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ALAMEDA POINT
SSIC NO. 5090.3

FEBRUARY 1990

SAMPLING PLAN

SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSAL ADDENDUM

REMEDIAL INVESTIGATION / FEASIBILITY STUDY
NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

VOLUME IA

DEPARTMENT OF THE NAVY
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA 94066-0727

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SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSAL
ADDENDUM A TO SAMPLING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

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February 22, 1990

86-018-15

Ms. Bella G. Dizon (Code 1813BD)
Western Division Naval Facilities
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PO Box 727
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Transmittal
Final Sampling Plan, SWAT Proposal Addendum, Volume 1A
Remedial Investigation/Feasibility Study
Naval Air Station Alameda
Alameda, California

Dear Ms. Dizon:

Enclosed are 20 copies of the final Sampling Plan, SWAT Proposal Addendum, Volume 1A of the Remedial Investigation/Feasibility Study Work Plan at the Naval Air Station Alameda.

This report completes a portion of the work authorized under Contract No. N62474-85-D-5620 Delivery Order 0008.

If you have any questions, please call us.

Respectfully submitted,

Claude Carlos White, Jr. by (TCB)

Claude Carlos White, Jr.
Project Engineer

CCW/kw

Enclosures

N00236.000786
ALAMEDA POINT
SSIC NO. 5090.3

FINAL SAMPLING PLAN, SOLID WASTE ASSESSMENT TEST PROPOSAL ADDENDUM REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) VOLUME 1A OF 8

DATED 01 FEBRUARY 1990

THIS RECORD CONTAINS MULTIPLE VOLUMES WHICH HAVE BEEN ENTERED SEPARATELY

VOLUME 1 OF 8 – FINAL SAMPLING PLAN, RI/FS DATED 2/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000785**

VOLUME 1A OF 8 – FINAL SAMPLING PLAN, SOLID WASTE ASSESSMENT TEST PROPOSAL ADDENDUM, RI/FS DATED 2/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000311**

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VOLUME 2 OF 8 – FINAL HEALTH AND SAFETY PLAN, RI/FS DATED 12/1/88 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000274**

VOLUME 2 OF 8 – REVISED FINAL HEALTH AND SAFETY PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000351**

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VOLUME 3 OF 8 – FINAL QUALITY ASSURANCE PROJECT PLAN – QUALITY ASSURANCE / QUALITY CONTROL PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000341**

VOLUME 3 OF 8 – FINAL QUALITY ASSURANCE PROJECT PLAN – QUALITY ASSURANCE / QUALITY CONTROL PLAN, RI/FS DATED 1/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000782**

VOLUME 4 OF 8 – COMMUNITY RELATIONS PLAN, RI/FS DATED 2/15/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000301**

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VOLUME 6 OF 8 – DATA MANAGEMENT PLAN, RI/FS DATED 5/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000361**

VOLUME 7 OF 8 – FINAL PRELIMINARY PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION PLAN, RI/FS DATED 6/1/89 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000371**

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VOLUME 8 OF 8 – FINAL FEASIBILITY STUDY PLAN, RI/FS DATED 1/1/90 IS ENTERED IN THE DATABASE AND FILED AT ADMINISTRATIVE RECORD NO. **N00236.000783**

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ADDENDUM TO SAMPLING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
VOLUME 1A

DATED 01 NOVEMBER 1990

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
VOLUME 1A

DATED 23 APRIL 1991

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SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSAL
ADDENDUM A TO SAMPLING PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

NAVAL AIR STATION ALAMEDA
ALAMEDA, CALIFORNIA

1.0 INTRODUCTION

The Work Plan for a Remedial Investigation/Feasibility Study (RI/FS) at NAS Alameda is currently under preparation. This Remedial Investigation Work Plan, while initiated under the Naval Assessment and Control of Installation Pollutants (NACIP) program purview, has been written to satisfy the Comprehensive Environmental Response, Compensation and Liability Act as amended by the Superfund Amendments and Reauthorization Act of 1986 (CERCLA/SARA) remedial investigation program developed by the U.S. Environmental Protection Agency (EPA). It is consistent with EPA guidance on CERCLA/SARA Remedial Investigation (RI) Work Plan development.

