional to the number of boreholes. Figure 4-9 for example, shows aquifers below the "B2" as being more continuous than above, but this is likely to be an artifact of having 3 widely spaced deep wells below this horizon and 10 closely spaced wells above.

Aquifers within the baylands area have been described as locally being "leaky" (Iwamura, 1980; Canonie, 1983) or having a "downward hydraulic gradient" (Harding Lawson, 1985). This is also suggested by saltwater intrusion into lower aquifers (Iwamura, 1980) and more recently by the presence of chemicals in the "A" and upper "B" aquifers (Harding Lawson, 1985; this report, Section 6). Based on this potential for local leakage, the limited number of wells within individual aquifers, and the close correspondence of water levels in different aquifers of the "A" and "B" aquifer zones, the following discussion of groundwater hydrology at Moffett Field relates to entire aquifer zones rather than individual aquifers. This in no way implies continuity between individual aquifers within a particular zone nor that monitoring wells should be constructed to sample more than one aquifer.

As of November 1985, 50 monitoring wells have been developed in the "A" aquifer at Moffett Field (see Table 5-2). Water level measurements recorded in the period from October 7 to 24, 1985 ranged from a high elevation of 23.90 feet in well 64A to a low of -5.77 feet in well W2-2A. Measurements were little changed from those made 2 months previous or 1 month later, ranging from a maximum increase of 4.4 feet in wells MW-12A and MW-12B to a maximum decrease of 0.9 feet in well W10-1A; no change was recorded in 8 of the wells. The water level change in wells established by EMCON (1983a; 1983b) is a consistant decrease of 0.2 to 1.8 feet from 1983 to October 1985 level, although this may be seasonal rather than a long-term trend. Depth to groundwater in the "A" aquifers ranged from 2.8 feet (W3-2A) to 19.9 feet (W1-3A) although some depths are exaggerated due to placement of fill.

Table 5-2

GROUNDWATER LEVELS AT MOFFETT FIELD
(all measurements in feet)

Monitoring Wells Installed in the "A" Aquifer:

Well No.	Location[1] Northing	Easting	Ground Surface Elevation	Depth[2] of Water	Water Level Elevations[3] Aug. 21-22, 1985	Aug. 27-Sept. 18, 1985	Oct. 7-24, 1985	Nov. 11-26, 1985
W1-1A	7,753.44	1,871.26	2.7	5.8	-3.0	-3.0	-3.15	-3.19
W1-2A	7,893.43	984.23	4.4	7.3	-2.8	-2.8	-2.91	-2.88
W1-3A	8,299.71	1,279.90	17.3	19.9	-1.9	-1.9	-2.64	-2.58
W1-4A	8,658.34	1,383.97	2.8	5.3	-2.3	-2.3	-2.51	-2.47
W2-1A	5,771.74	3,797.58	2.7	6.4	-3.7	-3.7	-3.74	-3.63
W2-2A	6,225.03	3,150.42	0.6	6.4	-6.2	-6.2	-5.77	-5.76
W2-3A	6,504.38	3,866.55	0.2	4.7	-4.5	-4.5	-4.49	-4.46
W3-1A	5,806.04	5,004.11	3.2	5.7	-2.5	-2.5	-2.53	-2.42
W3-2A	7,303.27	4,644.72	-2.0	2.8	-4.9	-4.9	-4.78	-4.73
W3-3A	7,204.10	5,061.86	-0.7	3.9	-4.7	-4.8	-4.63	-4.63
W4-1A	5,259,29	5,011.18	4.6	6.2	-1.7	-1.7	-1.65	-1.52
W4-2A	5,511.83	5,333.18	4.6	6.3	-3.8	-3.8	-1.74	-1.60
W5-1A	4,320.76	6,689.27	10.3	7.9	2.8	2.8	2.42	2.33
W5-2A	4,748.05	6,490.80	12.8	11.5	1.4	1.5	1.25	1.24
W5-3A	4,830.66	6,733.01	7.8	6.8	1.2	1.1	0.98	1.10
W6-1A	3,948.58	6,184.52	9.8	6.8	3.1	3.1	2.99	3.04
W7-1A	2,968.88	5,313.85	11.3	5.4	6.0	6.0	5.93	5.96
W7-2A	3,291.72	5,768.74	10.9	5.4	5.5	5.5	5.47	5.48
W7-3A	4,097.16	5,021.95	10.4	9.0	1.5	1.5	1.39	1.51
W8-1A	3,963.64	815.51	7.4	8.6	-1.2	-1.2	-1.17	-1.09
W9-1A	1,667.27	1,789.59	18.9	8.8	10.3	10.3	10.13	10.21
W9-2A	1,424.93	1,710.50	19.5	8.2	11.4	11.4	11.29	11.38

Table 5-2 (Continued)

Well No.	Location[1] Northing	Easting	Ground Surface Elevation	Depth[2] of Water	Water Level Elevations[3] Aug. 21-22, 1985	Aug. 27-Sept. 18, 1985	Oct. 7-24, 1985	Nov. 11-26, 1985
W10-1A	3,091.81	4,539.37	9.7	5.3	3.5	3.5	4.40	4.52
W10-2A	1,930.97	5,311.21	15.5	4.9	10.4	10.4	10.59	10.62
MW-1	5,795.02	3,902.31	10.8	8.1	2.7	2.7	2.68	2.75
MW-2	3,929.65	5,774.53	10.6	8.0	2.6		2.64	
MW-3	4,371.01	5,449.97	10.1	9.5	0.7		0.64	0.66
MW-4	4,392.99	5,433.28	9.9	9.4	0.5	0.5	0.49	0.53
MW-5	3,518.39	6,081.24	10.8	7.0	4.0	4.0	3.84	
MW-6	4,802.16	5,591.83	5.6	5.6	0.1	0.2	0.02	0.20
MW-7	4,875.85	5,373.97	6.1	6.4	-0.4	-0.4	-0.35	-0.15
MW-8	4,777.20	5,206.69	5.9	6.3	-0.4		-0.39	
MW-9	5,079.24	4,958.04	5.4	6.8	-1.3	-1.4	-1.41	-1.41
MW-10	5,109.24	5,207.29	5.1	6.3	-1.2		-1.24	
MW-11	5,183.82	5,426.55	4.0	5.4	-1.0	-1.0	-1.02	-1.02
MW-13	4,395.87	5,384.15	9.8	9.3	0.4		0.48	0.48
MW-15	4,799.55	5,253.58	5.7	6.0	-0.4	-0.4	-0.35	-0.25
MW-16	4,763.67	4,241.28	4.8	6.2	-1.6	-1.7	-1.45	
MW-17A	6,641.47	5,060.29	0.6	4.7	-4.0	-4.2	-4.07	-4.08
MW-18	6,528.34	4,675.11	0.4	4.3	-3.9	-4.0	-3.87	-3.78
MW-19	6,508.26	5,527.85	0.2	3.2	-3.2	-2.8	-3.05	
MW-20A	3,608.47	4,729.01	8.3	5.2	3.0	3.0	3.10	
63A			33.4	10.9	22.5		22.54	22.62
64A	333,300.3	1,549,209.3	32.2	8.6			23.59	
65A	334,390.6	1,548.698.4	27.4	8.0	19.6		19.44	19.62

Table 5-2 (Continued)

Well No.	Location[1] Northing	Easting	Ground Surface Elevation	Depth[2] of Water	Water Level Elevations[3] Aug. 21-22, 1985	Aug. 27- Sept. 18, 1985	Oct. 7-24, 1985	Nov. 11-26, 1985
66A			20.3	5.2	15.3		15.11	15.28
73A	335,168.0	1,549,510.0	21.2	4.5			16.72	16.94
74A	334,262.0	1,549,505.0	28.4	8.4			20.03	20.26
81A	335,064.0	1,548,889.0	22.1	4.9			17.15	17.23
82A	334,693.0	1,548,317.0	28.7	9.8			18.93	19.01
Monitoring Wells Installed in the "B" Aquifer:								
W3-1B	6,529.92	4,680.66	0.3	2.7	-2.4	-2.5	-2.45	-2.46
W3-2B	7,299.12	4,649.89	-2.2	0.8	-3.3	-3.2	-3.01	-2.98
W3-3B	7,200.86	5,062.22	-0.8	2.1	-3.1	-3.0	-2.91	-2.76
W4-1B	5,066.43	5,128.74	5.2	6.5	-1.3	-1.2	-1.30	-1.11
W6-1B	4,808.81	5,586.08	5.5	5.5	0.1	0.1	0.00	0.16
W7-3B	4,099.30	5,025.02	10.4	8.6	1.9	1.9	1.84	1.93
W10-1B	3,098.06	4,546.48	9.8	5.4	4.3	4.3	4.40	4.49
W10-2B	1,927.91	5,319.71	15.7	4.9	10.7	10.7	10.84	10.82
MW-12A	4,397.55	5,430.43	10.0	9.4	-3.8	-3.9	0.62	0.70
MW-12B	4,397.55	5,430.43	10.0	9.4	-3.8	-3.9	0.59	
MW-14	4,869.83	5,362.22	6.4	6.6	-0.1		-0.24	
MW-17B	6,640.72	5,069.45	0.6	3.1	-2.6	-2.6	-2.48	-2.53
MW-20B	3,611.10	4,722.71	8.3	5.2	3.1	3.2	3.05	
4B(1)	334,393.9	1,548,699.4	27.4	8.0			19.38	19.44
17B(2)	334,364.0	1,548,656.0	28.7	8.6			20.09	20.12
29B(3)	334,374.0	1,548,658.0	28.7	8.9			19.83	19.89
45B(2)			28.9	10.0			18.88	18.97

Table 5-2 (Continued)

Well No.	Location[1] Northing	Easting	Ground Surface Elevation	Depth[2] of Water	Water Level Elevations[3] Aug. 21-22, 1985	Aug. 27- Sept. 18, 1985	Oct. 7-24, 1985	Nov. 11-26, 1985
46B(1)	335,071.0	1,548,884.0	22.0	4.7			17.31	17.46
47B(1)	335,174.0	1,549,796.0	21.1	5.1			15.98	16.18
48B(1)	334,255.0	1,549,508.0	28.5	8.1			20.38	20.52
50B(1)	334,690.0	1,548,326.0	28.5	8.9			19.55	19.69
53B(2)	334,259.0	1,549,520.0	28.5	7.1			21.35	21.45
55B(3)	334,695.0	1,548,307.0	28.6	9.9			18.67	17.52
57B(3)	335,177.0	1,549,506.0	21.2	5.5			15.66	15.87
58B(3)	334,267.0	1,549,514.0	28.4	7.8			20.64	20.76
Monitoring Wells Installed in the "C" Aquifer:								
W3-1C	6,627.87	5,060.11	-0.2	0.2	-0.2	-0.2	-0.42	-.96
ME-3C	334,366.0	1,548,645.0	28.7	6.4			22.25	22.68

1 Location coordinates of "W" and "MW" series wells by Sandis and Associates for this investigation; other coordinates from Canonie Engineers (1985b).

2 Depth of groundwater October 7 to 24, 1985.

3 Initial measurements to nearest 0.1 foot; subsequent readings measured to 0.01 foot. Elevations relative to U.S.C.&G.S. Monument D1122-1967 (see Plate 1) having an elevation of +3.448 feet above mean sea level based on the National Geodetic Vertical Datum of 1929. Water level elevations in Middlefield-Ellis-Whisman area from Curran (written commun., 1985; 1986).

The groundwater level in monitoring wells established in the "A" aquifer shows a consistant northward decrease in elevation as can be seen in Figure 5-1. The gradient from the Bayshore Freeway to about elev. -1 is 1:230 (vertical to horizontal). North of this line the gradient decreases in slope to less than 1:400. An apparent trough in the groundwater surface exists in the north runway area creating a local southeast-sloping gradient of about 1:780. The cause of this anomaly is either high water levels in the Site 1 area or low water levels in the W2-2A/W2-3A area. Factors potentially influencing water level fluctuations such as precipitation, barometric pressure, or seasonal trends (see Harding Lawson, 1986) would be expected to have a uniform influence in the area and not produce this local variation.

Although the contours of Figure 5-1 resemble a cone of depression centered on the W2-2A area, no pumped well is known to exist in the area. Surface waters that collect here are pumped into the Bay via the canal separating the salt evaporators from the golf course. This should have no effect on groundwater levels.

A series of water level measurements was conducted in wells at Sites 1, 2, 3 and 4 to test the hypothesis that tidal fluctuations may effect water levels in the "A" aquifer zone. Sequential water level readings were made at about 2-hour intervals for a period of 4 hours on November 26, 1985 using a Fisher M-Scope water level indicator.

Water levels and the maximum fluctuation in each well are indicated on Table 5-3. With the exception of well W3-1C, water levels remained constant, or within the range of accuracy of the measuring device, over the period measured. The 0.14-foot increase in water level in the "C" aquifer zone monitoring well is peculiar, but not believed to be the result of tidal influences since nearby wells in the "A" and "B" aquifer did not show a similar change.

The most probable explanation for the apparent trough in the "A" aquifer is that the water levels at Site 1 are abnormally high due to inflow of Bay water. These wells were constructed partly within Bay mud deposits while all other "A" monitoring wells were established in Holocene alluvium. Although organic clays of the Bay mud should act as aquitards, sandy lenses or the basal contact may act as

Table 5-3

WATER LEVELS AT SITES 1, 2, 3, AND 4
ON NOVEMBER 26, 1985
(all measurements in feet)

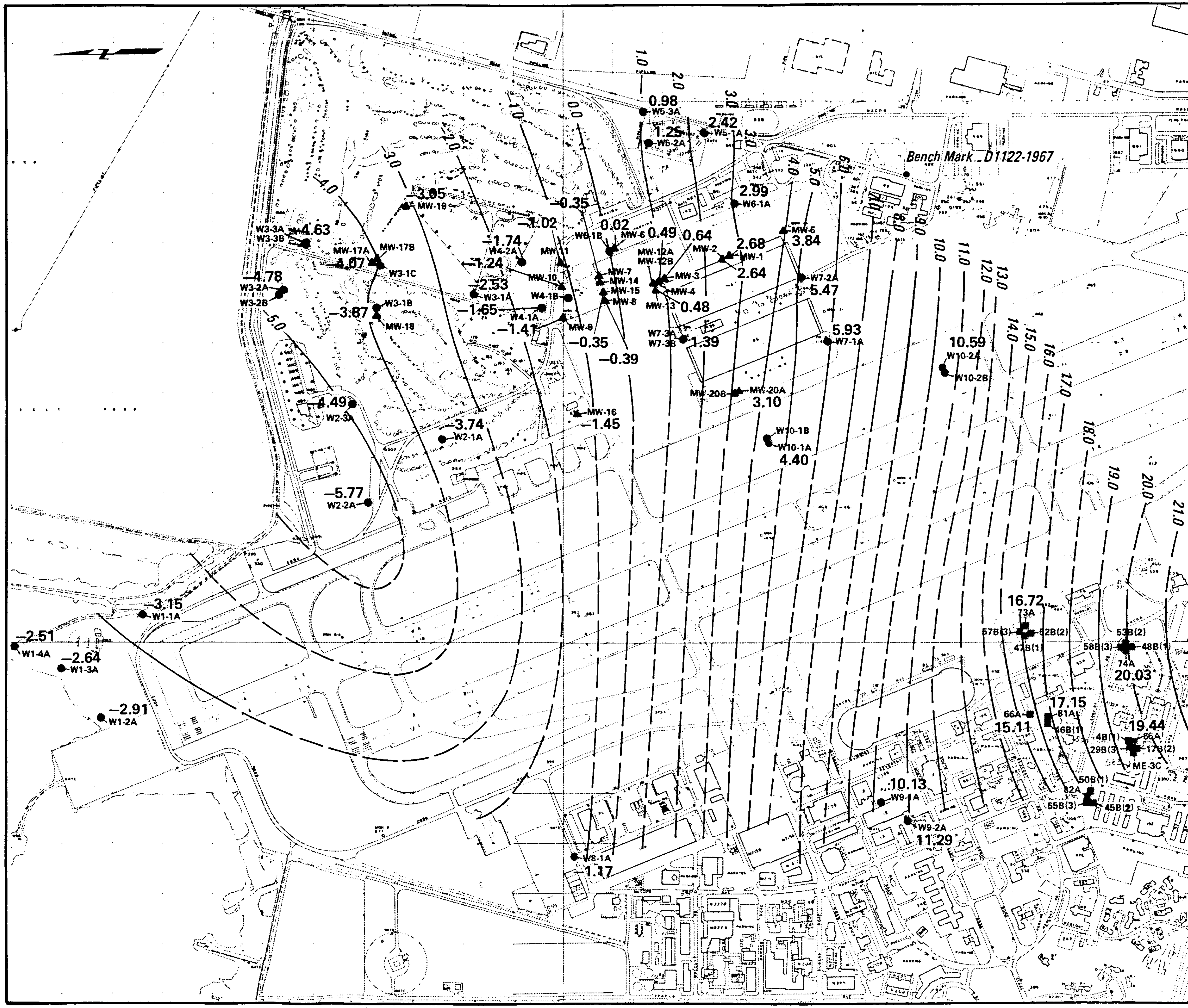
Well No.	Water Level Elevation 10:00 a.m.	12:00 p.m.	2:00 p.m.	Maximum Fluctuation
MW-17A	-3.83	-3.84	-3.84	0.01
MW-18	-3.54	-3.54	-3.55	0.01
W1-1A	-2.96	-2.96	-2.96	0
W1-2A	-2.66	-2.66	-2.66	0
W1-4A	-2.30	-2.28	-2.28	0.02
W2-1A	-3.42	-3.42	-3.41	0.01
W2-2A	-5.60	-5.60	-5.61	0.01
W2-3A	-4.15	-4.16	-4.16	0.01
W3-2A	-4.62	-4.62	-4.62	0
W3-3A	-4.40	-4.40	-4.40	0
W4-1A	-1.41	-1.41	-1.41	0
MW-17B	-2.29	-2.29	-2.29	0
W3-1B	-2.21	-2.21	-2.21	0
W3-2B	-1.88	-1.88	-1.88	0
W3-3B	-2.53	-2.53	-2.53	0
W3-1C	-1.31	-1.25	-1.17	0.14

NOTE: Water levels measured sequencially in order listed.

conduits to the Bay waters. This connection is further implied by the high conductance (see Section G, Table 6-4) of groundwater from the Site 1 wells.

Figure 5-2 shows groundwater levels measured in monitoring wells located within the "B" aquifer zone in October 1985. The piezometric surface in this aquifer is very similar to the water level in the "A" aquifer; the gradient is north-sloping at an inclination of 1:230 to near elev. -1, here decreasing to about 1:1200. Close correspondence between the "A" and "B" water level contours of Figures 5-1 and 5-2 suggests that the locally leaky groundwater conditions described elsewhere for the groundwater basin may be evident at Moffett Field. With the exception of areas where the "B" water levels are higher than the "A" levels such as north of the -1.0-foot contour on Figure 5-2 and at well 53B(2), the contours generally coincide so leakage cannot be precluded.

Two monitoring wells at Moffett Field tap the "C" aquifer: W3-1C and ME-3C. The piezometric surface in each of these wells (see Table 5-2) is about 2 feet higher than in nearby "A" and "B" aquifer monitoring wells and indicates true confined conditions within this aquifer. The piezometric gradient between these wells is 1:320 as measured in a northeasterly direction. If the piezometric surface slopes northward similar the "A" and "B" aquifer surface, the actual gradient would be steeper than that measured between the 2 wells, probably sloping near the inclination of the "A" and "B" surface.



EXPLANATON

−1.30 ● Monitoring well established by ESA, 1985, showing elevation of measured water level.

2.10 ▲ Monitoring well established by EMCON (1983a, 1983b) showing elevation of measured water level.

4.40 ■ Monitoring well established for Middlefield-Ellis-Whisman area investigation showing elevation of measured water level.

2.0 ——— Contour on surface of groundwater in measured aquifer; dashed where control points are widely spaced.