The Work Plan for the RI/FS at NAS Alameda consists of the following planning documents:

Volume 1 Sampling Plan
Volume 1A Sampling Plan, SWAT Proposal Addendum
Volume 1B Air Sampling Plan
Volume 2 Health and Safety Plan
Volume 3 Quality Assurance Project Plan (QAPP), Quality Assurance/Quality Control Plan (QA/QC)
Volume 4 Community Relations Plan
Volume 5 Project Management Plan/Schedule
Volume 6 Data Management Plan
Volume 7 Public Health and Environmental Evaluation Plan
Volume 8 Feasibility Study Plan

The purpose of Volume 1A is two-fold. First, it satisfies the requirements of the sampling plan of the RI/FS Work Plan for the two landfills. Second, it satisfies the requirements of the SWAT Proposal for the California Regional Water Quality Control Board (RWQCB).

The objectives of the NAS Alameda site investigation work plan are to determine if contamination of soil and ground water has occurred in areas which have been identified as potential waste release sites, define the nature and extent of contamination at confirmed waste release sites, and to collect the data necessary to complete a Feasibility Study (FS) and evaluate general response actions.

This document presents the Solid Waste Assessment Test (SWAT) proposal for two landfill sites located at the Naval Air Station (NAS) Alameda in Alameda, California (Figure 1-1). These two sites are designated as Site 1: the 1943-1956 Disposal Area and Site 2: the West Beach Landfill (Figure 1-2).

Implementation of a SWAT program by all landfill owners is required under the provisions of the Calderon Bill (AB 3525), which has been incorporated into the California Water Code (Section 13272). The program requires investigation of the site to determine if there is any migration of hazardous wastes.

The following SWAT proposal closely follows the format suggested in the SWAT Guidance document prepared by the California State Water Resources Control Board (SWRCB) in August 1988. This SWAT Guidance document is included as Appendix G so the reader can more easily follow the organization of this SWAT proposal.

The RI/FS Work Plan includes Volume 2, the Health and Safety Plan [Canonie Environmental Services Corp. (Canonie), 1988b], and Volume 3, the Quality Assurance Project Plan and Quality Assurance/Quality Control Plan (QAPP) (Canonie, 1988c). The principles and procedures set forth in those two volumes will be followed during the investigation outlined in this SWAT proposal, and this SWAT proposal will make reference to those two Work Plan documents concerning certain key procedures.

1.1 Site Name

Site 1: 1943-1956 Disposal Area

Site 2: West Beach Landfill

Previous Name: None

1.2 Operator and Owner

Owner: Naval Air Station Alameda
Alameda, California

Contact: Mr. Randolf Cate (Code OLE)
Department of the Navy
Naval Air Station Alameda
Alameda, California

Phone No: 415-869-4731

Operator (Inactive): Naval Air Station
Alameda, California

Phone No: 415-869-4731

Previous Owners: The property where the landfills are located was previously owned by the U.S. Army (1930-1936), but the property was covered by San Francisco Bay at that time, and the landfills had not been created.

1.3 Site Locations

The two landfill sites are adjacent to each other and are located at the extreme western end of NAS Alameda. A general location map is provided on Figure 1-1, and the location of the two landfill sites on the air station property is shown on Figure 1-2.

Site 1, the 1943-1956 Disposal Area, is located in the extreme northwestern corner of the station and occupies an area of about 120 acres. The Oakland Inner Harbor estuary lies along its northern perimeter and San Francisco Bay along its western perimeter.

Site 2, the West Beach Landfill, is located adjacent to and south of the 1943-1956 Disposal Area, on the southwestern corner of the station. It occupies an area of about 110 acres. San Francisco Bay is located along its western and southern perimeters.