NOTES:

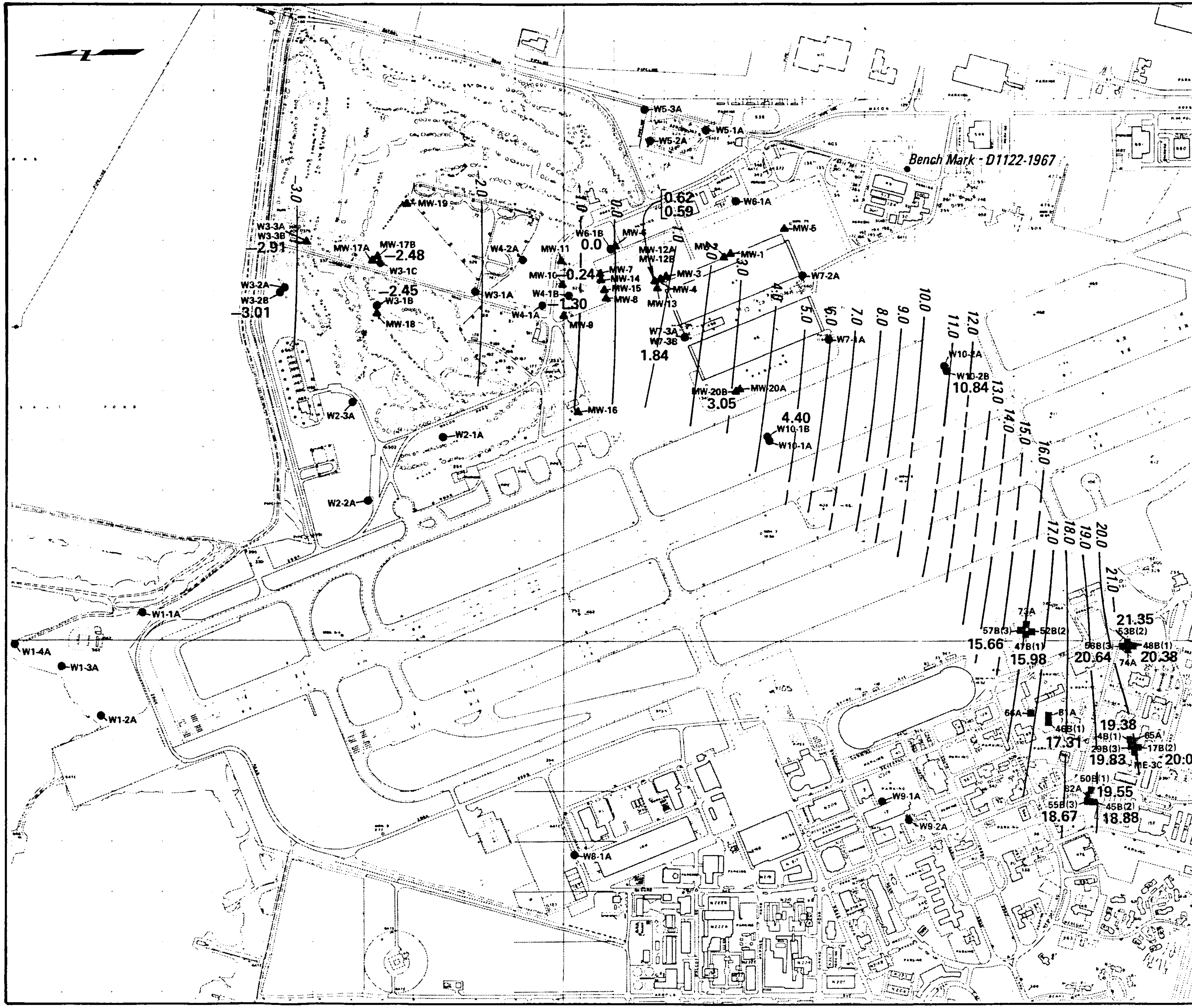
1) Base map from Naval Facilities Engineering Command Drawing No. 322-7, February 1982.
2) Contours based on water levels measured October 7 to 24, 1985.
3) Contours relative to mean sea level based on bench mark D1122-1967.

0 500 1000 feet

Earth Sciences Associates
Palo Alto, California

CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
GROUNDWATER LEVEL CONTOUR MAP
OF THE "A" AQUIFERS

Checked by [signature] Date 4/10/86	Approved by Julio Valera Date 4/10/86	Project No. 3110D	Figure No. 5-1



EXPLANATION

−1.30 ● Monitoring well established by ESA, 1985, showing elevation of measured water level.

2.10 ▲ Monitoring well established by EMCON (1983a, 1983b) showing elevation of measured water level.

4.40 ■ Monitoring well established for Middlefield-Ellis-Whisman area investigation showing elevation of measured water level.

2.0 ——— Contour on surface of groundwater in measured aquifer; dashed where control points are widely spaced.

NOTES:

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3) Contours relative to mean sea level based on bench mark D1122-1967.

0 500 1000 feet

Earth Sciences Associates
Palo Alto, California

CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
GROUNDWATER LEVEL CONTOUR MAP
OF THE "B" AQUIFERS

Checked by [signature] Date 9/10/86	Project No.	Figure No.
Approved by Julio Valera Date 9/10/86	3110D	5-2

6. CHEMICAL EVALUATION

Both soil samples and groundwater samples were collected and analyzed as part of the Stage I field investigation. Soil samples were collected from auger boring and from wells installed during the Stage I study. Groundwater samples were collected from wells installed by EMCON Associates in 1983 and from wells installed during the Confirmation Study (Vertification Step).

Tables 6-1 and 6-2 show the analyses conducted on soil and groundwater samples. The wells were sampled two to three times at approximately one month intervals. The three sampling periods were August 28 through September 18, October 7 through 22, and November 11 through 21, 1985. Field sampling procedures, analytical methods, and quality assurance/quality control procedures employed during the Stage I study are described in detail in the Quality Assurance/Quality Control Manual prepared for this investigation.

The following material describes the results of the chemical analyses on the soil and on the groundwater samples. Complete analytical results are provided in four supplemental volumes to this report. A list of volatile organics and common names is included in Appendix H of this report. A brief description of the disposal practices at each site is also provided. This information was extracted from the Initial Assessment Study Naval Air Station, Moffett Field, California (IAS) prepared by the Naval Energy and Environmental Support Activity.

6.1 Site 1 - Runway Landfill

6.1.1 Site Conditions

Site 1 is the landfill located at the northeast end of the runway and was operated from the early 1960's to 1978 to hold refuse, debris, and scrap equipment. Shops at Moffett Field used the landfill to dispose of hazardous materials, including trichloroethene (TCE), toluene, methyl ethyl ketone (MEK),

TABLE 6-1

SOILS ANALYSES

Site	Location	Depth feet	pH	Metals	VO	BNA	PCB	O.Pb
			Analyses					
1	A1-1	3.0-4.5	X	X	X	X	X	
		6.0-7.5	X	X	X	X	X	
	A1-2	6.0-7.5	X	X	X	X	X	
		13.0-14.5	X	X	X	X	X	
	A1-3	9.0-10.5	X	X	X	X	X	
	A1-4	3.0-4.5	X	X	X	X	X	
		9.0-10.5	X	X	X	X	X	
	W1-1A	3.0-4.5	X	X	X	X	X	
	W1-2A	10.0-11.5	X	X	X	X	X	
	W1-3A	30.0-31.5	X	X	X	X	X	
	W1-4A	3.0-4.5	X	X	X	X	X	
2	A2-1	3.0-4.5	X	X	X	X	X	
		6.0-7.5	X	X	X	X	X	
	A2-2	3.0-4.5	X	X	X	X	X	
		6.0-7.5	X	X	X	X	X	
	A2-3	3.0-4.5	X	X	X	X	X	
		6.0-7.5	X	X	X	X	X	
	W2-1A	10.0-11.5	X	X	X	X	X	
	W2-2A	5.0-6.5	X	X	X	X	X	
	W2-3A	8.0-9.5	X	X	X	X	X	
3	A3-1	0.0-0.5	X	X	X	X		
	A3-2	0.0-0.5	X	X	X	X		
	A3-3	0.0-0.5	X	X	X	X		
	W3-1A	5.5-6.5	X	X	X	X		
	W3-1C	4.0-5.5	X	X	X	X		
	W3-3A	10.0-11.5	X	X	X	X		
4	W4-1A	6.0-7.5	X	X	X	X		
5	A5-1	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A5-2	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A5-3	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	W5-1A	10.0-11.5	X		X			X
	W5-2A	10.0-11.5	X		X			X
	W5-3A	8.0-9.5	X		X			X

TABLE 6-1 (Continued)

SOILS ANALYSES

Site	Location	Depth feet	pH	Metals	VO	BNA	PCB	O.Pb
			Analyses					
6	W6-1A	3.0-4.5	X	X	X	X		
		6.0-7.5	X	X	X	X		
7	W7-1A	3.0-4.5	X	X	X	X		
		6.0-7.5	X	X	X	X		
	W7-2A	3.0-4.5	X	X	X	X		
		6.0-7.5	X	X	X	X		
	W7-3A	3.0-4.5	X	X	X	X		
		6.0-7.5	X	X	X	X		
8	A8-1	0.5-2.0	X				X	
	A8-2	0.5-2.0	X				X	
	A8-3	0.5-2.0	X				X	
	A8-4	0.5-2.0	X				X	
	A8-5	0.5-2.0	X				X	
	A8-6	0.5-2.0	X				X	
	W8-1A	6.0-7.5	X	X	X	X	X	
9	A9-1	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A9-2	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A9-3	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A9-4	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A9-5	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	A9-6	3.0-4.5	X		X			X
		6.0-7.5	X		X			X
	W9-1A	12.0-13.5	X		X			X
	W9-2A	13.0-14.5	X		X			X

Metals - Priority pollutant metals
VO - Volatile priority pollutants
BNA - Base/neutral and acid extractable priority pollutants
PCB - Polychlorinated biphenyls
O.Pb - Organic lead

TABLE 6-2

GROUNDWATER ANALYSES

Site	Loc.	No.	Analyses								
			pH	C	Metals	VO	BNA	PCB	O.Pb	NO3	TKN
1	W1-1A	3	X	X	X	X	X	X		X	X
	W1-2A	3	X	X	X	X	X	X		X	X
	W1-3A	3	X	X	X	X	X	X		X	X
	W1-4A	3	X	X	X	X	X	X		X	X
2	W2-1A	3	X	X	X	X	X	X		X	X
	W2-2A	3	X	X	X	X	X	X		X	X
	W2-3A	3	X	X	X	X	X	X		X	X
3	MW-17A	3	X	X	X	X	X				
	MW-17B	3	X	X	X	X	X				
	MW-18	3	X	X	X	X	X				
	MW-19	2	X	X	X	X	X				
	W3-1A	3	X	X	X	X	X				
	W3-1B	3	X	X	X	X	X				
	W3-1C	3	X	X	X	X	X				
	W3-2A	3	X	X	X	X	X				
	W3-2B	3	X	X	X	X	X				
	W3-3A	3	X	X	X	X	X				
	W3-3B	3	X	X	X	X	X				
4	MW-7	3	X	X	X	X	X				
	MW-9	3	X	X	X	X	X				
	MW-11	3	X	X	X	X	X				
	MW-15	3	X	X	X	X	X				
	MW-16	2	X	X	X	X	X				
	M4-1A	3	X	X	X	X	X				
	M4-1B	3	X	X	X	X	X				
	M4-2A	3	X	X	X	X	X				
5	W5-1A	3	X	X		X	X		X		
	W5-2A	3	X	X		X	X		X		
	W5-3A	3	X	X		X	X		X		
6	MW-6	3	X	X	X	X	X				
	M6-1A	3	X	X	X	X	X				
	W6-1B	3	X	X	X	X	X				

TABLE 6-2 (Continued)

GROUNDWATER ANALYSES

Site	Loc.	No.	Analyses								
			pH	C	Metals	VO	BNA	PCB	O.Pb	NO3	TKN
7	MW-1	3	X	X	X	X	X				
	MW-4	3	X	X	X	X	X				
	MW-5	2	X	X	X	X	X				
	MW-12A	3	X	X	X	X	X				
	MW-12B	2	X	X	X	X	X				
	MW-20A	2	X	X	X	X	X				
	MW-20B	2	X	X	X	X	X				
	W7-1A	3	X	X	X	X	X				
	W7-2A	3	X	X	X	X	X				
	W7-3A	3	X	X	X	X	X				
	W7-3B	3	X	X	X	X	X				
8	W8-1A	3	X	X	X	X	X	X			
9	W9-1A	3	X	X		X	X		X		
	W9-2A	3	X	X		X	X		X		
10	W10-1A	3	X	X		X	X				
	W10-1B	3	X	X		X	X				
	W10-2A	3	X	X		X	X				
	W10-2B	3	X	X		X	X				

C - Conductance
Metals - Priority pollutant metals
VO - Volatile priority pollutants
BNA - Base/neutral and acid extractable priority pollutants
PCB - Polychlorinated biphenyls
O.Pb - Organic lead
NO3 - Nitrate nitrogen
TKN - Total Kjeldahl Nitrogen

paint, solvents, lacquer, and oil. The Public Works paint shop disposed of paint and thinners at this site. Each year, the fuel farm sent about one pickup truck load of used fuel filters, and the electrical shop disposed of a few dozen filters and some sawdust contaminated with transformer oils possibly containing PCB. Assuming the squadrons disposed of five to ten percent of their liquid waste at the landfill, the total disposal may range from 75,000 to 150,000 gallons of hazardous waste. This site is in the City of Sunnyvale and is on the upgradient edge of the Leslie Salt Company evaporation ponds in the bay wetlands.

6.1.2 Soil Analyses

6.1.2.1 Inorganics

Table 6-3 presents the results of the pH and metals analyses. With the exception of the shallow sample at A1-1 all pH values were in the range of 7.4 to 9.2. This range was typical for other sites. pH at A1-1 (3.0 to 4.5 feet) was slightly lower than at other sites. Metals concentrations in most samples at Site 1 were similar to results at other sites. Compared to other soil samples elevated levels of lead and zinc were found at A1-4 (9.0 to 10.5 feet).

6.1.2.2 Organics

Several volatile priority pollutants (VO) and other organic compounds were detected at A1-4 and W1-1A (Table 6-4). Concentrations were below 0.29 mg/kg. No other volatiles were detected in soil samples. Base/neutral and acid extractable (BNA) priority pollutants were detected in four soil samples at this site. In A1-2 (6.0 to 7.5 feet), A1-4 (3.0 to 4.5 feet), A1-4 (9.0 to 10.5 feet), and W1-1A (3.0 to 4.5 feet) several polynuclear aromatic hydrocarbons (PAHs) were detected at or below 0.6 mg/kg. Chlorinated benzenes were detected in two samples, A1-4 (3.0 to 4.5 feet) and A1-9 (9.0 to 10.5 feet), at or below 0.4 mg/kg. Phthalates were detected in one sample, W1-1A (3.0 to 4.5 feet), at 0.7 to 0.8 mg/kg. Polychlorinated biphenyls were detected at the following locations:

TABLE 6-3

SITE 1 - INORGANIC ANALYSES FOR SOILS

	A1-1		A1-2		A1-3	A1-4		W1-1A	W1-2A	W1-3A	W1-4A
Parameter	3-4.5'[a]	6-7.5'	6-7.5'	13-14.5'	9-10.5'	3-4.5'	9-10.5'	3-4.5'	10-11.5'	30-31.5'	3-4.5'
pH	6.4	7.4	8.1	9.2	8.2	8.4	8.1	8.8	8.6	8.4	8.4
Silver	< 0.5	< 0.5	<0.44	<0.50	< 0.5	<0.49	<0.50	<0.47	<0.47	<0.45	<0.50
Arsenic	2.9	< 1	7	6.9	3.8	8.8	10	15	6.5	14	7.9
Bryllium	< 0.4	< 0.4	<0.35	0.20	0.4	<0.39	0.40	0.28	<0.37	0.45	0.50
Cadmium	< 0.3	< 0.3	<0.26	<0.30	0.3	<0.29	2.1	<0.28	<0.28	<0.27	<0.30
Chromium	33	15	35	39	32	31	35	52	25	35	39
Copper	14	3.6	46	18	23	28	33	34	11	25	17
Mercury	0.03	0.03	0.14	0.04	0.09	0.10	0.18	0.078	<0.03	0.06	0.03
Nickel	30	31	50	43	44	48	44	58	56	53	50
Lead	< 5	< 5	8.5	< 5	< 5	< 4.9	49	< 4.7	< 4.7	< 4.5	< 5
Antimony	<0.15	<0.15	<0.13	<0.15	<0.15	0.2	<0.15	<0.14	0.37	<0.14	0.50
Selenium	1	3	0.88	3	3	3.9	4	0.94	<0.75	3.6	<0.79
Thallium	<0.54	<0.54	<0.47	<0.53	<0.54	<0.53	<0.54	<0.51	<0.50	<0.46	<0.53
Zinc	36	34	76	37	57	92	260	56	33	45	47

[a] Depth of sample.
All results in mg/kg except pH in units.

TABLE 6-4

SITE 1 - VO ANALYSES FOR SOILS

Parameter	A1-4 3-4.5'[a]	A1-4 9-10.5'	W1-1A 3-4.5'
Priority Pollutants			
Ethylbenzene	(0.009)	0.097	
Toluene	(0.003)	0.040	(0.002)
Trichloroethene			0.022
Nonpriority Pollutants			
m,p-Xylenes	0.013	0.29	
o-Xylene	(0.005)	0.098	
cis-1,2-Dichloroethene			0.011
Other Compounds			
C6-C13 alkanes		(0.13)	
C3-benezenes		(0.090)	

[a] Depth of sample.

All results in mg/kg.

Blanks indicate compound not detected.

Values in ( ) are tentative concentrations.

1. A1-1 at 6.0 to 7.5 feet - 0.1 mg/kg
2. A1-2 at 6.0 to 7.5 feet - 0.5 mg/kg
3. A1-4 at 9.0 to 10.5 feet - 6.9 mg/kg

6.1.3 Groundwater Analyses

6.1.3.1 Inorganics

Tables 6-5 through 6-7 show results of pH, conductance, nitrate nitrogen, Total Kjeldahl Nitrogen (TKN), and metals. In general, results for the three sampling periods were similar. pH in all wells was near neutral. Conductance in all wells exceeded 50,000 µmhos/cm. Conductance at other sites was typically below 2,000 µmhos/cm. The high conductance was probably due to salt water intrusion. Nitrate nitrogen was typically below 0.5 mg/l, TKN in the downgradient wells was 3 to 15 times higher than in the upgradient well, W1-1A.

All groundwater samples were field filtered for metals. Metals concentrations were similar at all Site 1 wells. There was also little variation between the three sampling periods. Arsenic showed some variation between the three sampling periods ranging from 0.005 to 0.023 mg/l. The average concentration was approximately 0.014 mg/l. Selenium concentrations were much higher during the first sampling period but dropped below the detection limit of 0.01 mg/l during the latter two sampling periods.

Some of the highest metals concentrations were observed at Site 1 wells. Arsenic, metal, lead, and zinc were typically higher at Site 1 wells than at other sites. Lead, in particular, was 10 to 15 times higher at Site 1 wells.

6.1.3.2 Organics

Table 6-8 shows the VO results for all three sampling periods. Six priority pollutants and three nonpriority pollutants were detected in Site 1 wells. Toluene, TCE, and cis-1,2-dichloroethene were detected the most frequently and

TABLE 6-5

SITE 1 - INORGANIC ANALYSES FOR GROUNDWATERS
FIRST SAMPLING PERIOD

Parameter	W1-1A	W1-2A	W1-3A	W1-4A
pH	7.2	6.9	7.0	6.9
Conductance	>50,000	>50,000	>50,000	>50,000
Nitrate-nitrogen	<0.1	<0.1	0.65	<0.1
TKN	3.6	32	35	38
Silver	<0.005	<0.005	<0.005	<0.005
Arsenic	0.005	0.006	0.007	0.005
Beryllium	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029
Copper	0.010	<0.007	<0.007	<0.007
Mercury	0.0003	<0.0003	<0.0003	<0.0003
Nickel	0.10	0.046	0.057	0.050
Lead	0.031	0.026	0.024	0.030
Antimony	0.008	0.009	0.011	0.007
Selenium	<0.010	0.090	0.24	0.15
Thallium	<0.005	<0.005	<0.005	<0.005
Zinc	0.16	0.015	0.11	0.10

All results in mg/l except pH in units and conductance in μmhos/cm.

TABLE 6-6

SITE 1 - INORGANIC ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	W1-1A	W1-2A	W1-3A	W1-4A
pH	6.6	6.9	6.8	6.9
Conductance	>50,000	>50,000	>50,000	>50,000
Nitrate-nitrogen	<0.15	<0.4	<0.4	<0.4
TKN	3.3	14	56	49
Silver	<0.005	<0.005	<0.005	<0.005
Arsenic	0.023	0.023	0.023	0.023
Beryllium	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029
Copper	0.013	0.008	0.014	<0.007
Mercury	<0.0003	<0.0003	<0.0003	<0.0003
Nickel	0.024	0.024	0.015	0.026
Lead	0.019	0.019	0.019	0.019
Antimony	0.019	0.012	0.015	0.012
Selenium	<0.01	<0.01	<0.01	<0.01
Thallium	0.012	0.013	0.013	0.013
Zinc	0.037	0.026	0.029	0.072

All results in mg/l except pH in units and conductance in µmhos/cm.

TABLE 6-7

SITE 1 - INORGANIC ANALYSES FOR GROUNDWATERS THIRD SAMPLING PERIOD

Parameter	W1-1A	W1-2A	W1-3A	W1-4A
pH	6.6	6.6	6.8	6.9
Conductance	>50,000	>50,000	>50,000	>50,000
Nitrate-nitrogen	<0.20	<0.20	<0.20	<0.20
TKN	4.8	15	15	50
Silver	<0.005	0.006	<0.005	0.008
Arsenic	0.014	0.012	0.012	0.012
Beryllium	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029
Copper	0.011	<0.007	<0.007	0.011
Mercury	0.0003	<0.0003	<0.0003	<0.0003
Nickel	0.053	0.034	0.024	<0.008
Lead	0.026	0.031	0.031	0.028
Antimony	0.006	0.007	0.005	0.008
Selenium	<0.01	<0.01	<0.01	<0.01
Thallium	<0.005	<0.005	<0.005	<0.005
Zinc	0.025	0.034	0.023	0.017

All results in mg/l except pH in units and conductance in µmhos/cm.

TABLE 6-8

SITE 1 - VO ANALYSES FOR GROUNDWATER

Parameter	W1-1A			W1-2A			W1-3A		
	1[a]	2	3	1	2	3	1	2	3
Priority Pollutants									
Benzene							(0.3)	0.6	
Chloroform	1			1.3					
1,1-Dichloroethene		(0.1)							
Ethylbenzene						(0.4)		0.5	
Toluene	(0.3)			0.5			2.8	6.8	
Trichloroethene	2.1	2.7	(0.2)	2.4		1.3	0.5	(0.2)	
Nonpriority Pollutants									
m,p -Xylenes				0.8			0.5	0.9	
o-Xylene						(0.2)		(0.4)	
cis -1,2 -Dichloroethene	0.5	6.4	0.9					(0.1)	

[a] Sampling period.
All results in μ g/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

at the highest concentrations. Except for toluene (at 6.8 µg/l) and cis-1,2-dichloroethene (at 6.4 µg/l) during one period each, all concentrations were below 3 µg/l. No VOs were detected at W1-4A during any sampling period, at W1-2A during the second sampling period, or at W1-3A during the third sampling period. No BNAs or PCBs were detected in groundwater samples at this site.

6.2 Site 2 - Golf Course Landfill

6.2.1 Site Conditions

Site 2 is a landfill located in the western part of the golf course. This landfill was in operation from the 1940's to the early 1960's. Little information is available on the specific quantities of wastes which were disposed of at this site, or on the exact location of the landfill. However, all organizations at Moffett had access to this landfill, and some might have disposed of hazardous waste there. Reportedly, this site was used by the same shops and to the same degree as the more recent runway landfill. A burn pit in the golf course area was used for disposal of outdated flares and cartridge-activated devices until 1971. The golf course was constructed by filling the area, using soil from off-base.

6.2.2 Soil Analyses

6.2.2.1 Inorganics

Table 6-9 shows the inorganic analyses for soils. pH values were in the range of 8.2 to 9.4 which was typical of all sites. Arsenic concentrations for the auger borings were below 1 µg/l and for the wells were between 5.8 and 15 µg/l. The soil concentrations from the well boreholes were typical of other sites while those from the auger borings were low. All other metal concentrations were similar at Site 2 locations and typical of other sites.

TABLE 6-9

SITE 2 - INORGANIC ANALYSES FOR SOILS

Parameter	A2-1		A2-2		A2-3		W2-1A	W2-2A	W2-3A
	3-4.5'	6-7.5'	3-4.5'	6-7.5'	3-4.5'	6-7.5'	10-11.5'	5-6.5'	8-9.5'
pH	8.3	8.7	8.6	8.7	8.6	9.3	8.2	8.2	8.6
Silver	<0.50	<0.49	<0.50	<0.49	<0.48	<0.50	<0.49	<0.45	<0.45
Arsenic	< 1	< 1	< 1	< 1	< 1	< 1	5.8	7.3	15
Beryllium	<0.40	<0.39	0.40	<0.39	0.38	<0.40	<0.39	<0.36	0.27
Cadium	<0.30	<0.29	<0.30	<0.29	0.38	<0.30	<0.29	<0.27	<0.27
Chromium	49	12	27	17	26	23	35	33	40
Copper	16	5.1	27	15	16	16	29	24	34
Mercury	0.03	0.10	0.03	0.09	0.04	0.06	0.08	0.05	0.11
Nickel	55	40	43	29	54	33	52	45	59
Lead	< 5	< 4.9	< 5	< 4.9	< 4.8	< 5	< 4.9	< 4.5	< 4.5
Antimony	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.14	<0.14	<0.14
Selenium	1	3	2	< 1	2	2	0.97	0.91	0.91
Thallium	<0.54	<0.54	<0.54	<0.54	<0.54	<0.54	<0.52	<0.49	<0.50
Zinc	46	35	40	24	47	27	51	47	64

All results in mg/kg except pH in units.

6.2.2.2 Organics

VOs and BNAs were not detected in the soil samples. PCBs were found at A2-2 (6.0 to 7.5 feet) at 2.0 mg/kg.

6.2.3 Groundwater Analyses

6.2.3.1 Inorganics

Tables 6-10 through 6-12 show the inorganic analyses for monitoring wells. In general, results from the three sampling periods were similar. Conductance in the two wells nearest the salt evaporator ponds, W2-2A and W2-3A, were elevated compared with the upgradient well, W2-1A probably due to salt water intrusion. Concentrations of arsenic, nickel, and zinc were also somewhat higher in the downgradient wells.

6.2.3.2 Organics

Table 6-13 shows the VO results. TCE and cis-1,2-dichloroethene were the most commonly detected VOs. Several more VOs were detected in W2-1A during the second sampling period than during the other two sampling periods. These compounds included chloroform, 1,1-dichloroethane, 1,1-dichloroethene, 1,1,1-trichloroethane, and TCE. All of these compounds except TCE were detected at 0.1 µg/l. TCE was not detected during the first sampling period and no VOs were detected during the last sampling period, but TCE was detected at 7.9 µg/l during the second sampling period. The most consistent results were observed at W2-3A. TCE was found at approximately 5 µg/l and cis-1,2-dichloroethene of 0.2 µg/l in all samples. No BNAs or PCBs were detected in groundwater samples even though PCBs were detected in a soil sample.

6.3 Sites 3, 4, 6, and 7 - Marriage Road Ditch, Former Industrial Holding Pond, Runway Apron, and Hangars 2 and 3

Sites 3, 4, 6, and 7 are analyzed together because the groundater data indicate that the sites interact and quality impacts extend beneath all sites.

TABLE 6-10

SITE 2 - INORGANIC ANALYSES FOR GROUNDWATER
FIRST SAMPLING PERIOD

Parameter	W2-1A	W2-2A	W2-3A
pH	7.5	7.0	7.4
Conductance	1,590	1,100	13,900
Nitrate-Nitrogen	2.3	3.8	0.46
TKN	<0.5	<0.5	0.77
Silver	<0.005	<0.005	<0.005
Arsenic	<0.001	0.005	0.006
Beryllium	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007
Mercury	<0.0003	0.0005	<0.0003
Nickel	<0.008	0.024	0.045
Lead	<0.002	<0.002	<0.002
Antimony	<0.002	0.022	<0.002
Selenium	0.010	0.010	<0.010
Thallium	<0.005	<0.005	<0.005
Zinc	<0.007	0.071	0.037

All results in mg/l except pH in units and conductance in μmhos/cm.

TABLE 6-11

SITE 2 - INORGANIC ANALYSES FOR GROUNDWATER
SECOND SAMPLING PERIOD

Parameter	W2-1A	W2-2A	W2-3A
pH	7.3	7.0	7.3
Conductance	1,610	10,800	13,000
Nitrate-Nitrogen	2.0	3.5	<0.15
TKN	0.5	0.7	0.7
Silver	<0.005	<0.005	<0.005
Arsenic	<0.001	0.019	0.023
Beryllium	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029
Copper	0.010	0.007	<0.007
Mercury	<0.0003	<0.0003	<0.0003
Nickel	<0.008	<0.008	<0.008
Lead	<0.002	<0.002	0.002
Antimony	0.002	0.029	0.023
Selenium	<0.01	<0.01	<0.01
Thallium	<0.005	<0.005	0.011
Zinc	0.008	0.039	0.019

All results in mg/l except pH in units and conductance in μmhos/cm.

TABLE 6-12

SITE 2 - INORGANIC ANALYSES FOR GROUNDWATER
THIRD SAMPLING PERIOD

Parameter	W2-1A	W2-2A	W2-3A
pH	7.3	7.0	7.4
Conductance	1,580	10,500	12,800
Nitrate-Nitrogen	0.87	2.9	<0.20
TKN	<0.5	<0.5	0.8
Silver	<0.005	<0.005	<0.005
Arsenic	<0.001	0.018	0.012
Beryllium	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007
Mercury	<0.0003	0.0003	<0.0003
Nickel	<0.008	0.025	0.092
Lead	<0.002	<0.002	<0.002
Antimony	<0.002	0.016	0.014
Selenium	0.02	0.02	<0.01
Thallium	<0.005	<0.005	<0.005
Zinc	<0.007	<0.007	0.008

All results in mg/l except pH in units and conductance in μmhos/cm.

TABLE 6-13

SITE 2 - VO ANALYSES FOR GROUNDWATER

Parameter	W2-1A			W2-2A			W2-3A		
	1[a]	2	3	1	2	3	1	2	3
Priority Pollutants									
Chloroform		(0.1)		0.5			(0.1)		
1,1-Dichloroethane		(0.1)						(0.1)	(0.1)
1,1-Dichloroethene		(0.1)							
Toluene	(0.2)	(0.1)							
1,1,1-Trichloroethene		(0.1)							
Trichloroethene		7.9		(0.4)	(0.2)		6.5	4.8	5.2
Nonpriority Pollutants									
cis -1,2 -Dichloroethene	(0.2)	2.3					(0.2)	(0.1)	(0.2)

a Sampling period.
All results in μ g/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

6.3.1 Site Conditions

6.3.1.1 Site 3 - Marriage Road Ditch

Marriage Road Ditch begins at the intersection of Marriage Road and Macon Road and is graded so that water flows toward the dike at the northern boundary of Moffett Field where water is pumped into Guadalupe Slough. An estimated 150,000 to 720,000 gallons of mixed hazardous waste containing waste oils, solvents, fuels, detergents, paints, paint strippers, and hydraulic fluids were disposed in storm drains in and around Hangars 1, 2, and 3 from the 1940's to the 1970's. The storm drains flowed to Marriage Road Ditch.

6.3.1.2 Site 4 - Former Industrial Wastewater Holding Pond

The former industrial wastewater holding ponds northeast of Hangar 3 were unlined and received about 15 million gallons of wastewater from aircraft washing, ground support equipment maintenance, and Hangars 2 and 3 from 1968 to 1978. The wastewater was held in the ponds, treated, and discharged to the sanitary sewers. As much as 35,000 gallons of toluene, MEK, dry cleaning solvent, paint sludge, freon 113, TCE, trichloroethane, carbon remover, paint stripper, ethylene glycol, fuel, and oil may have been discharged to the ponds directly and in the wastewater. The industrial wastewater treatment ponds have been moved to an adjacent area to the east and some of the area has been paved. The ponds were probably deep enough to penetrate the saturated zone of ground water. Water in the "A" aquifer may flow into Marriage Road Ditch and be pumped into Guadalupe Slough.

6.3.1.3 Site 6 - Runway Apron

Site 6 is the area surrounding the runway apron north and east of Hangar 3. The runway apron of Hangar 3 was enlarged in late 1979, covering an area formerly used for disposal of waste from aircraft maintenance, which included solvents, oils, fuels, paints, and paint strippers from the 1940's to the 1970's.

The volume of hazardous waste disposed at this site has been estimated to be 120,000 to 600,000 gallons. Chlorinated solvents disposed at this site are the pollutants of greatest concern.

6.3.1.4 Site 7 - Hangars 2 and 3

Site 7 is the area surrounding Hangars 2 and 3 on the eastern sides of the runways. Construction of Hangars 2 and 3 was completed in 1942. The deck drains in and around Hangars 2 and 3 flowed to Marriage Road Ditch from the early 1940's to 1978. Unpaved areas at each corner of Hangars 2 and 3 were used to dispose of an estimated 120,000 to 600,000 gallons of hazardous waste including paints, paint strippers, oils, solvents, fuels, and hydraulic fuels. An Aircraft Intermediate Maintanance Department power plant shop formerly located at the northeast corner of Hangar 3 disposed of chlorinated solvents, including TCE, down deck drains and on unpaved areas around Hangar 3. Chlorinated solvents such as TCE and other compounds have been detected in ground water samples from monitoring wells to the north and east of Hangar 3.

6.3.2 Soil Analyses

6.3.2.1 Inorganics

Table 6-14 shows the inorganic results from soil samples. All pH values were similar and typical of other sites as were most metals concentrations. Elevated levels of cadmium, lead, and zinc were observed in A3-1 through A3-3. These soils are the sediments in the bottom of the ditch. Concentrations of the three metals were highest in A3-1, the upstream sample point, and lowest in A3-3, the downstream sample point. It appears that metals associated with suspended matter settled out in the ditch with the highest loads settling out in the upstream reaches.

Soil samples from auger borings in Marriage Road Ditch were analyzed by the Waste Extraction Test (California Administrative Code, Title 22, Division 4,

TABLE 6-14

SITES 3, 4, 6, AND 7 - INORGANIC ANALYSES FOR SOILS

	A3-1	A3-2	A3-3	W3-1A	W3-1C	W3-3A	W4-1A	
Parameter	0-.5'[a]	0-.5'	0-.5'	5.5-6.5'	4-5.5'	10-11.5'	3-4.5'	6-7.5'
pH	8.0	7.8	8.0	8.3	8.4	7.8	9.0	8.3
Silver	0.64	1	<0.48	<0.48	<0.49	0.46	<0.49	<0.50
Arsenic	2.7	1.8	5.7	8.6	<1	16	11	6.9
Beryllium	<0.36	<0.36	<0.38	<0.38	0.78	<0.37	<0.39	<0.40
Cadmium	9.5	9	6	<0.29	<0.29	<0.28	<0.29	<0.30
Chromium	47	74	34	43	33	48	41	32
Copper	32	46	31	29	24	44	26	27
Mercury	0.09	0.12	0.04	0.05	0.06	0.07	0.03	0.08
Nickel	29	29	41	59	51	79	57	57
Lead	220	220	51	<4.8	<4.9	<4.6	<4.9	<5.0
Antimony	0.27	<0.14	<0.14	<0.14	<0.15	<0.14	<0.14	<0.15
Selenium	3.6	2.7	1.9	1.9	2	<.74	2.9	3.0
Thallium	<0.49	<0.49	<0.51	<0.51	<0.54	<0.50	<0.52	<0.53
Zinc	200	200	110	48	42	75	52	55

[a] Depth of sample.
All results in mg/kg except pH in units.

TABLE 6-14 (Continued)

SITES 3, 4, 6, AND 7 - INORGANIC ANALYSES FOR SOILS

	W6-1A		W7-1A		W7-2A		W7-3A	
Parameter	3-4.5'[a]	6-7.5'	3-4.5'	6-7.5'	3-4.5'	6-7.5'	3-4.5'	6-7.5'
pH	8.1	8.0	8.3	8.2	8.8	8.5	8.0	7.9
Silver	<0.48	<0.46	<0.48	<0.50	<0.48	<0.46	<0.50	<0.48
Arsenic	11	7.4	4.8	2.0	16	16	7.9	7.7
Beryllium	0.67	<0.37	<0.38	0.40	<0.38	0.83	0.30	<0.38
Cadmium	<0.29	<0.28	<0.29	<0.30	<0.29	<0.28	<0.30	<0.29
Chromium	40	35	32	19	51	48	46	41
Copper	30	25	20	12	32	35	28	29
Mercury	0.06	0.08	0.08	<0.03	<0.03	0.05	0.06	<0.03
Nickel	61	56	43	21	68	69	60	51
Lead	<4.8	<4.6	<4.8	<5.0	17	<4.6	<5	27
Antimony	<0.14	<0.14	<0.14	<0.15	<0.14	<0.14	<0.15	<0.14
Selenium	0.96	0.92	2.8	<0.79	<0.77	1.8	0.99	1.9
Thallium	<0.52	<0.50	<0.51	<0.53	<0.52	<0.50	<0.53	<0.52
Zinc	53	46	35	29	57	60	48	45

[a] Depth of sample.
All results in mg/kg except pH in units.

Chapter 30, Article 11, Section 66700) to determine whether the soils would be classified as hazardous wastes and to estimate potential soluble concentrations. These results are presented in Table 6-15 and indicate that soils were below both total and soluble concentrations for designation as a hazardous waste.

6.3.2.2 Organics

Table 6-16 shows the results of VO analyses. VOs were detected in several samples from Site 3 and in one sample from Site 4 but not at Sites 6 or 7. VOs did not demonstrate the same behavior as metals in ditch soil samples. Concentrations were higher in the two downstream samples. No VOs were detected in A3-1. Both solvent-related (chlorinated volatiles) and fuel related (alkanes and benzenes) organics were detected in these samples. Concentrations were generally less than 0.05 mg/kg.

Table 6-17 shows the soil results from samples collected by EMCON Associates during well installation in 1983. Volatiles were detected in most samples. The only exceptions were MW-16, -17A, -18, and -20B. The largest number of compounds and the highest concentrations were detected in soils from wells on the northeasterly side of Hangars 2 and 3. At most sites concentrations were below 0.5 mg/kg as was noted for soil samples collected at these sites during the Confirmation Study (Verification Step).

BNAs were detected in two soil samples from the Confirmation Study (Verification Step). At A3-2 (0. to 0.5 feet deep) several PAHs were detected at concentrations at or below 0.5 mg/kg. At W7-1A (3.0 to 4.5 feet) di-n-butyl phthalate was detected at 1.2 mg/kg.

TABLE 6-15

SITES 3, 4, 6, AND 7 –
SOLUBLE METALS CONCENTRATIONS IN SOILS

Parameter	A3-1 Total (mg/kg)[a]	A3-1 Soluble (mg/l)[b]	A3-2 Total (mg/kg)[a]	A3-2 Soluble (mg/l)
Camium	9.5	0.17	9	0.13
Chromium	47	0.33	74	0.28
Lead	220	2.4	220	2.8
Zinc	200	2.7	200	3.1

a From Table 6-14.

b Based on California Waste Extraction Test.

TABLE 6-16

SITES 3, 4, 6, AND 7 - VO ANALYSES FOR SOILS

Parameter	A3-2	A3-3	W3-1A	W4-1A	
	0-0.5'[a]	0-0.5'	5.5-6.5'	3-4.5'	6-7.5'
Priority Pollutants					
Benzene			(0.007)		(0.001)
1,1-Dichloroethane		(0.001)			
Tetrachloroethene		(0.002)			
Toluene	(0.002)		(0.001)		(0.001)
Trichloroethene		(0.007)			
trans -1,2-Dichloroethene		(0.003)			
Nonpriority Pollutants					
m,p - Xylenes	(0.004)		(0.003)		
cis -1,2 Dichlroethene		(0.005)			
Other Compounds					
C6-C10 Cyclic Alkanes			(0.038)		
C6-C10 Alkanes					(0.010)
C8-C10 Alkanes			(0.033)		
C9-C13 Alkanes	0.46				
C3-Benzenes			(0.019)		

a Depth of sample.
All results in mg/kg.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-17

VO ANALYSES FOR SOILS FROM EXISTING WELLS

Parameter	MW-1 5'	MW-2 5'	MW-3 5'	MW-4 5'	MW-5 5'	MW-6 6.5'	MW-7 5'	MW-8 5'	MW-9 5'	MW-10 5'	MW-11 5'	MW-13 5'	MW-14 5'	MW-14 30'	MW-17B 35'	MW-20A 5'	MW-20A 10'
Benzene												0.002	0.001	0.004			
Methyl Chloride							0.009	0.012									
Methylene Chloride	0.015	0.016	0.026	0.048													
Tetrachloroethene	0.008	0.003		0.002								0.004					
Toluene	0.011	0.034	0.035	0.033	0.013	0.046	0.005		0.006	0.004	0.008	0.050	0.023		0.10	0.025	0.127
Trichloroethene	0.23	0.004	0.005	0.014								0.002					
trans-1,2-Dichloroethene	0.005		0.007	0.010													

All results in mg/kg.

Source: EMCON Associates, Phase II and III Hydrogeologic Investigation
Moffett Field Naval Air Station
Sunnyvale, California
June 1983

EMCON Associates, Phase IV and V Hydrogeologic Investigation
Moffett Field Naval Air Station
Sunnyvale, California
December 1983

6.3.3 Groundwater Analyses

6.3.3.1 Inorganics

Results of inorganic analyses are shown in Tables 6-18 through 6-20. pH values for the "A" aquifer wells were typically 7.3 and for the "B" and "C" aquifer wells were 8.0. For most wells conductance in the "A" aquifer ranged from 1000 to 1800 µmhos/cm. In the "B" and "C" aquifer wells conductance ranged from 400 to 1300 µmhos/cm. These values are typical of wells at other sites.

Conductance was high at several wells including W3-2A, W3-3A, MW-17A, MW-18, and MW-19. At Site 2 conductance was high in W2-2A and W2-3A and at Site 1 in all wells. These wells are closest to the northerly boundary of Moffett Field which is adjacent to salt evaporation ponds. The high conductance levels are probably due to salt water intrusion into the "A" aquifer.

Metals concentrations were generally near or below detection limits. There was some variation from one sampling period to the next. This was most apparent for zinc. However, metals concentrations were similar for most wells and were typical of wells at other sites.