Other location parameters include the following:

Township, range and section numbers (Mt. Diablo Base Line and Meridian):

Site 1: The northern half is within T1S, R4W, Section 32.

The southern half is within T2S, R4W, Section 5.

Site 2: T2S, R4W, Section 5.

Assessors parcel numbers:

Site 1: The site is entirely within the City and County of Alameda, Assessor's Parcel Number (APN) Book 74, Pages 890 and 891, Parcel No. 1.

Site 2: The northeast half of Site 2 is within the City and County of Alameda, APN Book 74, Pages 890 and 891, Parcel No. 1.

The southwest half of Site 2 is within the City and County of San Francisco, but the Assessor's office has not assigned a parcel number.

1.4 Site Use

The two landfill sites were not open to the public, but were for the use of NAS Alameda and other Naval facilities in the Oakland vicinity.

During the periods that the landfills were in use, records of the waste materials deposited at the landfills were not maintained. In 1980 the U.S. Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations. An Initial Assessment Study (IAS) was performed at NAS Alameda by Ecology and Environment, Inc. (E&E, 1983). This report assembled information concerning disposal practices and waste materials disposed at the two landfill sites. A summary of this information follows.

1.4.1 Site 1: 1943-1956 Disposal Area

Waste disposal operations at the 1943-1956 Disposal Area began during the early 1940s and continued through 1956. The exact quantities of wastes disposed of at this site are unknown, but have been estimated at 15,000 to 200,000 tons. Long-term employees have reported that the area received all of the wastes generated on the base other than those drained to storm sewers. Materials known to have been disposed of at the site include old aircraft engines, cooked garbage, cables, scrap metal, waste oil, paint waste, solvents, cleaning compounds, construction debris, and radioactive material.

The disposal method reportedly used consisted of digging trenches to the water table, filling them with waste, and compacting the material with a bulldozer. Cover material was applied on an irregular basis.

Based on aerial photographs dated March 24, 1947 (Figure C-2, Appendix C) and September 6, 1949, most of the waste disposal activity appears to have been concentrated in the northern half of the site. An aerial photograph dated August 14, 1953 shows that by that date the area had been covered by the present runways.

1.4.2 Site 2: West Beach Landfill

The West Beach Landfill served as the NAS Alameda disposal area from approximately 1952 through March 1978. Waste disposal operations began at the site in the early 1950s with the disposal of waste chemical drums in the northeast corner of the site. Disposal operations increased after 1956 when waste disposal at the 1943-1956 Disposal Area ceased. By the late 1960s and early 1970s, most of the disposal of hazardous wastes at the site had been discontinued. Disposal operations at this landfill ceased in March 1978.

In addition to wastes from NAS Alameda, this landfill was used for disposal of wastes from Oak Knoll Naval Hospital (now Oakland Naval Hospital); Naval Supply Center, Oakland; and Treasure Island. Materials reportedly disposed of at the landfill included municipal garbage; solvents; oily waste and sludges; paint waste, strippers, thinners, and sludges; plating wastes; industrial strippers and cleaners; acids; mercury; polychlorinated biphenyl (PCB)-contaminated fluids and TAC rags; batteries; low-level radiological wastes; scrap metal; inert ordnance; spoiled food; asbestos; pesticides; tear gas agents (CS and CSC); infectious waste; creosote; and waste medicines and reagents.

Estimates of the amounts of waste in the landfill vary. It has been estimated that a maximum of 1.6 million tons of municipal garbage and 30,000 tons to 500,000 tons of hazardous waste are present in the landfill.

Details of these estimates are available in the Initial Assessment Study (E&E, 1983), but some of this detail will be presented in the following paragraphs.

Table 6-15 in Appendix F lists the wastes from overhauled aircraft which were disposed of at this site. Table 6-16 lists estimated volumes of materials disposed of by plant maintenance and Public Works personnel.

PCB-contaminated oil from base transformers was disposed of, as well as approximately three tons of PCB-contaminated oils contained in oil-soaked TAC rags.

Approximately 30 cubic yards of infectious waste was received from Oak Knoll Naval Hospital each day.