6.3.3.2 Organics

Results of VO analyses are shown in Tables 6-21 through 6-23. A wide variety of volatiles were detected in the "A" aquifer wells at Sites 3, 4, 6, and 7. The predominant compounds are the chlorinated volatiles indicating solvents and degreasers as the source rather than fuels. Wells with the highest concentrations include W3-1A, W4-1A, W4-2A, MW-1, MW-3, MW-4, MW-7, MW-9, MW-12A, MW-13, and MW-15. These wells are all located at or downgradient from the northeasterly side of Hangars 2 and 3. The highest concentrations were observed in MW-3, MW-4, and MW-12A which are at the northeasterly corner of the hangars. Of the 25 volatiles detected at Sites 3, 4, 6, and 7, wells MW-3, MW-4,

TABLE 6-18

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
FIRST SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
pH	7.2	8.1	8.3	7.0	8.2	7.0	8.8	7.2	7.4	7.2
Conductance	1,310	667	431	16,600	815	9,800	1,110	1,340	679	1,380
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	0.012	0.005	0.003	0.004	0.001	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.008
Mercury	<0.0003	0.0007	<0.0003	<0.0003	<0.0003	<0.0003	0.0004	<0.0003	0.0003	<0.0003
Nickel	0.014	<0.008	<0.008	0.012	<0.008	0.14	<0.008	0.013	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	<0.002	<0.002	<0.002	0.011	0.003	0.010	0.005	<0.002	<0.002	<0.002
Selenium	<0.010	<0.010	<0.010	0.020	<0.10	<0.010	<0.010	<0.010	<0.010	<0.010
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.007	<0.007	<0.007	0.018	<0.007	0.066	<0.007	<0.007	<0.007	0.049

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-18 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATER
FIRST SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	W7-3B	MW-1	MW-4	MW-5	MW-6	MW-7	MW-9
pH	7.3	7.6	7.5	7.3	7.2	8.6	7.2	6.9	7.3	7.2	7.3	7.2
Conductance	1,440	1,130	1,030	1,050	1,440	489	1,290	1,350	1,430	1,330	1,260	1,400
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.008	<0.001	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	0.034	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Mercury	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Nickel	<0.008	<0.008	0.027	0.012	<0.008	<0.008	<0.008	0.011	<0.008	<0.008	0.009	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	0.002	<0.002	0.005	0.005	0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002
Selenium	0.010	<0.010	<0.010	<0.010	0.020	0.010	<0.010	0.020	<0.010	<0.010	<0.010	0.010
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.010	0.010	0.064	0.013	0.008	0.014	<0.007	0.007	0.020	<0.007	0.009	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-18 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATER
FIRST SAMPLING PERIOD

Parameter	MW-11	MW-12A	MW-12B	MW-15	MW-16	MW-17A	MW-17B	MW-18	MW-19	MW-20A	MW-20B
PH	7.3	7.3	7.7	7.2	8.6	7.0	7.8	7.7	7.3	7.2	7.9
Conductance	1,320	1,260	986	1,280	1,520	2,440	502	5,490	3,790	1,720	493
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	0.002	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	0.003	<0.003	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.004
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.010	<0.007
Mercury	<0.0003	<0.0003	<0.0003	<0.0003	0.0008	<0.0003	<0.0003	0.0005	0.0005	<0.0003	<0.0003
Nickel	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Selenium	0.010	<0.010	<0.010	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.010	<0.007	<0.007	<0.007	<0.007	0.015	0.017	<0.007	<0.007	0.046	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-19

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
pH	7.2	8.1	8.3	7.3	7.9	7.0	8.2	7.2	8.4	7.2
Conductance	1,270	502	419	17,200	778	9,500	863	1,330	1,060	1,380
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	0.005	0.024	0.002	<0.001	0.003	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	0.007	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.006
Chromium	<0.029	<0.029	<0.029	0.059	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007	0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Mercury	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0003	<0.0003	<0.0003	<0.0003
Nickel	0.009	<0.008	<0.008	0.019	0.014	0.037	0.016	<0.008	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	0.002	<0.002	<0.002	0.026	<0.002	0.030	<0.002	<0.002	<0.002	<0.002
Selenium	0.02	<0.01	<0.01	0.03	0.02	<0.01	0.02	0.01	0.01	0.02
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.007	0.19	<0.007	0.021	<0.007	0.039	0.009	<0.007	<0.007	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-19 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	W7-3B	MW-1	MW-4	MW-5	MW-6	MW-7	MW-9
pH	7.3	7.6	7.4	7.3	7.2	8.5	7.1	6.9	7.3	7.2	7.3	7.2
Conductance	1,470	1,330	1,070	1,100	1,470	510	1,300	1,330	1,420	1,350	1,270	1,470
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.008	<0.001	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	0.056	<0.029	<0.029	<0.029
Copper	<0.007	0.008	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Mercury	0.0011	0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0003	<0.0003
Nickel	<0.008	0.011	<0.008	<0.008	<0.008	<0.008	<0.008	0.010	<0.008	<0.008	<0.008	0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	0.004	0.003	0.006	0.010	0.002	0.003	0.004	0.002	0.004	0.003	<0.002	<0.002
Selenium	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	<0.01	0.01	0.01	0.02	0.01
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.007	0.049	<0.007	0.007	0.012	<0.007	0.009	0.008	0.012	0.008	<0.007	0.008

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-19 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	MW-11	MW-12A	MW-12B	MW-15	MW-16	MW-17A	MW-17B	MW-18	MW-19	MW-20A	MW-20B
pH	7.3	7.4	8.0	7.2	7.9	7.1	8.1	7.8	7.1	7.0	7.8
Conductance	1,330	1,260	974	1,180	1,570	4,470	467	5,050	3,770	1,810	505
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	<0.007	<0.007	<0.007	<0.007	0.010	<0.007	<0.007	<0.007	<0.007	<0.007
Mercury	<0.0003	<0.0003	<0.0003	<0.0003	0.0004	<0.0003	<0.0003	<0.0003	0.0003	<0.0003	<0.0003
Nickel	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.014	<0.008	0.019	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	<0.002	0.003	0.005	<0.002	0.002	0.002	<0.002	0.002	0.003	0.003	0.003
Selenium	0.01	0.01	0.01	0.02	<0.01	0.01	<0.01	<0.01	0.02	<0.01	<0.01
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.011	<0.007	<0.007	<0.007	<0.007	0.008	<0.007	<0.007	<0.007	0.007	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-20

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
THIRD SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
pH	7.2	8.1	8.4	7.2	7.6	7.0	8.0	7.2	8.4	7.2
Conductance	1,290	503	413	17,100	714	9,130	694	1,310	1,060	1,380
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	0.003	0.005	0.010	0.003	0.009	0.004	<0.001	0.001	<0.001
Beryllium	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	0.009	<0.007	<0.007	0.007	<0.007	0.008	<0.007	<0.007	<0.007	0.012
Mercury	0.0004	<0.0003	0.0003	<0.0003	<0.0003	0.0005	<0.0003	<0.0003	0.0005	0.0004
Nickel	<0.008	<0.008	<0.008	<0.008	<0.008	0.043	<0.008	<0.008	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	0.007	<0.002	0.008	0.011	0.009	0.002	0.003	0.004	<0.002	0.002
Selenium	0.02	<0.01	0.02	0.04	0.02	0.02	<0.01	0.02	0.01	0.02
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.007	0.092	<0.007	<0.007	<0.007	0.010	<0.007	0.007	<0.007	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-20 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
THIRD SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	W7-3B	MW-1	MW-3	MW-4	MW-6
pH	7.3	7.5	7.4	7.4	7.2	8.2	7.1	7.4	7.2	7.2
Conductance	1,470	1,200	1,020	1,070	1,420	490	1,300	1,300	1,320	1,320
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	0.007	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029	<0.029
Copper	0.010	0.008	<0.007	<0.007	0.018	<0.007	<0.007	0.014	0.008	<0.007
Mercury	<0.0003	0.0003	<0.0003	0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0003
Nickel	<0.008	<0.008	<0.008	0.019	<0.008	<0.008	<0.008	0.023	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Antimony	0.005	0.002	0.006	0.007	<0.002	<0.002	0.002	0.002	0.005	0.005
Selenium	0.02	0.02	0.03	0.02	0.02	<0.01	0.03	0.02	0.01	0.03
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.012	<0.007	<0.007	<0.007	0.012	<0.007	<0.007	<0.007	0.013	<0.007

All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-20 (Continued)

SITES 3, 4, 6 AND 7 - INORGANIC ANALYSES FOR GROUNDWATERS
THIRD SAMPLING PERIOD

Parameter	MW-7	MW-9	MW-11	MW-12A	MW-13	MW-15	MW-17A	MW-17B	MW-18
pH	7.3	7.2	7.3	7.7	7.2	7.2	7.1	7.8	7.8
Conductance	1,260	1,410	1,310	1,280	1,240	1,150	444	499	4,500
Silver	<0.005	<0.005	<0.005	<0.005	NA[a]	<0.005	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.002	0.002	<0.001	NA	<0.001	<0.001	0.002	<0.001
Beryllium	<0.004	<0.004	<0.004	<0.004	NA	<0.004	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003	<0.003	NA	<0.003	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029	<0.029	NA	<0.029	<0.029	<0.029	<0.029
Copper	<0.007	0.007	0.008	<0.007	NA	<0.007	<0.007	<0.007	<0.007
Mercury	0.0007	0.0005	0.0004	0.0003	NA	<0.0003	<0.0003	0.028	0.0020
Nickel	<0.008	0.014	<0.008	<0.008	NA	<0.008	<0.008	<0.008	<0.008
Lead	<0.002	<0.002	<0.002	<0.002	NA	<0.002	<0.002	<0.002	<0.002
Antimony	0.005	<0.002	<0.002	0.003	NA	0.007	0.016	<0.002	<0.002
Selenium	0.03	0.02	0.02	0.02	NA	0.02	0.05	<0.01	<0.01
Thallium	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
Zinc	<0.007	<0.007	0.007	0.009	NA	<0.007	0.008	<0.007	0.008

[a] NA - not analyzed.
All results in µg/l except pH in units and conductance in µmhos/cm.

TABLE 6-21

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
FIRST SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
Priority Pollutants										
Benzene	(0.1)			(0.1)				(0.2)	(0.1)	(0.2)
Carbon Tetrachloride									2.9	
Chloroform	(0.1)	1.6	(0.2)		3.8		3.3	(0.1)	1.9	
1,1-Dichloroethane	7.9							6.7	1.7	3.3
1,2-Dichloroethane										
1,1-Dichloroethene	3.1							5.1	(0.2)	
Ethylbenzene										
Methylene Chloride										
Tetrachloroethene	1.8							(0.4)		
Toluene	(0.1)			(0.1)				(0.1)	(0.1)	(0.1)
1,1,1-Trichloroethane	0.5							1.0	(0.1)	
Trichloroethene	19							22	1.2	5.9
Vinyl Chloride	8.2							11		
trans-1,2-Dichloroethene	0.6									
Nonpriority Pollutants										
m,p-Xylenes	(0.1)							(0.1)		
o-Xylene										
cis-1,2-Dichloroethene	17							20	(0.2)	4.2
Other Compounds										
1,2-Dichloro-1,1,2-trichloroethane	(3.2)							(8.5)		
2,2'-oxybis-Propane										
TOTAL VOs[a]	62	1.6	0.2	0.2	3.8	ND[b]	3.3	75	8.4	14

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-21 (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
FIRST SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	W7-3B	MW-1	MW-4	MW-5	MW-6	MW-7	MW-9
Priority Pollutants												
Benzene								6.8				(0.3)
Carbon Tetrachloride		0.5										
Chloroform		5.6	1.2			7.4	(0.3)	3.1			(0.2)	(0.1)
1,1-Dichloroethane		2.5			(0.2)					2.4	5.3	3.4
1,2-Dichloroethane												
1,1-Dichloroethene		(0.2)								(0.4)	1.2	1.4
Ethylbenzene								70				
Methylene Chloride												0.7
Tetrachloroethene							7.5					
Toluene						(0.4)		2,600				(0.1)
1,1,1-Trichloroethane	(0.2)											
Trichloroethene		(0.6)	(0.3)				16	37		7.1	23	15
Vinyl Chloride								780				
trans-1,2-Dichloroethene								160		(0.1)		0.8
Nonpriority Pollutants												
m,p-Xylenes								250				(0.1)
o-Xylene								100				
cis-1,2-Dichloroethene		(0.4)				1.4	0.9	3,600		2.0	2.0	16
Other Compounds												
1,2-Dichloro-1,1,2-trifluoroethane										(3.8)	(5.6)	(8.2)
2,2'-oxybis-Propane												
TOTAL VOs[a]	0.2	9.8	1.5	ND[b]	0.2	9.2	25	7,600	ND	16	37	46

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE [illegible] (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
FIRST SAMPLING PERIOD

Parameters	MW-11	MW-12A	MW-12B	MW-15	MW-16	MW-17A	MW-17B	MW-18	MW-19	MW-20A	MW-20B
Priority Pollutants											
Benzene	(0.2)	0.5									
Carbon Tetrachloride		5.3									
Chloroform		14	1.2	(0.4)							
1,1-Dichloroethane	1.4	6.9	1.6	3.4				(0.4)			
1,2-Dichloroethane								0.5			
1,1-Dichloroethene	(0.2)	6.1		1.4							
Ethylbenzene											
Methylene Chloride		22									
Tetrachloroethene		91		(0.2)							
Toluene	(0.1)	(0.1)									
1,1,1-Trichloroethane		15	(0.3)	0.5							
Trichloroethene		50	(0.1)	65							
Vinyl Chloride											
trans-1,2-Dichloroethene	(0.2)	3.2		(0.1)							
Nonpriority Pollutants											
m,p-Xylenes	(0.1)										
o-Xylene		0.6									
cis-1,2-Dichloroethene	2.6	120	(0.4)	1.8							
Other Compounds											
1,2-Dichloro-1,1,2-trifluoroethane	(1.2)										
2,2'-oxybis-Propane									(0.9)		
TOTAL VOs[a]	6	330	3.6	73	ND[b]	ND	ND	0.9	0.9	ND	ND

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-22

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
Priority Pollutants										
Benzene		(0.2)	(0.2)					(0.2)	(0.1)	
Carbon Tetrachloride								(0.2)		
Chloroform		1.2	(0.1)			(0.1)	1.0	(0.1)	2.0	(0.1)
1,1-Dichloroethane								11	0.7	1.3
1,2-Dichloroethane						0.5		1.0		
1,1-Dichloroethene								4.2		(0.1)
Ethylbenzene			(0.2)							
Tetrachloroethene								(0.4)		
Toluene		0.6	1.3							
1,1,1-Trichloroethane								0.9	(0.1)	
Trichloroethene					(0.1)			18	(0.3)	54
Vinyl Chloride										
trans-1,2-Dichloroethene								0.7		(0.3)
Nonpriority Pollutants										
m,p-Xylenes		(0.5)	0.8							
o-Xylene			(0.2)							
cis-1,2-Dichloroethene								21	(0.1)	4.9
Other Compounds										
1,2-Dichloro-1,1,2-trifluoroethane								(9.7)		(0.8)
2,2'-oxybis-Propane										
TOTAL VOs[a]	ND[b]	2.5	2.8	ND	0.1	0.6	1.0	67	3.3	62

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-22 (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	M7-3B	MW-1	MW-4	MW-5	MW-6	MW-7	MW-9
Priority Pollutants												
Chlorobenzene											(0.1)	
Benzene						(0.1)					(0.1)	(0.3)
Carbon Tetrachloride		(0.4)										
Chloroform		1.3			(0.1)	1.1	(0.2)			0.5	(0.3)	
1,1-Dichloroethane	(0.1)	2.4			(0.1)		(0.2)			1.6	4.0	2.4
1,2-Dichloroethane											(0.1)	0.7
1,1-Dichloroethene	(0.1)	(0.1)					(0.1)			(0.3)	1.1	1.3
Ethylbenzene								70				
Tetrachloroethene							8.2					(0.3)
Toluene						(0.4)		1,600				
1,1,1-Trichloroethane	(0.2)	(0.1)					(0.2)					
Trichloroethene		(0.4)					11	(18)		5.7	36	17
Vinyl Chloride												
trans-1,2-Dichloroethene								100		(0.1)	(0.1)	0.7
Nonpriority Pollutants												
m,p-Xylenes								(320)				
o-Xylene								(310)				
cis-1,2-Dichloroethene	(0.1)	0.5			(0.1)		0.8	4,400		1.9	2.0	21
Other Compounds												
Trichlorotrifluoroethane					(3.3)		(6.7)					
1,2-Dichloro-1,1,2-trifluoroethane		(0.9)			(4.3)		(4.8)			(3.2)	(5.2)	(8.9)
2,2'-oxybis-Propane												
TOTAL VOs[a]	**0.5**	**6.1**	**ND[b]**	**ND**	**7.9**	**1.6**	**32**	**6,800**	**ND**	**13**	**49**	**53**

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-22 (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
SECOND SAMPLING PERIOD

Parameters	MW-11	MW-12A	MW-12B	MW-15	MW-16	MW-17A	MW-17B	MW-18	MW-19	MW-20A	MW-20B
Priority Pollutants											
Benzene		(0.4)	(0.1)	(0.1)		(0.2)					
Carbon Tetrachloride		7.0	0.9	(0.1)							
Chloroform	(0.1)	14	(0.4)	(0.4)		(0.1)					
1,1-Dichloroethane	1.2	5.2	2.0	3.6		7.9		0.5			
1,2-Dichloroethane				(0.1)				0.6			
1,1-Dichloroethene	(0.2)	6.3	(0.1)	1.8		4.0					
Ethylbenzene											
Tetrachloroethene		110		(0.2)							
Toluene											
1,1,1-Trichloroethane		17	(0.3)	0.7		0.6					
Trichloroethene	11	36	(0.1)		(0.1)	16					
Vinyl Chloride						18					
trans-1,2-Dichloroethene	(0.2)	1.8		(0.2)		0.6					
Nonpriority Pollutants											
m,p-Xylenes											
o-Xylene											
cis-1,2-Dichloroethene	3.1	44	(0.3)	2.3		18					
Other Compounds											
1,2-Dichloro-1,1,2-trifluoroethane	(1.6)	(1.7)		(1.6)		(3.9)					
2,2'-oxybis-Propane									(1.7)		
TOTAL VOs[a]	17	240	4.2	11	0.1	69	ND[b]	1.1	1.7	ND	ND

[a]Summation of all compounds detected.
[b]ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-23

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
THIRD SAMPLING PERIOD

Parameter	W3-1A	W3-1B	W3-1C	W3-2A	W3-2B	W3-3A	W3-3B	W4-1A	W4-1B	W4-2A
Priority Pollutants										
Benzene			(0.3)						(0.1)	
Carbon Tetrachloride								(0.3)	(0.2)	
Chloroform		1.0	(0.1)		(0.3)	(0.1)	0.6		1.4	
1,1-Dichloroethane	8.7							6.6	0.9	1.9
1,2-Dichloroethane						(0.3)				
1,1-Dichloroethene	3.3							5.1	(0.1)	(0.1)
Ethylbenzene			(0.2)							
Tetrachloroethene	1.6							(0.3)		
Toluene			1.7							
1,1,1-Trichloroethane	0.8							0.9		
Trichloroethene	19							16	(0.3)	60
Vinyl Chloride										
trans-1,2-Dichloroethene	0.7							0.6		(0.3)
Nonpriority Pollutants										
m,p-Xylenes			1.2							
o-Xylene			(0.3)							
cis-1,2-Dichloroethene	19							17	(0.1)	5.7
Other Compounds										
1,2-Dichloro-1,1,2-trifluoroethane		(4.7)								
TOTAL VOs[a]	58	1.0	3.8	ND[b]	0.3	0.4	0.6	47	3.1	68

a Summation of all compounds detected.
b ND - no volatiles detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-23 (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS
THIRD SAMPLING PERIOD

Parameter	W6-1A	W6-1B	W7-1A	W7-2A	W7-3A	W7-3B	MW-1	MW-3	MW-4	MW-6
Priority Pollutants										
Benzene								(0.2)	(4.3)	
Carbon Tetrachloride		0.7						0.6		
Chloroform		1.5					(0.1)	4.4		
Dichlorobromomethane								1.9		
1,1-Dichloroethane		4.3					(0.2)	8.4	17	1.6
1,2-Dichloroethane										
1,1-Dichloroethene		(0.3)					(0.1)	4.5	(3.5)	(0.3)
Ethylbenzene									50	
Tetrachloroethene			(0.4)				8.2	180		
Toluene									1,400	
1,1,1-Trichloroethane	(0.2)	(0.1)					(0.3)	17		
Trichloroethene		0.9	(0.3)				9.1	63	7.6	5.5
Vinyl Chloride									(500)	
trans-1,2-Dichloroethene								2.7	74	(0.1)
Nonpriority Pollutants										
m,p-Xylenes									170	
o-Xylene									77	
cis-1,2-Dichloroethene		0.7					1.5	27	2,500	1.6
Other Compounds										
Trichlorotrifluoroethane							(3.6)			
1,2-Dichloro-1,1,2-trifluoroethane		(1.0)					(3.1)	(1.9)		(0.1)
TOTAL VOs[a]	**0.2**	**9.5**	**0.7**	**ND[b]**	**ND**	**ND**	**26**	**310**	**4,800**	**9.2**

a Summation of all compounds detected.
b ND - no volatiles detected.
All results in μ g/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-23 (Continued)

SITES 3, 4, 6 AND 7 - VO ANALYSES FOR GROUNDWATERS THIRD SAMPLING PERIOD

Parameters	MW-7	MW-9	MW-11	MW-12A	MW-13	MW-15	MW-17A	MW-17B	MW-18
Priority Pollutants									
Benzene		(0.2)			(0.2)				
Carbon Tetrachloride	2.9	2.4	6.8		(0.1)				
Chloroform		12		(0.4)					
Dichlorobromomethane				1.1					
1,1-Dichloroethane	2.9	2.4	1.0	6.2	7.1	4.6			(0.4)
1,2-Dichloroethane		0.7							0.7
1,1-Dichloroethene	0.8	1.2	(0.2)	5.1		1.0			
Ethylbenzene									
Tetrachloroethene		(0.3)		120	3.7				
Toluene									
1,1,1-Trichloroethane		(0.4)		16	1.9	0.9			
Trichloroethene	36	16	8.8	37	3.7	61			
Vinyl Chloride									
trans-1,2-Dichloroethene		0.8	(0.2)	1.6	(0.1)	0.2			
Nonpriority Pollutants									
m,p-Xylenes									
o-Xylene									
cis-1,2-Dichloroethene	1.1	20	2.8	22	3.4	2.1			
Other Compounds									
Trimethyl cyclohexane					(8.2)				
Dimethyl cyclooctane					(12)				
1,2-Dichloro-1,1,2-trifluoroethane	(0.1)	(8.8)	(1.4)		(1.5)				
2-2'-oxybis-Propane									
TOTAL VOs[a]	**41**	**51**	**14**	**230**	**42**	**70**	**ND[b]**	**ND**	**1.1**

a Summation of all compounds detected.
b ND - no volatiles detected.
All results in μ g/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

and MW-12A accounted for the highest concentrations for approximately two-thirds of the compounds.

VOs were also detected in the "B" aquifer wells. Wells W4-1B, W6-1B, and MW-12B contained the most compounds. These wells are at or immediately downgradient of the northeasterly corner of the hangars. The same compounds were found in both aquifers. Concentrations in the "B" aquifer were markedly lower than in the "A" aquifer. Maximum concentrations were less than 10 µg/l and concentrations were typically below 2 µg/l

Chloroform was detected in the "B" aquifer at concentrations ranging from 0.4 to 7.4 µg/l. Concentrations in the "B" aquifer during the second and third sampling periods were lower than found during the first sampling period. "B" aquifer concentrations for chloroform were higher than typically found in the "A" aquifer. Chloroform was found at all "B" aquifer wells except MW-17B and MW-20B.

VOs were also detected in the only "C" aquifer well, W3-1C. In the first sampling period, chloroform was detected at 0.2 µg/l. However, in the last two sampling periods, several VOs, in addition to chloroform, were detected including toluene and xylenes at concentrations of 1 to 2 µg/l. In the last two periods, the same compounds were detected at similar concentrations suggesting that the data are not an artifact of sampling and analysis.

In general, the same VOs were detected during all periods with the following exceptions:

1. Methylene chloride was detected only during the first sampling period.

2. Chlorobenzene was detected during the second sampling period.

3. Dichlorobromomethane, trimethyl cyclohexane, and dimethyl cyclo-octane were detected only during the third sampling period.

4. Trichlorotrifluoroethane was detected only during the second and third sampling periods.

5. 2,2'-oxybis-Propane was detected only during the first and second sampling periods.

VO concentrations for individual compounds varied throughout the three sampling periods. Table 6-24 shows a comparison for wells having total VOs exceeding 10 μg/l. W3-1A had a total VO concentration of approximately 60 μg/l during the first and third sampling periods; no VOs were detected during the second sampling period. At MW-17A, no VOs were detected during the first and third sampling periods; total VOs were 69 μg/l during the second sampling period. It is believed that samples from these two wells may have been interchanged during the second sampling period.

Significant changes in concentrations were also noted at the following locations:

1. W4-2A. TCE concentration increased significantly following the first sampling period.

2. MW-4. Toluene, vinyl chloride, o-xylene, and cis-1,2-dichloroethene concentrations fluctuated during the three sampling periods.

3. MW-12A. Methylene chloride was detected only during the first sampling period and cis-1,2-dichloroethene concentration dropped significantly after the first sampling period.

4. MW-15. TCE was not detected during the second sampling period but was detected at approximately 60 μg/l during the other two periods.

Table 6-25 summarizes total VOs for all three sampling periods. Although there were several wells in which VOs concentrations changed markedly during

TABLE 6-24

SITES 3,4,6, AND 7 - COMPARISON OF VOS AT SELECTED WELLS

Parameter	W3-1A			W4-1A			W4-2A			MW-1		
	1[a]	2	3	1	2	3	1	2	3	1	2	3
Priority Pollutants												
Benzene	(0.1)			(0.2)	(0.2)		(0.2)					
Carbon Tetrachloride					(0.2)	(0.3)						
Chloroform	(0.1)			(0.1)	(0.1)			(0.1)		(0.3)	(0.2)	(0.1)
1,1-Dichloroethane	7.9		8.7	6.7	11	6.6	3.3	1.3	1.9		(0.2)	(0.2)
1,2-Dichloroethane					1.0							
1,1-Dichloroethene	3.1		3.3	5.1	4.2	5.1		(0.1)	(0.1)		(0.1)	(0.1)
Ethylbenzene												
Methylene Chloride												
Tetrachloroethene	1.8		1.6	(0.4)	(0.4)	(0.3)				7.5	8.2	8.2
Toluene	(0.1)			(0.1)			(0.1)					
1,1,1-Trichloroethane	0.5		0.8	1.0	0.9	0.9					(0.2)	(0.3)
Trichloroethene	19		19	22	18	16	5.9	54	60	16	11	9.1
Vinyl Chloride	8.2			11								
trans-1,2-Dichloroethene	0.6		0.7		0.7	0.6		(0.3)	(0.3)			
Nonpriority Pollutants												
m,p-Xylenes	(0.1)			(0.1)								
o-Xylene												
cis-1,2-Dichloroethene	17		19	20	21	17	4.2	4.9	5.7	(0.9)	0.8	1.5
Other Compounds												
Trichlorotrifluoroethane											(6.7)	(3.6)
1,2-Dichloro-1,1,2-trifluoroethane	(3.2)		(4.7)	(8.5)	(27)			(0.8)			(4.8)	(3.1)
2,2'-oxybis-Propane												
TOTAL VOs[b]	62	ND[c]	58	75	67	47	14	62	60	25	32	26

a Sampling Period.
b Summation of all compounds detected.
c ND - no volatiles detected
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-24 (Continued)

SITES 3,4,6, AND 7 - COMPARISON OF VOS AT SELECTED WELLS

Parameter	MW-4			MW-6			MW-7			MW-9		
	1[a]	2	3	1	2	3	1	2	3	1	2	3
Priority Pollutants												
Chlorobenzene								(0.1)				
Benzene	6.8		(4.3)					(0.1)		(0.3)	(0.3)	(0.2)
Carbon Tetrachloride												
Chloroform	3.1				0.5		(0.2)	(0.3)		(0.1)		
1,1-Dichloroethane			17	2.4	1.6	1.6	5.3	4.0	2.9	3.4	2.4	2.4
1,2-Dichloroethane								(0.1)			0.7	0.7
1,1-Dichloroethene			(3.5)	(0.4)	(0.3)	(0.3)	1.2	1.1	0.8	1.4	1.3	1.2
Ethylbenzene	70	70	50									
Methylene Chloride										0.7		
Tetrachloroethene											(0.3)	(0.3)
Toluene	2,600	1,600	1,400							(0.1)		
1,1,1-Trichloroethane												(0.4)
Trichloroethene	37	(18)	7.6	7.1	5.7	5.5	23	36	36	15	17	16
Vinyl Chloride	780		(500)									
trans-1,2-Dichloroethene	160	100	74	(0.1)	(0.1)	(0.1)		(0.1)		0.8	0.7	0.8
Nonpriority Pollutants												
m,p-Xylenes	250	(320)	170							(0.1)		
o-Xylene	100	(310)	77									
cis-1,2-Dichloroethene	3,600	4,400	2,500	2.0	1.9	1.6	2.0	2.0	1.1	16	21	20
Other Compounds												
1,2-Dichloro-1,1,2-Trifluoroethane				(3.8)	(3.2)	(0.1)	(5.6)	(5.2)	(0.1)	(8.2)	(8.9)	(8.8)
2,2'-oxybis-Propane												
TOTAL VOs[b]	7,600	6,800	4,800	16	13	9.2	37	49	41	46	53	51

a Sampling Period.
b Summation of all compounds detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-24 (Continued)

SITES 3,4,6, AND 7 - COMPARISON OF VOS AT SELECTED WELLS

Parameter	MW-11			MW-12A			MW-15		
	1[a]	2	3	1	2	3	1	2	3
Priority Pollutants									
Dichlorobromomethane						1.1			
Benzene	(0.2)			0.5	(0.4)			(0.1)	
Carbon Tetrachloride				5.3	7.0	6.8		(0.1)	(0.1)
Chloroform		(0.1)		14	14	12	(0.4)	(0.4)	(0.4)
1,1-Dichloroethane	1.4	1.2	1.0	6.9	5.2	6.2	3.4	3.6	4.6
1,2-Dichloroethane								(0.1)	
1,1-Dichloroethene	(0.2)	(0.2)	(0.2)	6.1	6.3	5.1	1.4	1.8	1.0
Ethylbenzene									
Methylene Chloride				22					
Tetrachloroethene				91	110	120	(0.2)	(0.2)	
Toluene	(0.1)			(0.1)					
1,1,1-Trichloroethane				15	17	16	0.5	0.7	0.9
Trichloroethene		11	8.8	50	36	37	65		61
Vinyl Chloride									
trans-1,2-Dichloroethene	(0.2)	(0.2)	(0.2)	3.2	1.8	1.6	(0.1)	(0.2)	(0.2)
Nonpriority Pollutants									
m,p-Xylenes	(0.1)								
o-Xylene				0.6					
cis-1,2-Dichloroethene	2.6	3.1	2.8	120	44	22	1.8	2.3	2.1
Other Compounds									
1,2-Dichloro-1,1,2-Trifluoroethane	(1.2)	(1.6)	(1.4)		(1.7)			(1.6)	
2,2'-oxybis-Propane									
TOTAL VOs[b]	6	17	14	330	240	230	73	11	70

a Sampling Period.
b Summation of all compounds detected.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-25

COMPARISON OF TOTAL VOs FOR ALL SAMPLING PERIODS

Well	Sampling Period 1	2	3
W3-1A	62	ND[a]	58
W3-1B	1.6	2.5	1.0
W3-1C	0.2	2.8	3.8
W3-2A	0.2	ND	ND
W3-2B	3.8	0.1	0.3
W3-3A	ND	0.6	0.4
W3-3B	3.3	1.0	0.6
W4-1A	75	67	47
W4-1B	8.4	3.3	3.1
W4-2A	14	62	68
W6-1A	0.2	0.5	0.2
W6-1B	9.8	6.1	9.5
W7-1A	1.5	ND	0.7
W7-2A	ND	ND	ND
W7-3A	0.2	7.9	ND
W7-3B	9.2	1.6	ND
MW-1	25	32	26
MW-3	NS[b]	NS	310
MW-4	7,600	6,800	4,800
MW-5	ND	ND	NS
MW-6	16	13	9.2
MW-7	37	49	41
MW-9	46	53	51
MW-11	6	17	14
MW-12A	330	240	230
MW-12B	3.6	4.2	NS
MW-13	NS	NS	42
MW-15	73	11	70
MW-16	ND	0.1	NS
MW-17A	ND	69	ND
MW-17B	ND	ND	ND
MW-18	0.9	1.1	1.1
MW-19	0.9	1.7	NS
MW-20A	ND	ND	NS
MW-20B	ND	ND	NS

[a] No volatiles detected.
[b] NS - not sampled.
All results in µg/l.

the three sampling periods, for most wells, the data were relatively consistent. The same general trends were noted in all three sampling periods.

Several BNAs were detected at these sites (Table 6-26). The only consistent data were observed at MW-4. At most other wells, phthalates were the only BNAs detected and they were detected only once. The phthalates are probably an artifact of sampling and analysis. BNAs were detected in MW-4 during all sampling periods. The predominant compounds were dichlorobenzenes, naphthalene, 2,4-dimethylphenol, and phenol. These compounds were detected in at least two samples in the same general concentration range. MW-4 was also the well with the highest VO concentrations.

6.3.4 Groundwater Contours

Concentration contours in the "A" aquifer are shown on Figures 6-1 through 6-4 for the first sampling period and Figures 6-5 through 6-8 for the second sampling period for 1,1-dichloroethane, TCE, cis-1,2-dichloroethene, and total volatiles. Total volatiles is the summation of concentrations for all VOs detected in the wells. Contours were not plotted for the second sampling period because of variations in the data for several key wells as discussed above.

For 1,1-dichloroethane, there were two areas of peak concentrations--at the northeast corner of the hangars and the upstream reach of Marriage Road Ditch where storm drains from the hangar areas discharge (Figures 6-1 and 6-4). Concentration contours extend in a northerly direction from the northeast corner of the hangars along the Marriage Road Ditch. Peak concentrations of 8 to 17 µg/l were observed.

A similar pattern was also noted for cis-1,2-dichloroethene (Figures 6-3 and 6-7) suggesting two sources--one at the northeast corner of the hangars and the other at the storm drain discharge to the ditch. Cis-1,2-dichloroethene was tentatively identified at Site 2 wells at 0.2 µg/l. There may have been another source for the cis-1,2-dichloroethene detected at this site. Measured concentra-

TABLE 6-26

SITES 3, 4, 6 AND 7 - BNA ANALYSES FOR GROUNDWATERS

Parameter	W4-1A	W4-2A	MW-4			MW-9	MW-12A	MW-17A	MW-17B	MW-18
	2[a]	3	1	2	3	3	3	1	1	1
bis (2-Chloroethyl) ether	(5.3)									
bis (2-Ethylhexyl) phthalate								84	140	120
1,2-Dichlorobenzene			45	35	75					
1,4-Dichlorobenzene			5	(3.7)	8.5					
Di-n-butyl phthalate			38				10			
Di-n-octyl phthalate		13				110				
Napthalene			100	100	120					
2,4-Dimethylphenol			22		70					
Phenol			490	260						

a Sampling period.
All results in µ/g/l.
Blanks indicate compound not detected
Valves in ( ) are tentative concentrations

tions at Sites 3, 4, 6, and 7 ranged from 0.2 to 27 µg/l except at the hangar corner where concentrations ranging from 120 to 3600 µg/l were observed.

TCE contours are shown on Figures 6-2 and 6-6. During the first sampling period, a peak concentration of 65 µg/l was observed at MW-15. In the third sampling period, peak concentrations of 60 µg/l were observed at MW-3, MW-15, and W4-2A. Subsequent monitoring should clarify whether the peak contour extends northerly connecting these three wells or whether these are separate peaks or variations in sampling. The highest concentration was observed at MW-15 which is north of the corner of the hangars. As with the other compounds, the plume appears to extend northerly along the ditch. TCE was also detected at W2-3A but it is not known whether this is due to the plume from the hangar area or another source.

As an indicator of the total impact on groundwater quality, contours of total VOs detected in the wells were plotted (Figures 6-4 and 6-8). Measured concentrations ranged from 0.2 to 7600 µg/l. MW-4 had a combined VO concentration of 4800 µg/l or more, while in the wells immediately next to it, MW-3, MW-12A, and ME-13, the combined concentrations ranged from 40 to 300 µg/l. As with the individual parameters, VOs were not detected or were present at low concentrations approximately halfway down Marriage Road Ditch. Contamination was not observed to extend to the southerly or westerly sides of the hangars.

6.3.5 Previous Sampling Data

Groundwater samples from the wells labeled MW-, installed by EMCON Associates, were sampled and analyzed in 1983. Results of these analyses and results from the Confirmation Study (Verification Step) are shown in Table 6-27. Only selected wells are shown and only those compounds reported in both sets of analyses are listed. Only data from the first sampling period are shown for comparative purposes because, for these wells, the first set of data were representative of the other two sampling periods. (Note: several organics, e.g.,

TABLE 6-27

COMPARISON OF SAMPLING RESULTS WITH PREVIOUS STUDIES

	MW-1			MW-4			MW-6		
	4/83	11/83	9/85	4/83	11/83	9/85	5/83	11/83	9/85
Priority Pollutants									
Benzene				37	31	6.8			
Carbon Tetrachloride									
Chloroethane				120					
Chloroform			(0.3)			3.1			
1,1-Dichloroethane				130	70		3	2	2.4
1,2-Dichloroethane									
1,1-Dichloroethene				7	13				(0.4)
Ethylbenzene				60	90	70			
Methylene Chloride				95					
Tetrachloroethene	8	8	7.5	110	25				
Toluene				2,200	1,900	2,600			
1,1,1-Trichloroethane	3	1		60					
Trichloroethene	16	8	16	7,900	5,900	37	7	7	7.1
Vinyl Chloride					2,800	780			
trans-1,3-Dichloropropene									
trans-1,2-Dichloroethene				550	2,700	160	2	3	(0.1)
Nonpriority Pollutants									
Acetone				2,000	NR[a]		NR	NR	
Xylene isomers (o-,m-, p-)				150	570	350			
Total Priority Pollutants[b]	27	17	24	11,300	13,500	3,660	12	12	10

[a]NR - not recorded.
[b]Summation of priority pollutants only.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-27 (Continued)

COMPARISON OF SAMPLING RESULTS WITH PREVIOUS STUDIES

	MW-9			MW-12A			MW-12B		
	5/83	11/83	9/85	5/83	11/83	9/85	5/83	11/83	9/85
Priority Pollutants									
Benzene			(0.3)			0.5			
Carbon Tetrachloride					14	5.3		2	
Chloroethane									
Chloroform			(0.1)	21	14	14			1.2
1,1-Dichloroethane	4	3	3.4		6	6.9			1.6
1,2-Dichloroethane									
1,1-Dichloroethene		2	1.4		8	6.1			
Ethylbenzene									
Methylene Chloride			0.7			22			
Tetrachloroethene				26	140	91			
Toluene			(0.1)			(0.1)			
1,1,1-Trichloroethane					11	15			(0.3)
Trichloroethene	27	23	15	16	70	50			(0.1)
Vinyl Chloride		19							
trans-1,3-Dichloropropene									
trans-1,2-Dichloroethene	30	31	0.8	5	22	3.2			
Nonpriority Pollutants									
Acetone	NR[a]	NR		NR	NR		NR	NR	
Xylene isomers (o-,m-, p-)			(0.1)			0.6			
Total Priority Pollutants[b]	61	78	22	68	285	214	ND[c]	2	3

[a]NR - not recorded.
[b]Summation of priority pollutants only.
[c]ND - no volatiles detected
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-27 (Continued)

COMPARISON OF SAMPLING RESULTS WITH PREVIOUS STUDIES

Parameter	MW-15		MW-17A		MW-17B		MW-18	
	11/83	9/85	11/83	8/85	11/83	8/85	11/83	8/85
Priority Pollutants								
Benzene								
Carbon Tetrachloride								
Chloroethane								
Chloroform		(0.4)						
1,1-Dichloroethane		3.4						(0.4)
1,2-Dichloroethane								0.5
1,1-Dichloroethene		1.4						
Ethylbenzene	3							
Methylene Chloride								
Tetrachloroethene		(0.2)						
Toluene	17		3		4		4	
1,1,1-Trichloroethane		0.5						
Trichloroethene	121	65						
Vinyl Chloride								
trans-1,3-Dichloropropene	71		48				65	
trans-1,2-Dichloroethene		(0.1)						
Nonpriority Pollutants								
Acetone	NR[a]		NR		NR		NR	
Xylene isomers (o-,m-, p-)	28				40		16	
Total Priority Pollutants[b]	212	71	51	ND[c]	4	ND	69	0.9

[a]NR - not recorded.
[b]Summation of priority pollutants only.
[c]ND - no volatiles detected
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

cis-1,2-dichloroethene, were not listed as analyzed in EMCON's Study and therefore are not shown in Table 6-27.) The table also includes the summation of the priority pollutants. The detection limits from analyses conducted during the Confirmation Study were lower than for the EMCON testing. Therefore compounds detected in 1985 below 1 µg/l may not have been detected in the earlier sampling.

The Confirmation Study sampling results were somewhat lower than the earlier results but showed the same trends with MW-4 and -12A having the highest concentrations. VOs were not detected in MW-5, -16, -20A, and -20B during any sampling period. The most marked differences between the sampling periods was noted at MW-4. TCE and trans -1,2 dichloroethene concentrations were significantly lower during the Confirmation Study. Vinyl chloride and acetone concentrations were also lower but were highly variable in the two 1983 samples.

6.4 Site 5 - Fuel Farm French Drains

6.4.1 Site Conditions

Site 5 is situated east of Site 6 adjacent to Patrol Road. Water and fuel were pumped into the French drains during routine tank drainage at the main fuel facilities for approximately 15 years, from the early 1950's to the mid-1960's. The exact location of the drains and the quantities of fuel placed in the French drains are unknown, although two vertical open pipes were found during an on-site survey. A calculation based on the thickness of fuel layer observed in a well at the storage facility shows that as much as 28,000 gallons of fuel could be present on the groundwater at this site.

6.4.2 Soil Analyses

Table 6-28 shows pH and organic lead results. Organic lead concentrations were below detection limits except at A5-3 indicating fuel contamination. Table

TABLE 6-28

SITE 5 - pH AND ORGANIC LEAD FOR SOILS

Location	Depth feet	pH units	Organic Lead mg/kg
A5-1	3.0-4.5	8.3	<0.30
	6.0-7.5	8.1	<0.30
A5-2	3.0-4.5	8.4	<0.30
	6.0-7.5	8.1	<0.30
A5-3	3.0-4.5	8.3	5.4
	6.0-7.5	8.2	6.9
W5-1A	10.0-11.5	8.1	<0.30
W5-2A	10.0-11.5	8.1	<0.30
W5-3A	8.0-9.5	8.1	<0.30

6-29 shows VO results for soils. In addition to organic lead A5-3 also showed high levels of C_6 - C_{12} alkanes (70 mg/kg), C_8 - C_{12} cyclic alkanes (16 mg/kg), C_9 -C_{16} alcohols (19 mg/kg), C_2 - C_5 benzenes (18 mg/kg), and C_6 - C_{12} alkenes (13 mg/kg). These compounds are indicative of fuel contamination. Concentrations decreased markedly with depth. The concentrations of volatile compounds at other locations were generally below 1 mg/kg.