Several hundred pounds of tear gas agents (CS and CSC) as a loose powder in containers were disposed of after the Berkeley student riots in 1968 or 1969.

Inert ordnance was also disposed of at the site. Approximately four truckloads of these explosives, ranging in size from 4 feet long and 12 inches wide to smaller ammunition, were buried in 1976.

In the late 1970s a quantity of pesticides covered by the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) were reportedly disposed of in an area covering 900 to 2,500 square feet. The pesticides included both solids and liquids but were primarily solids that were contained in cardboard containers, glass bottles, and plastic containers. No official records regarding the various types and quantities of pesticides that were disposed of in the landfill

are available. However, previous studies performed at the landfill detected the presence of organochlorine pesticides. The results of these analyses are presented in Appendix A on the EAL Corporation Priority Pollutant Data Sheets for pesticides, covering Harding Lawson Wells No. 21, 22, and 23, dated September 7, 1983.

Two unlined oil sumps into which tanker trucks drained waste oils were located on the site.

In 1981, 24,000 cubic yards of dredge spoils from the Seaplane Lagoon were deposited in the southwest corner of the site.

Disposal methods used at the site reportedly consisted of excavating a trench to the water table, filling the trench in with disposal materials, spreading and compacting the material with a bulldozer, and then covering the area with the excavated soil on an intermittent basis (E&E, 1983).

A map of the West Beach Landfill which originally appeared in the IAS (E&E, 1983) and which shows the estimated locations of some of the hazardous wastes disposed of at the site is provided as Figure 6-7 in Appendix F. The information used by E&E to develop this map was incomplete. The map shown as Figure 6-7 of Appendix F is not considered to be accurate but can be used for general guidance. Additional discussion of disposal methods is provided in Section 2.1.2.

1.5 Administrative Orders

On September 9, 1983 the California Regional Water Quality Control Board (RWQCB) gave notice to the Navy of a Tentative Order of Closure Requirements for the Class II Solid Waste Disposal Site (West Beach Landfill). The Tentative Order was followed by Order No. 83-35 on September 28, 1983. The Closure Requirements contained specifications for the final cover, the leachate cutoff barrier, methane gas control, earthquake damage control, drainage, and erosion control; and prohibited

disposal of dredge spoils pending further review by the RWQCB. The order also set due dates for task completions and compliance report submittals.

On June 30, 1988 the California Department of Health Services (DHS) sent the Navy a Notice of Remedial Action Order. This order found that the landfill sites constituted a nuisance that is injurious to health or offensive to the senses. The Navy was ordered to conduct remedial activities including a remedial investigation and feasibility study (RI/FS), and the order outlined the requirements of the RI/FS.

1.6 Site Closure Information

1.6.1 Site 1: 1943-1956 Disposal Area

The 1943-1956 Disposal Area was used for waste disposal until 1956, but closure of the site began in 1952 when plans for the extension of Runway 12 (now Runway 13-31) and Runway 7-25 required covering of much of the site. An aerial photograph dated August 14, 1953 shows that the present runway configuration in this former landfill area was complete by that date. Spoils stockpiled in this area during dredging operations of the late 1940s were used as fill during the 1952 runway construction.

Disposal operations apparently continued in the landfill in the areas which had not been covered by runways from 1952 until 1956. In 1956 disposal operations were moved to the West Beach Landfill which had opened immediately to the south. The entire 1943-1956 Disposal Area was eventually covered with soil of an unknown depth.

During the mid-1950s, the western edge of the 1943-1956 Disposal Area was developed as the West Beach Fleet Recreation Area. At the present time, facilities in this area include a baseball diamond, picnic area, and a recreation building. The site also includes two ammunition storage facilities and a pistol range. A jogging course runs the length of the site.

The area is today covered by an unknown depth of soil, but no exposed waste is apparent. The perimeter of the landfill is assumed to extend to the rock seawall at the edge of San Francisco Bay, and the recreational facilities in the area are located directly on top of the former waste disposal areas.