6.4.3 Groundwater Analyses

pH and conductance were similar for the three wells and typical of other "A" aquifer wells (Table 6-30). No organic lead was detected in groundwater. Table 6-31 shows VO results for the wells. Results were highly variable from one sampling period to the next. Several volatile priority pollutants were detected at concentrations below 0.2 µg/l but only during the first sampling period. The most predominant organics were the alkanes indicative of fuel contamination. W5-2A had the highest concentrations of VOs. A variety of methylated organics (e.g., trimethyl cyclohexane) were reported as individual compounds during the first and third sampling periods. These would be included in the classes of compounds identified as the C6-C9 or C7-C9, or C6-C10 alkanes.

BNAs were not detected during the second or third sampling period. During the first sampling month, di-n-butyl phthalate was tentatively identified at 3.1 µg/l in W5-2A. This may have been an artifact of sampling and analysis.

6.5 Site 8 - Waste Oil Transfer Area

6.5.1 Site Conditions

Site 8 is located near Building 127 where the off-site branch of the Defense Property Disposal Office, Alameda maintained a 5,000-gallon waste oil tank from the 1940's until 1981. Trucks from shops and squadrons disposed of waste oil into a sump next to the road from which the waste oil was transferred into the tank. The Public Works electrical shop is reported to have used the tank for

TABLE 6-29

SITE 5 - VO ANALYSES FOR SOILS

Parameter	A5-1		A5-2		A5-3		W5-1A	W5-2A	W5-3A
	3-4.5'[a]	6-7.5'	3-4.5'	6-7.5'	3-4.5'	6-7.5'	10-11.5'	10-11.5'	8-9.5'
Priority Pollutants									
Benzene					0.95	0.054		(0.004)	
Chlorobenzene								(0.002)	
Chloroform						(0.009)		(0.004)	
Tetrachloroethene								(0.002)	
Toluene							(0.003)	(0.003)	
Trichloroethene								(0.002)	
Nonpriority Pollutants									
m, p-Xylenes					2.3			(0.002)	
o-Xylene					0.61				
Other Compounds									
C6-C8 Alkanes						(3.2)			
C6-C9 Alkanes							(0.024)		
C6-C12 Alkanes					(70)				
C9-C13 Alkanes						(2.7)			
C8-C9 Alkanes		(0.15)							
C7-C10 Cyclic Alkanes						(8)			
C8-C12 Cyclic Alkanes					(16)				
C6-C12 Alkenes					(13)				
C10-C16 Alkenes						(0.51)			
C9-C16 Alcohols					(19)				
C11-C12 Alcohols						(0.66)			
C2-C5 Benzenes					(18)				

[a] Depth of sample
All results in mg/kg.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-30

SITE 5 - GROUNDWATER PARAMETERS

Parameter	W5-1A			W5-2A			W5-3A		
	1[a]	2	3	1	2	3	1	2	3
pH, units	7.6	7.4	7.4	7.3	7.3	7.5	7.6	7.5	7.8
Conductance, µmhos/cm	900	924	877	1090	1120	1090	709	713	694
Organic Lead, mg/l	<0.05	<0.05	<0.10	<0.05	<0.05	<0.10	<0.05	<0.05	<0.10

[a] Sampling period.

TABLE 6-31

SITE 5 - VO ANALYSES FOR GROUNDWATERS

Parameter	W5-1A			W5-2A			W5-3A		
	1[a]	2	3	1	2	3	1	2	3
Priority Pollutants									
Benzene	(0.1)						(0.1)		
Toluene	(0.1)						(0.1)		
Trichloroethene	(0.2)								
Other Compounds									
C6-C9 alkanes							(1.0)		
C7-C9 alkanes					(200)			(7.1)	
C6-C10 alkanes	(70)			(60)					
Trimethyl cyclohexane	(2.2)			(1.8)		(2.7)			
Dimethyl cyclohexane				(1.6)					
Trimethyl cyclopentane				(3.1)					
2,4 - Dimethylpentane						(2.5)			
2,2,3,3 - Tetramethyl-butane						(13)			
3 - Methylhexane						(1.5)			
2,3 - Dimethylhexane			(1.1)			(12)			
2,3,3 - Trimethylpentane			(1.0)			(14)			
2,2,5 - Trimethylhexane						(3.1)			

[a] Sampling period.
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

disposal of about 100 gallons per year of transformer oils contaminated with water. The transformer oil may have contained PCBs. Also, the transportation shops may have placed as much as 200 gallons per year of solvents into the tank. Oil was spilled onto the ground around the sump during oil transfer.

The sump was located immediately next to the salvage yard at the head of a drainage ditch. A grab sample of a small, discolored area of soil at this location showed a PCB concentration of 7.8 mg/kg.

6.5.2 Soil Analyses

pH values were within the range 7.3 to 9.1 which was typical of soils at all sites. Metals were analyzed only in a sample from W8-1A at a depth of 6.0 to 7.5 feet (Table 6-32). Concentrations were typical of soils at other sites. PCBs were measured at all sites but detected at only one site. Arochlor 1260 was detected at A8-3 (0.5 to 2.0 feet) at a concentration of 25 mg/kg. No PCBs were detected at other locations.

6.5.3 Groundwater Analyses

Table 6-33 shows results for inorganic parameters. All values were similar to other "A" aquifer wells. Several volatile compounds were detected in the groundwater samples (Table 6-34). The most predominant volatiles were 1,1-dichloroethane (5 µg/l), 1,1-dichloroethene (13 µg/l), 1,1,1-trichloroethane (40 µg/l), and TCE (12 µg/l). The types of volatiles present in groundwater indicate solvents as the source of contamination rather than oils or fuels. No PCBs were detected in the groundwater.

Bis(2-ethylhexyl phthalate was detected at 29 µg/l during the second sampling period. No BNAs were detected during the first or third sampling period. The presence of bis(2-ethylhexyl) phthalate may be an artifact of sampling and analysis.

TABLE 6-32

SITE 8 - INORGANIC ANALYSES FOR SOILS

Parameter	W8-1A 6.0 - 7.5'[a]
pH	8.7
Silver	<0.45
Arsenic	24
Beryllium	0.63
Cadmium	<0.27
Chromium	56
Copper	38
Mercury	0.06
Nickel	82
Lead	<4.5
Antimony	<0.14
Selenium	0.90
Thallium	<0.49
Zinc	69

[a] Depth of sample.

All units in mg/kg except pH in units.

TABLE 6-33

SITE 8 - INORGANIC ANALYSES FOR GROUNDWATER WELL W8-1A

Parameter	1[a]	2	3
pH	7.2	7.3	7.4
Conductance	1470	1440	1410
Silver	<0.005	<0.005	<0.005
Arsenic	<0.001	<0.001	<0.001
Beryllium	<0.004	<0.004	<0.004
Cadmium	<0.003	<0.003	<0.003
Chromium	<0.029	<0.029	<0.029
Copper	<0.007	0.007	<0.007
Mercury	<0.0003	<0.0003	0.0006
Nickel	0.026	<0.008	<0.008
Lead	<0.002	<0.002	<0.002
Antimony	<0.002	0.003	0.002
Selenium	0.010	<0.01	<0.01
Thallium	<0.005	<0.005	<0.005
Zinc	0.017	0.020	0.012

[a] Sampling period.
All results in mg/l except pH in units and conductance in µmhos/cm.

TABLE 6-34

SITE 8 - VO ANALYSES FOR GROUNDWATER
WELL W8-1A

Parameter	1[a]	2	3
Priority Pollutants			
Benzene	(0.2)		
Chloroform	2.0	1.1	1.7
Dichlorobromomethane			(0.2)
1,1-Dichloroethane	5.1	4.5	6.1
1,1-Dichloroethene	12	13	13
Toluene	(0.2)		
1,1,1-Trichloroethane	41	40	30
Trichloroethene	12	12	14
trans-1,2 - Dichloroethene			0.7
Nonpriority Pollutants			
m, p-Xylenes	(0.2)		
cis-1,2-Dichloroethene	0.5	(0.4)	
Other Compounds			
Trichlorotrifluoroethane		(8.0)	
1,2 - Dichloro - 1,1,2 - trifluoroethane		(1.2)	

a Sampling period.
All results in μg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

6.6 Site 9 - Old Fuel Farm

6.6.1 Site Conditions

Site 9 comprises both the old fuel farm which was located in the area of Building 12 and the old NEX gas station which was at the present site of Building 31. The old fuel farm was used from the 1940's until 1964. Aviation gas (AvGas) was stored in six underground 10,000-gallon steel tanks in an unpaved area that is now the parking lot of Building 12. Motor vehicle gas (MoGas) was stored in two underground 5,000 gallon steel tanks near Building 31. Tanks were filled until fuel flowed from the vent onto the ground. Fuel samples were also disposed to the ground. An estimated 60,000 gallons of AvGas containing about 1,000 pounds of tetraethyl lead was disposed over the life of the fuel farm. In the mid-1960's, two of the AvGas tanks began leaking. These tanks were not repaired. In 1964, the old fuel farm was abandoned and the tanks were filled with water. Reportedly, fuel odors occur occasionally in the area.

6.6.2 Soil Analyses

Soil pHs were within the range of 7.8 to 8.9 (Table 6-35). Organic lead was below the detection limit of 0.3 mg/kg in all samples except A9-3 (3.0 to 4.5 feet). Organic lead was detected in this sample at a concentration of 0.6 mg/kg. VOs were detected in three soil samples (Table 6-36). No volatile priority pollutants were found but some alkanes, indicative of fuel contamination, were detected at concentrations below 2 mg/kg.

6.6.3 Groundwater Analyses

pH and conductance measurements were within the range normally observed in "A" aquifer wells (Table 6-37). Organic lead was below the detection limit of 0.1 mg/l. Table 6-38 shows the VO results. Site 9 wells contained a variety of volatile compounds including the dichloroethanes, dichloroethenes, 1,1,1-trichloroethane, and TCE. The highest concentrations were observed at

TABLE 6-35

SITE 9 - pH AND ORGANIC LEAD FOR SOILS

Location	Depth feet	pH units	Organic Lead mg/kg
A9-1	3.0-4.5	8.7	<0.30
	6.0-7.5	8.5	<0.30
A9-2	3.0-4.5	8.3	<0.30
	6.0-7.5	8.5	<0.30
A9-3	3.0-4.5	8.8	0.60
	6.0-7.5	8.5	<0.30
A9-4	3.0-4.5	8.6	<0.30
	6.0-7.5	8.9	<0.30
A9-5	3.0-4.5	7.8	<0.30
	6.0-7.5	8.4	<0.30
A9-6	3.0-4.5	8.6	<0.30
	6.0-7.5	8.4	<0.30
W9-1A	12.0-13.5	8.3	<0.30
W9-2A	13.0-14.5	8.0	<0.30

TABLE 6-36

SITE 9 - VO ANALYSES FOR SOILS

Parameter	A9-5 6-7.5'[a]	W9-1A 12-13.5'	W9-2A 13-14.5'
Other Compounds			
C8-C10 Alkanes	(0.47)		
C8-C9 Alkanes and alcohols		(0.45)	(0.016)
C10 Alkanes		(1.7)	
Trimethyl cyclopentane		(0.080)	
Trimethyl cyclohexanes		(0.60)	

[a] Depth of sample.
All results in mg/kg.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

TABLE 6-37

SITE 9 - GROUNDWATER PARAMETERS

Parameter	W9-1A			W9-2A		
	1[a]	2	3	1	2	3
pH, units	7.2	7.2	7.2	7.6	7.2	7.2
Conductance, μmhos/cm	1420	1410	1360	1330	1320	1300
Organic Lead, mg/l	<0.05	<0.002	<0.10	<0.10	<0.002	<0.10

[a] Sampling period.

TABLE 6-38

SITE 9 - VO ANALYSES FOR GROUNDWATER

Parameter	W9-1A			W9-2A		
	1[a]	2	3	1	2	3
Priority Pollutants						
Benzene	(0.3)	(0.3)	(0.2)		(1.0)	0.8
Chloroform	(0.2)				(2.3)	2.3
1,1-Dichloroethane	4.8	4.0	2.9	72	120	71
1,2-Dichloroethane	16	20				
1,1-Dichlorethene	4.2	2.2	1.3	170	340	200
Toluene	(0.1)					
Tetrachloroethene					(0.3)	(0.2)
1,1,1-Trichloroethane	4.2		0.5	180	240	200
1,1,2-Trichloroethane						1.5
Trichloroethene	60	9.4	4.2	4,600	11,000	8,100
trans-1,2-Dichloroethene						0.9
Nonpriority Pollutants						
m,p-Xylenes	(0.1)					
cis-1,2-Dichloroethene	14	6.8	4.7	620	1,200	630
Other Compounds						
1,1-Dichloro-1,1,2-trifluoroethane		(2.3)			(13)	(9.2)
2,2'-oxybis-Propane	(20)	(16)	(9.8)			
1-(1-methylpropoxy)-Butane	(1.2)	(2.0)				
Trichlorotrifluoroethane		(1.2)		(250)	(62)	(44)
1,2-Diethoxyethane			(0.7)			

a Sampling period.
All results in μg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

W9-2A which is at the corner of Building 31 where MoGas was stored in underground tanks. Several compounds were detected above 100 µg/l. These compounds included 1,1-dichloroethane (120 µg/l), 1,1-dichloroethene (170-340 µg/l), 1,1,1-trichloroethane (180-240 µg/l), TCE (4600-11,000 µg/l), cis-1,2-dichloroethene (620-1200 µg/l), and trichlorotrifluoroethane (250 µg/l). Virtually all of the volatiles detected were chlorinated compounds suggesting solvents and degreasers as the source. Fuel related organics (e.g. alkanes, alkenes, benzenes) were either not detected or were present at low concentrations. The soil samples contained fuel-related organics.

Bis (2-ethylhexy) and di-n-butyl phthalates were detected in W9-1A during the first sampling period but not during subsequent sampling periods. In both cases concentrations were below the minimum detection limit and were probably an artifact of sampling and analysis.

6.7 Site 10 - Runway

6.7.1 Site Condition

The purpose of the monitoring and sampling program for this area is to establish whether contaminants from Hangars 2 and 3 are contributing to the contaminant plume present within the Chase Park area which is southwest of Site 10. Volatile organics have been identified in monitoring wells installed in the Chase Park area in an effort to define a contaminant plume that apparently has migrated northward onto Moffett Field from one or more sources south of the Bayshore Freeway. No source of contaminants is known in the Chase Park area or along any ground water flowline upgradient of the Chase Park monitoring wells onto Moffett Field. Hydrologic and chemical data also indicate an off-station source to the south. Contaminant levels are higher in the "B" aquifer which is stratigraphically below the "A" aquifer. Water levels in the "B" aquifer monitoring wells are similar to levels in the "A" aquifer wells, indicating very little driving force for contaminant migration between these aquifers.

6.7.2 Soil Analyses

No soils were analyzed from the wells installed in the Confirmation Study (Verification Step).

6.7.3 Groundwater Analyses

3.7.3.1 Inorganics

Table 6-39 shows groundwater parameters for the two wells in each of the "A" and "B" aquifers. With the exception of W10-2B, pH values were similar to values for other sites during the first sampling period. Conductance in the "A" wells was approximately 1800 µmhos/cm and in the "B" wells 400 µmhos/cm. Typical conductance in the "A" wells is between 1000 to 2000 µmhos/cm and in the "B" wells between 400 to 1000 µmhos/cm at other sites.

6.7.3.2 Organics

Table 6-40 shows the VO results. Volatiles were detected in both the "A" and "B" aquifers. The "B" wells consistently contained chloroform at higher concentrations than the "A" wells. This was characteristic of conditions at other sites. MW-20A and -20B which are downgradient from W10-1A and -1B did not contain any volatiles. W7-1A which is downgradient from W10-2A contained chloroform, tetrachlorothene, and TCE, none of which were detected in W10-2A. These data suggest that the source of volatiles detected at Site 10 was not Hangars 2 and 3.

2-Bromocyclohexanol was detected in W10-1A at a concentration of 7.7 µg/l during the second sampling period. Several polynuclear aromatic hydrocarbons and di-n-butylphthalates were detected but were below the minimum detection limit and could not be quantified during the third sampling period. No BNAs were detected at W10-1A during the first sampling period or at other Site 10 wells during any sampling period.

TABLE 6-39

SITE 10 - GROUNDWATER PARAMETERS

Well	Sampling Period	pH Units	Conductance µmhos/cm
W10-1A	1	7.4	1,760
	2	7.3	1,700
	3	7.4	1,670
W10-1B	1	8.1	462
	2	7.9	463
	3	7.9	443
W10-2A	1	7.3	1,700
	2	7.1	1,700
	3	7.4	1,690
W10-2B	1	11.2	386
	2	8.1	430
	3	8.1	432

TABLE 6-40

SITE 10 - VO ANALYSES FOR GROUNDWATERS

Parameters	W10-1A			W10-1B			W10-2A			W10-2B		
	1[a]	2	3	1	2	3	1	2	3	1	2	3
Priority Pollutants												
Benzene		(0.2)	(0.1)		(0.1)					(0.1)	(0.1)	
Chloroform	(0.1)			6.7	0.7	(0.3)				3.8	2.1	1.7
Methylene Chloride	(0.3)											
Toluene			1.1							(0.1)		
Trichloroethene	0.6											
Nonpriority Pollutants												
m,p-Xylenes										(0.1)		
cis-1,2-Dichloroethene										(0.1)	(0.2)	
Other Compounds												
Pentane							(20)					
Cyclopentane							(1.4)					
3-Methylpentane			(1.9)[b]									

a Sampling period.
b Detected in travel blank.
All results in μg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.

6.8 Private Wells

Six existing wells were sampled--three wells on Moffett Field and three wells off Moffett Field. These wells included an active well on the south easterly corner of Moffett Field (24D-1) used for agricultural irrigation; two inactive wells southwest of Hanger 1 (14M-1 and 14M-2); and a SCVWD well (10G1), a NASA well (10Q*), and a PG&E well (10Q03) all of which are active and used for agricultural irrigation.

These wells were sampled only once. At the time of sampling, all active wells except the PG&E well were purged before sampling. Although there was no pump on the PG&E well, it was flowing at the time of sampling. No VOs were detected in the active wells.

Several VOs were detected in 14M-1 and 14M-2 (Table 6-41). These wells are both drilled to a total depth of 1000 feet and are approximately 300 to 400 feet apart. Neither well could be purged prior to sampling. Therefore, the results probably do not adequately characterize the deep aquifers. Although 14M-1 and -2 are near one another, with the exception of TCE, the same VOs were not detected in these wells. 14M-1 contained predominantly fuel-related volatiles while 14M-2 contained exclusively chlorinated volatiles. Volatile concentrations in both wells were low. All compounds were detected below 3 µg/l and most were below 1 µg/l. Both wells were artesian at one time and a drain pipe connects well M-1 to the sewer to prevent overflowing at grade. Contaminants in the wells could result from contamination in the shallow aquifers if the wells were not properly cased; from surface runoff entering the wells; or from backflow through the drain pipe if the sewer surcharged.

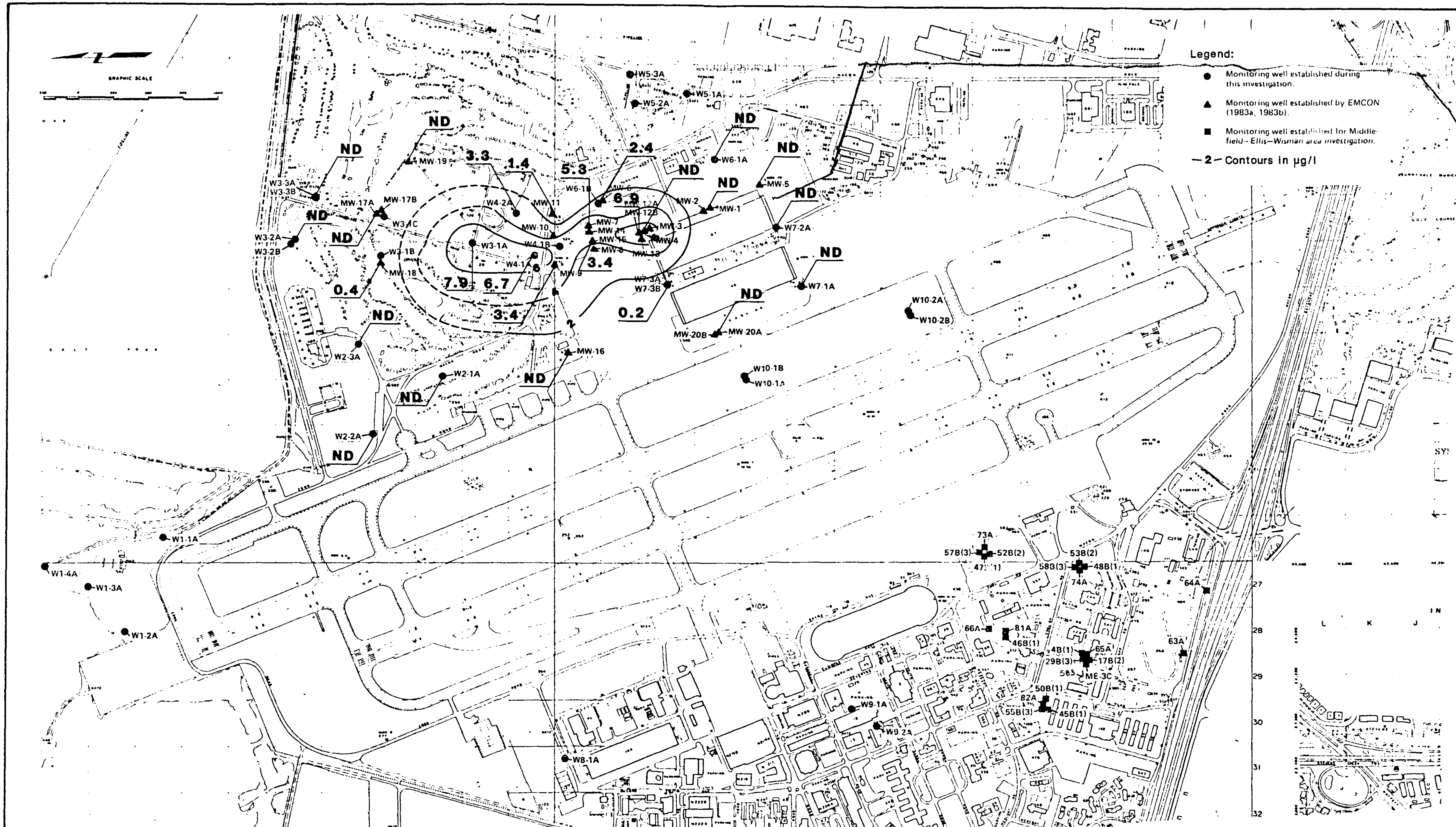
BNAs were analyzed only on samples from wells on Moffett Field (14M-1, 14M-2, and 24D-1). No BNAs were detected.

TABLE 6-41

PRIVATE WELLS - VO ANALYSES FOR GROUNDWATERS

Parameter	14M-1	14M-2
Priority Pollutants		
Benezene	(0.4)	
1,1-Dichloroethane		(0.2)
1,1-Dichloroethene		(0.1)
Ethylbenzene	0.7	
Tetrachloroethene		(0.3)
Toluene	1.1	
1,1,1-Trichloroethane		(0.2)
Trichloroethene	(0.4)	1.6
Nonpriority Pollutants		
m,p-Xylene	2.9	
o-Xylene	1.5	
cis-1,2-Dichloroethene		(0.4)

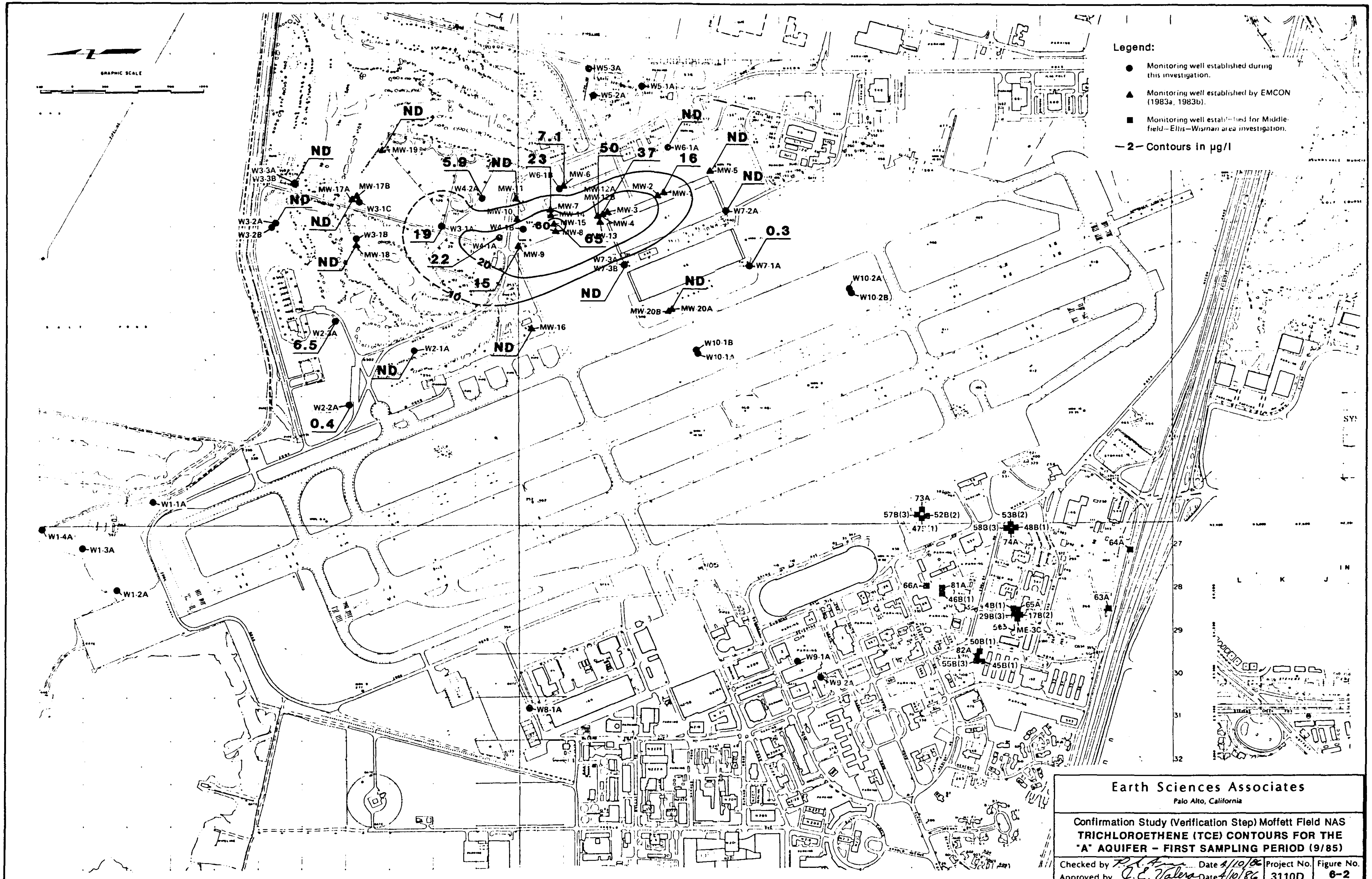
All results in µg/l.
Blanks indicate compound not detected.
Values in ( ) are tentative concentrations.



Earth Sciences Associates
Palo Alto, California

Confirmation Study (Verification Step) Moffett Field NAS
1,1 - DICHLOROETHANE CONTOURS FOR THE "A" AQUIFER - FIRST SAMPLING PERIOD (9/85)

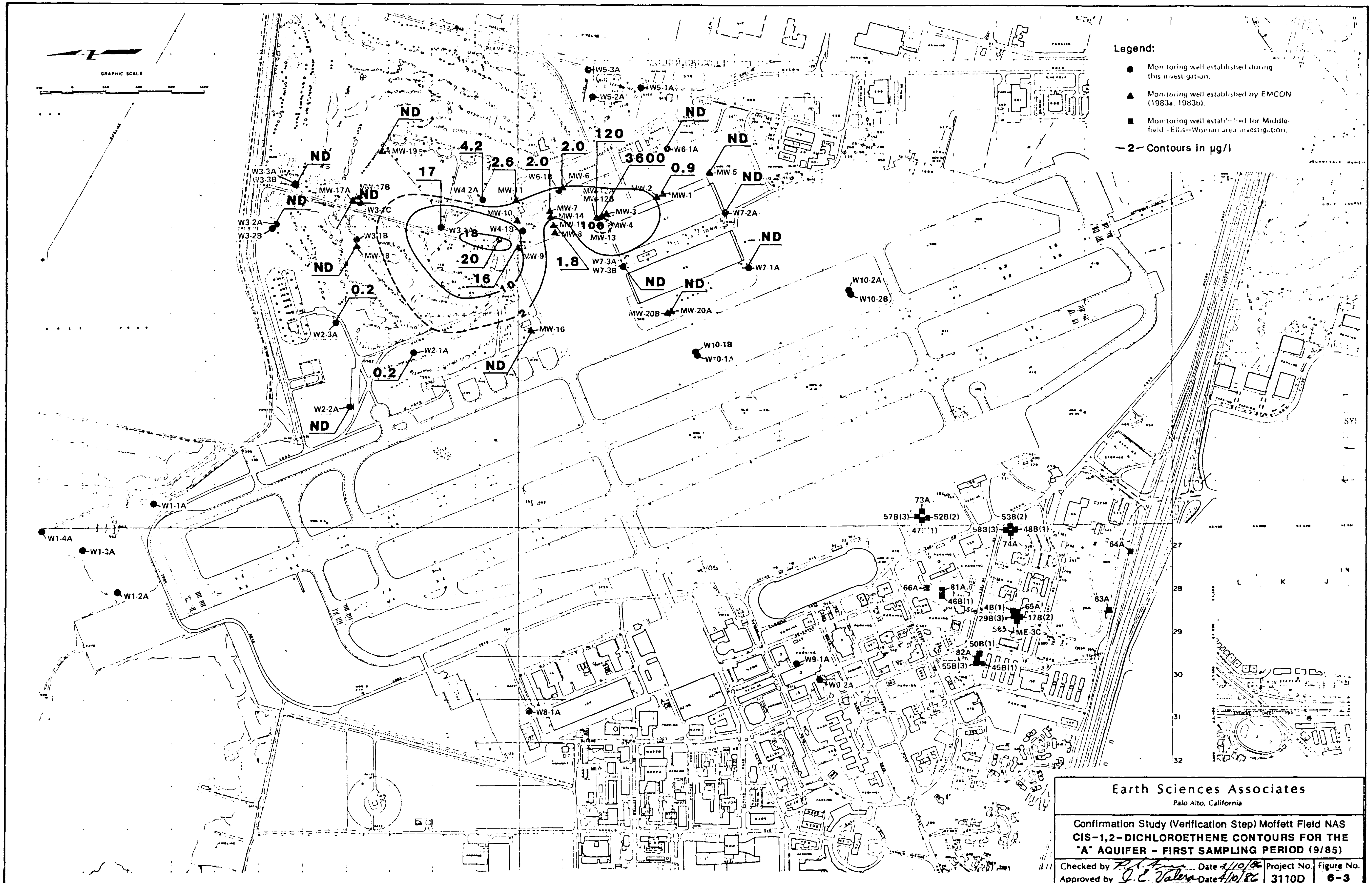
Checked by R. L. A... Date 4/10/86	Project No.	Figure No.
Approved by J. E. Valera Date 4/10/86	3110D	6-1



Earth Sciences Associates
Palo Alto, California

Confirmation Study (Verification Step) Moffett Field NAS
TRICHLOROETHENE (TCE) CONTOURS FOR THE "A" AQUIFER - FIRST SAMPLING PERIOD (9/85)

Checked by / Approved by	Date	Project No.	Figure No.
Checked by [signature]	Date 4/10/86	3110D	6-2
Approved by J. E. Valera	Date 4/10/86		



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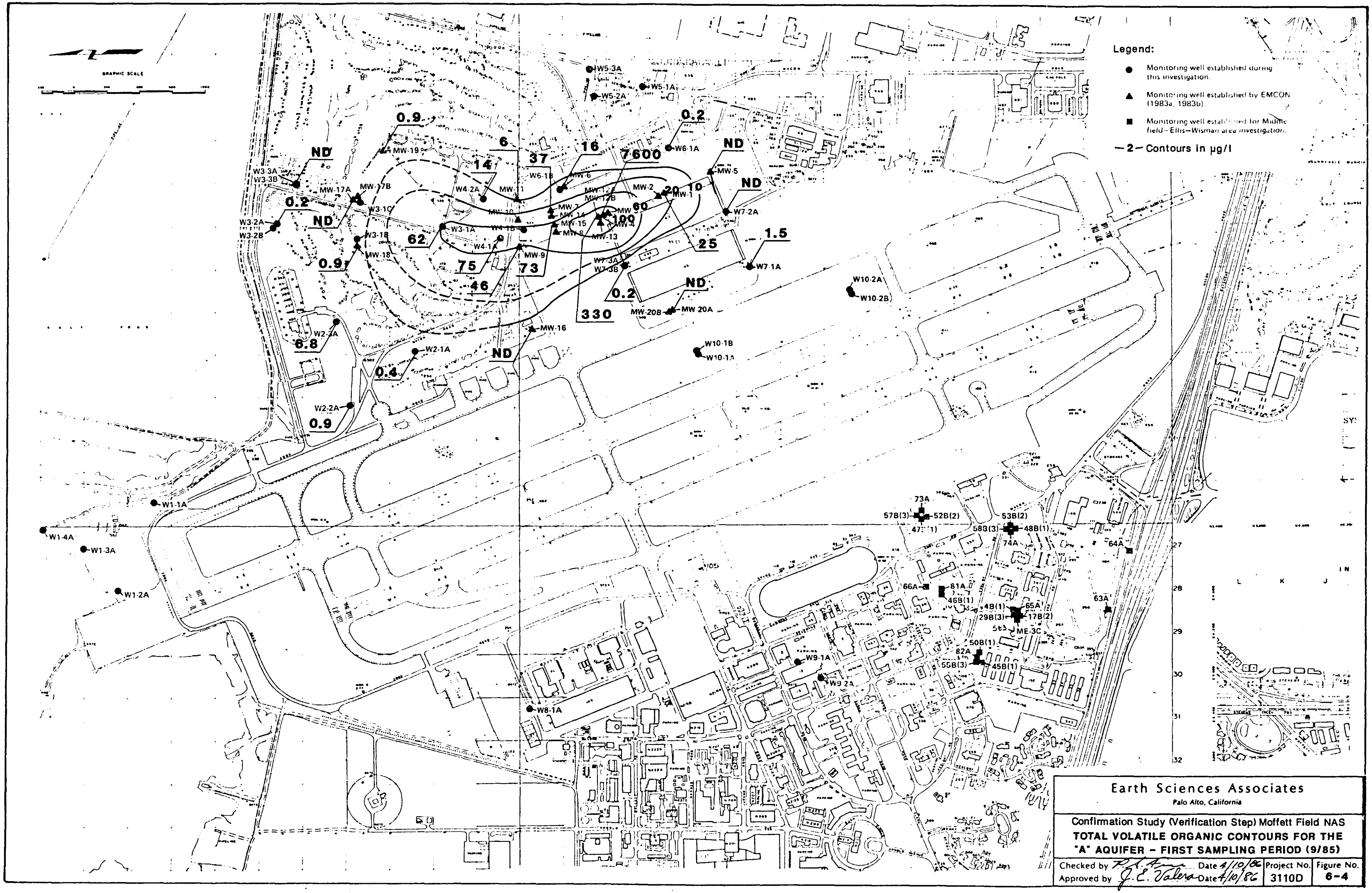
Confirmation Study (Verification Step) Moffett Field NAS
CIS-1,2-DICHLOROETHENE CONTOURS FOR THE "A" AQUIFER - FIRST SAMPLING PERIOD (9/85)

Checked by R. L. [signature] Date 4/10/86	Project No. 3110D	Figure No. 6-3
Approved by J. E. Valera Date 4/10/86		


GRAPHIC SCALE
Legend:
Monitoring well established during this investigation.
Monitoring well established by EMCON (1983a, 1983b).
Monitoring well established for Middlefield–Ellis–Wisman area investigation.
—2— Contours in µg/l
0.9
ND
0.2
6
14
37
16
7600
0.2
ND
ND
20
10
60
100
62
75
73
46
25
1.5
ND
0.2
330
6.8
0.4
ND
0.9
MW-19
W3-3A
W3-3B
MW-17A
MW-17B
W3-2A
W3-2B
W3-1C
W3-1B
MW-18
W4-2A
MW-11
MW-10
W3-1A
W4-1B
W4-1A
MW-9
W6-1B
MW-6
MW-7
MW-14
MW-15
MW-8
MW-12
MW-12B
MW-2
MW-1
MW-3
MW-4
MW-13
MW-5
W7-2A
W7-3A
W7-3B
W7-1A
MW-20B
MW-20A
MW-16
W5-3A
W5-1A
W5-2A
W6-1A
W10-2A
W10-2B
W10-1B
W10-1A
W2-3A
W2-1A
W2-2A
W1-1A
W1-4A
W1-3A
W1-2A
W8-1A
W9-1A
W9-2A
73A
57B(3)
52B(2)
47B(1)
53B(2)
58B(3)
48B(1)
74A
64A
66A
81A
46B(1)
4B(1)
65A
29B(3)
17B(2)
ME-3C
63A
50B(1)
82A
55B(3)
45B(1)
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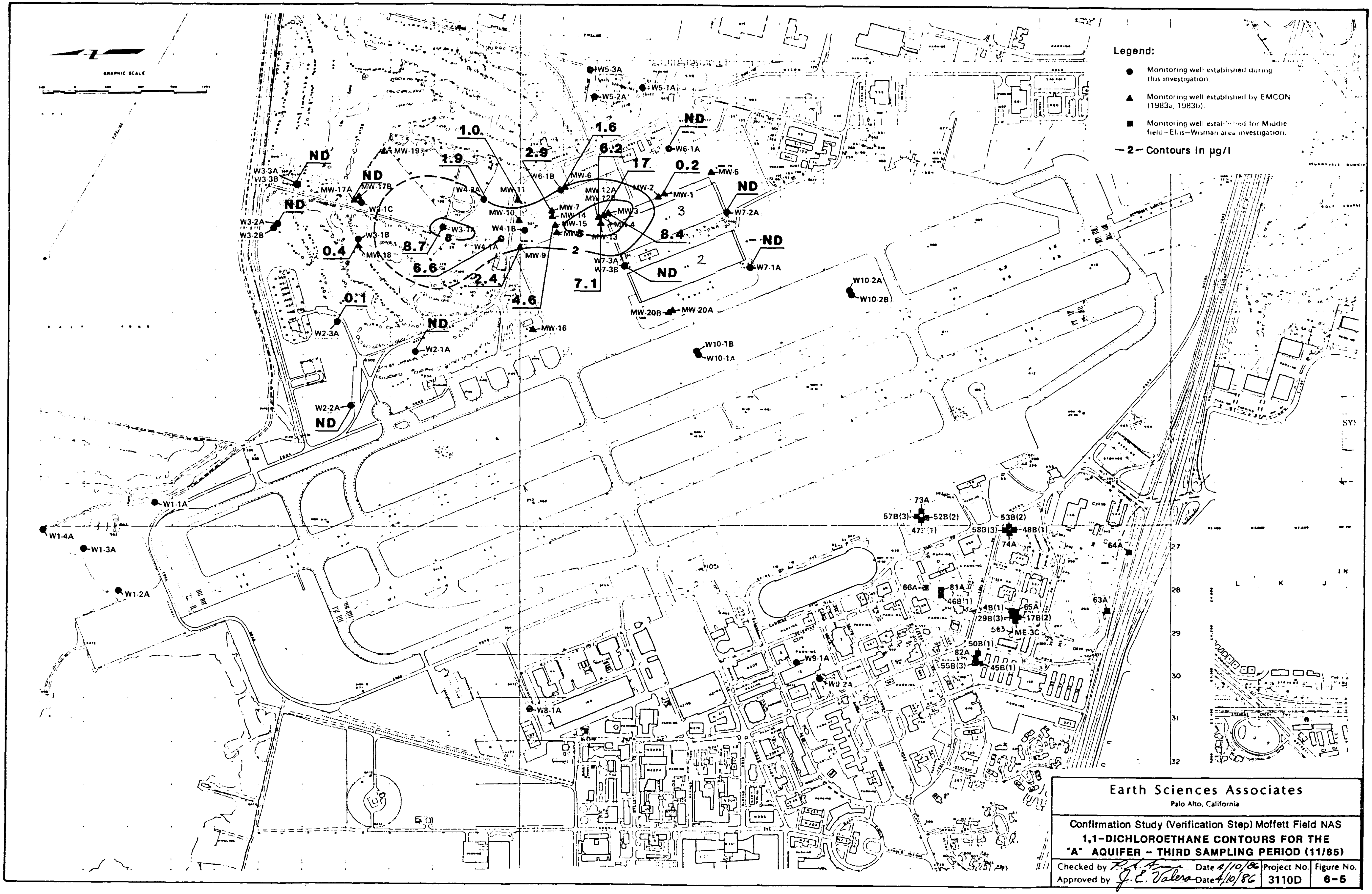
Confirmation Study (Verification Step) Moffett Field NAS
TOTAL VOLATILE ORGANIC CONTOURS FOR THE "A" AQUIFER - FIRST SAMPLING PERIOD (9/85)
Checked by R. L. Ayres Date 4/10/86
Approved by J. E. Valera Date 4/10/86
Project No. 3110D
Figure No. 6-4



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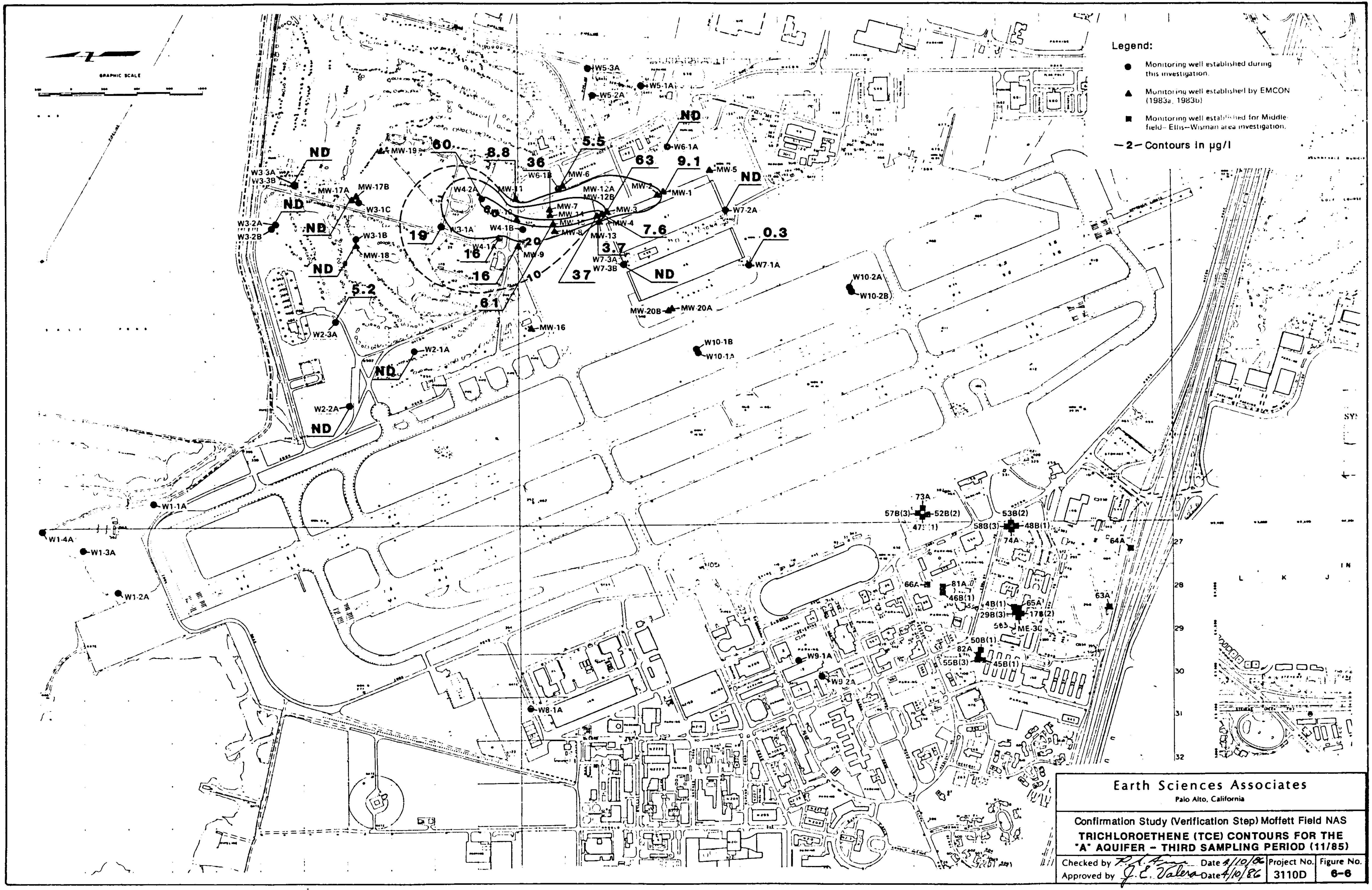
Confirmation Study (Verification Step) Moffett Field NAS

1,1-DICHLOROETHANE CONTOURS FOR THE "A" AQUIFER - THIRD SAMPLING PERIOD (11/85)

Checked by	Date 4/10/86	Project No.	Figure No.
Approved by J. E. Valera	Date 4/10/86	3110D	6-5



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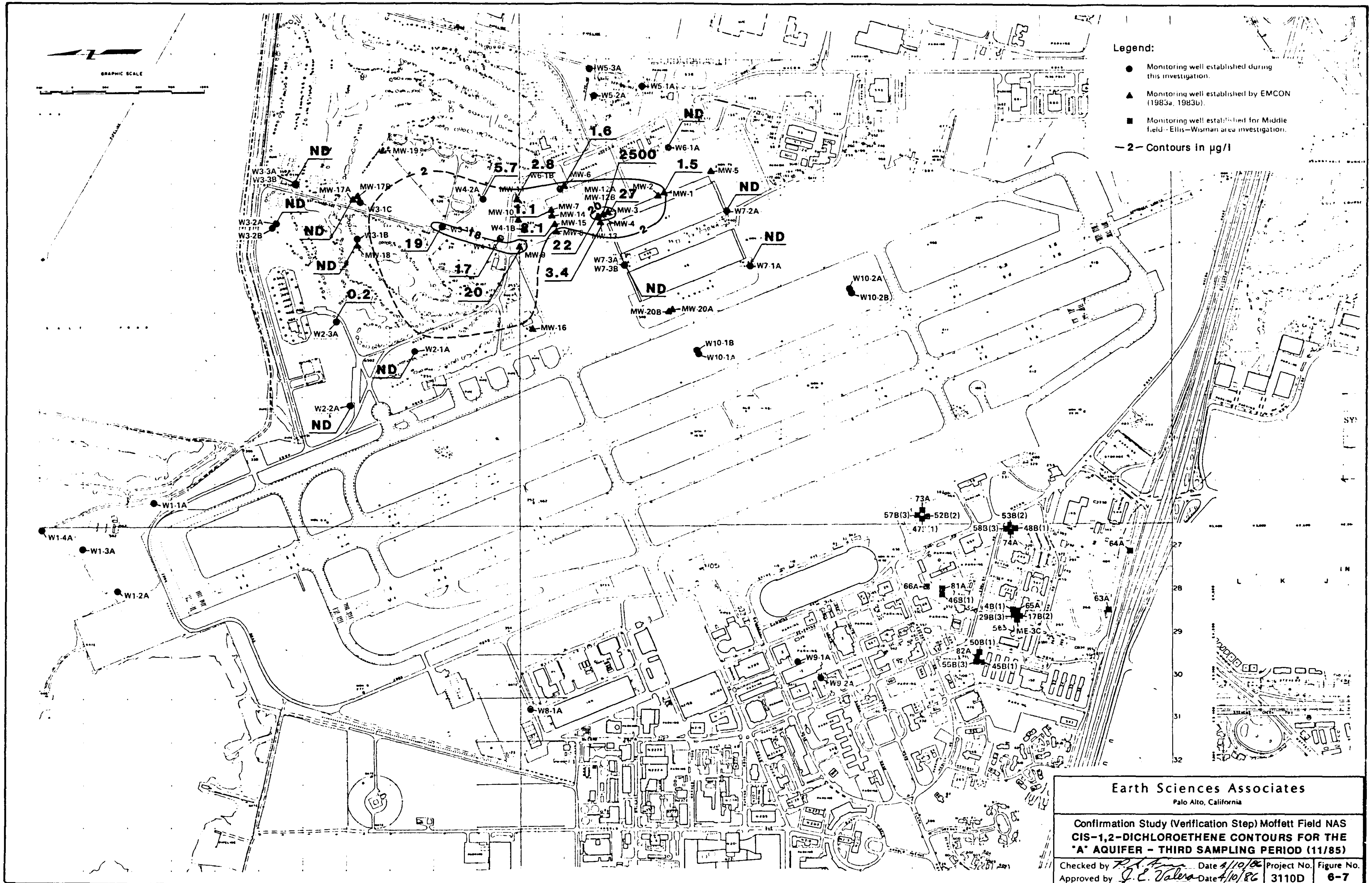
Confirmation Study (Verification Step) Moffett Field NAS

TRICHLOROETHENE (TCE) CONTOURS FOR THE "A" AQUIFER – THIRD SAMPLING PERIOD (11/85)

Checked by	Date 4/10/86	Project No. 3110D	Figure No. 6-6
Approved by J. E. Valera	Date 4/10/86		



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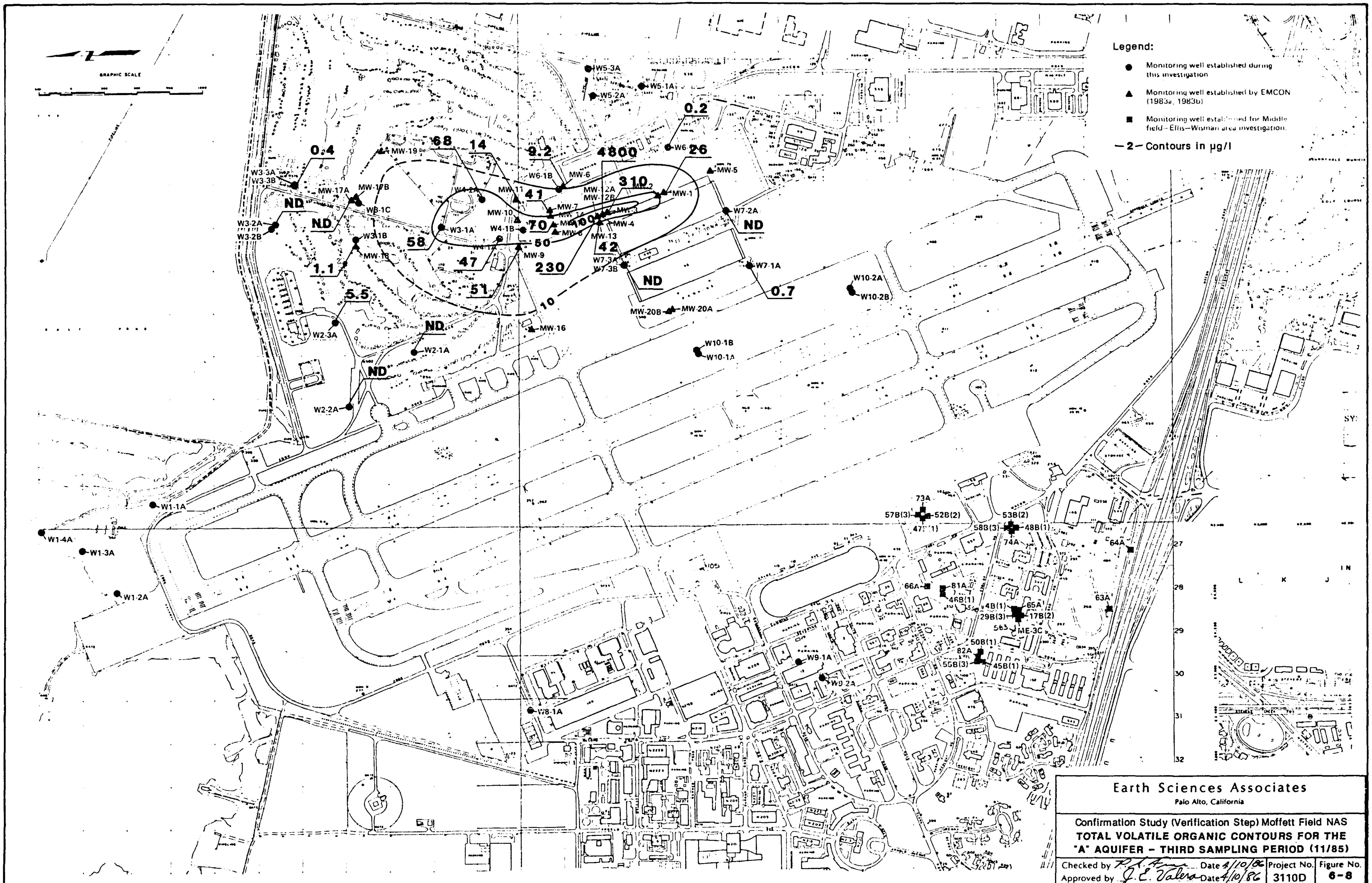
Confirmation Study (Verification Step) Moffett Field NAS
CIS-1,2-DICHLOROETHENE CONTOURS FOR THE "A" AQUIFER - THIRD SAMPLING PERIOD (11/85)

Checked by	Date 4/10/86	Project No. 3110D	Figure No. 6-7
Approved by J. E. Valera	Date 4/10/86		



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Confirmation Study (Verification Step) Moffett Field NAS
TOTAL VOLATILE ORGANIC CONTOURS FOR THE "A" AQUIFER - THIRD SAMPLING PERIOD (11/85)

Checked by	Date 4/10/86	Project No. 3110D	Figure No. 6-8
Approved by J. E. Valera	Date 4/10/86		

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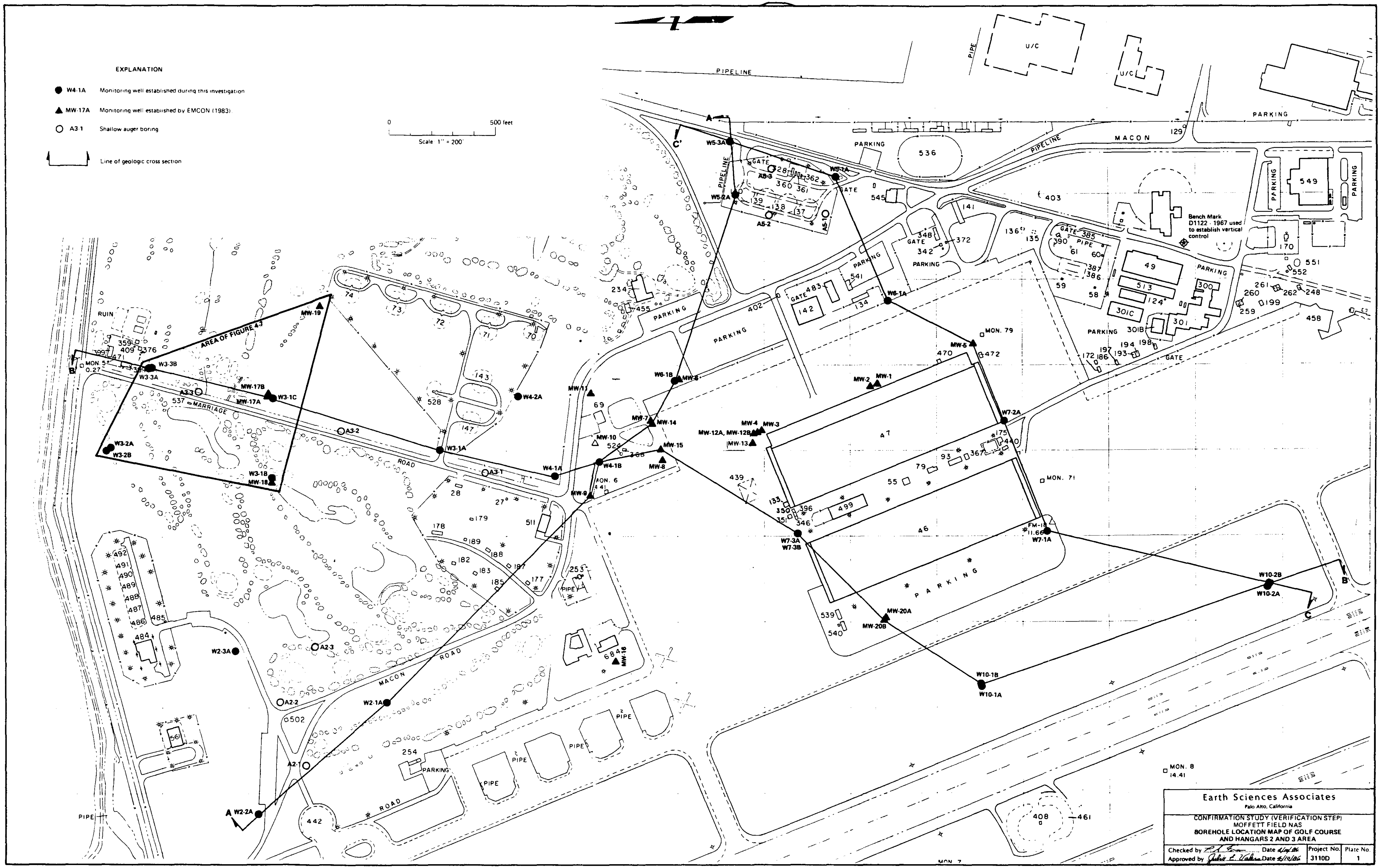
MOFFETT FIELD
SSIC NO. 5090.3

PLATES

CONFIRMATION STUDY (VERIFICATION STEP)

DATED 01 APRIL 1986



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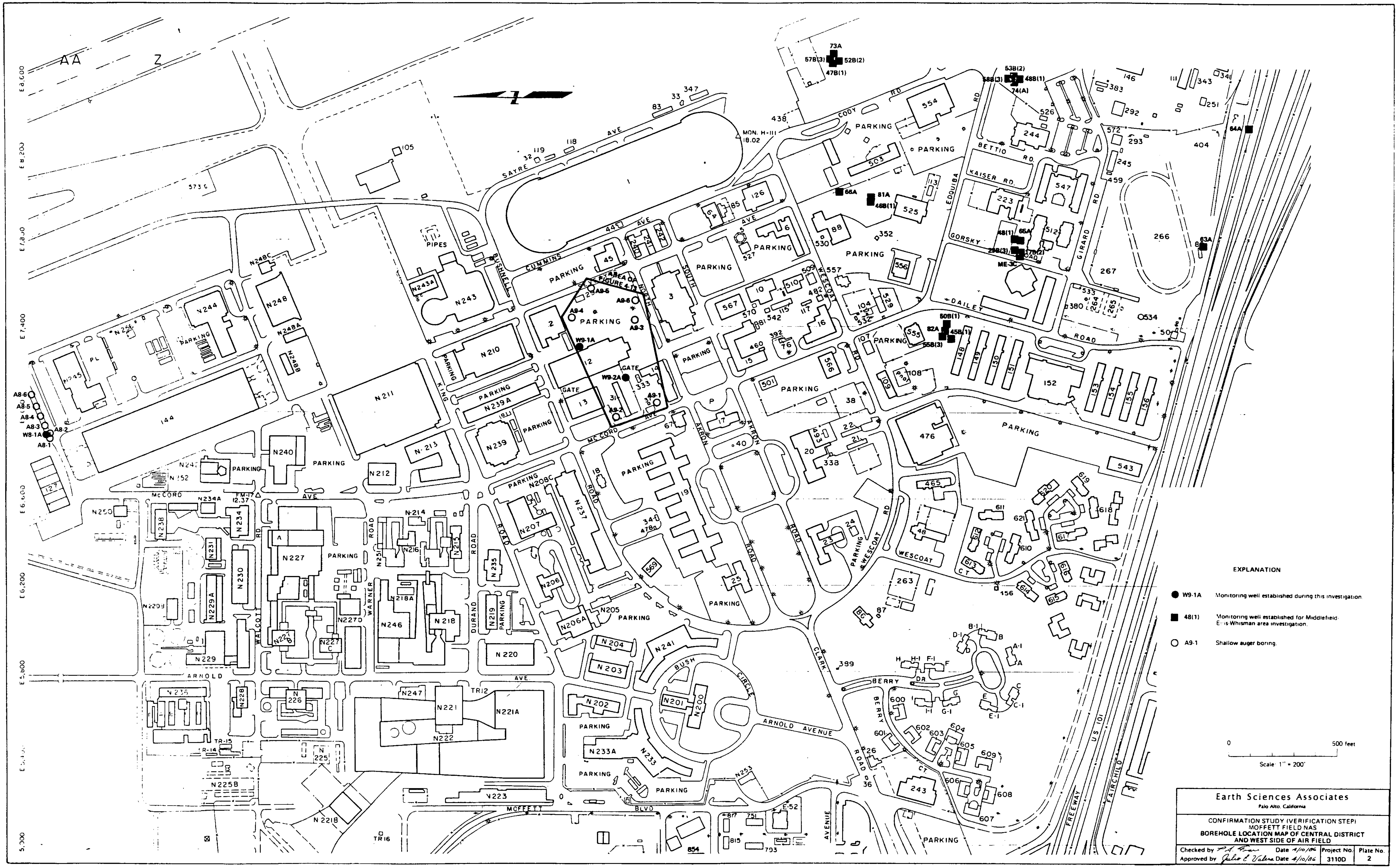
CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
BOREHOLE LOCATION MAP OF GOLF COURSE AND HANGARS 2 AND 3 AREA

Checked by	Date	Project No.	Plate No.
[signature]	4/10/86	3110D	1
Approved by [signature]	4/10/86		



EXPLANATION

● W9-1A — Monitoring well established during this investigation.

■ 48(1) — Monitoring well established for Middlefield-Ellis-Whisman area investigation.

○ A9-1 — Shallow auger boring.

0 — 500 feet

Scale: 1'' = 200'

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CONFIRMATION STUDY (VERIFICATION STEP)
MOFFETT FIELD NAS
BOREHOLE LOCATION MAP OF CENTRAL DISTRICT AND WEST SIDE OF AIR FIELD

Checked by P.A. [signature] Date 4/10/86	Project No.	Plate No.
Approved by Julio E. Valera Date 4/10/86	3110D	2

CONFIRMATION STUDY (VERIFICATION STEP)

DATED 01 APRIL 1986

THIS RECORD CONTAINS MULTIPLE VOLUMES
WHICH HAVE BEEN ENTERED SEPARATELY

VOLUME II OF II IS FILED AS ADMINISTRATIVE
RECORD NO. **N00296.000053**