1.6.2 Site 2: West Beach Landfill

Disposal operations at the West Beach Landfill ended in March 1978. The Navy developed plans to close the site as a Class II landfill in accordance with state and local regulations. Various investigations and designs for closure of the site were completed by contractors working for the Navy during the late 1970s and early 1980s and discussed with regulatory agencies; but due to a series of difficulties encountered at the site, an approved plan for closure was not completed.

A brief history of these closure efforts since 1978 is provided in the following paragraphs.

In March 1978, Harding-Lawson Associates (HLA) submitted the Sanitary Landfill Site Study (HLA, 1978) for the West Beach Landfill. Results of chemical analyses from this study are discussed in Section 2.2.2. Water quality tests indicated that polluting materials were present in the water and that leachate was seeping into San Francisco Bay from the landfill, but the concentrations at the seawall were not significantly greater than those found in the bay waters adjacent to the site. The report also concluded that the site cover material at that time was not adequate to prevent surface water infiltration. This study was submitted in August 1978 to the DHS for review.

In June 1980, the Navy submitted the Draft Sanitary Landfill Closure Plan (HLA, 1980) to the RWQCB for review. This plan included construction plans and specifications by HLA dated May 30, 1980. The closure concept was that the existing landfill surface would be stripped and resurfaced with one

foot of compacted low-permeability borrow material obtained from the existing dredge material pond, a dike would be constructed to enclose the entire 110-acre area to accommodate disposal of future dredged material, surface runoff would be collected and disposed of through storm drains, and a continuous gas venting system would be installed along the north and east sides of the landfill to prevent lateral migration of methane. In the June 13, 1980 meeting between the RWQCB and the Navy, the RWQCB expressed concern about the leachate seeping from the landfill to the San Francisco Bay waters in the vicinity of Wells 4 or 5 (see Figure 2-2). The Navy agreed to include measures to seal this area.

On September 9, 1983, the RWQCB issued a Tentative Order of Closure Requirements for the West Beach Landfill. The Tentative Order was followed by Order No. 83-35 on September 28, 1983. The order contained requirements for the final cover, the leachate cutoff barrier, methane gas control, earthquake damage, drainage, erosion control, and compliance reports. Commencement of the placement of dredge spoils onto the landfill was prohibited until the RWQCB could determine that measures necessary to protect the ground water quality had been taken. These measures were to be addressed in the NPDES permit application. The completion date for the cover and grading work was specified as October 15, 1987.

On October 19, 1983, HLA submitted the Confirmation Study (HLA, 1983). Additional ground water sampling had been performed. The report concluded that there did not appear to be significant amounts of hazardous materials in the ground water, and that the landfill should be closed as a Class II site.

In June 1985, the Navy notified the RWQCB that the slurry wall and the seawall repairs had been completed on October 1, 1984. It was also reported that the cover thickness had been checked and found to be less than the thickness specified.

On November 26, 1985, the Navy informed the RWQCB that the borrow area from which the cover soil had been taken had been declared a wetlands, and the additional cover material required to meet the cover-thickness requirements could no longer be taken from this borrow site. It would be necessary to find an alternate source of suitable cover material. On April 25, 1986, the Navy informed the RWQCB that the most recent survey of the cover at the site had indicated that 75,000 cubic yards of additional cover material would be required. The contractor was at that time spreading the 20,000 cubic yards of imported material that had been located.

On March 28, 1986, the Navy submitted as-built drawings of the Solid Waste Disposal System plans prepared by HLA to the RWQCB (Appendix D, Drawing C-2). The as-built drawings show the approximate boundary between refuse area and dredge spoils area, the plans and construction details of the perimeter dikes surrounding the landfill, the slurry wall along the northwestern shoreline of the landfill, the gas venting system along the northern and eastern part of the landfill, drainage swales and ditches, and the decant weir. The as-built drawings indicate that the slurry wall is approximately 820 feet in length, 2 feet in width, with the depth varying between 20 and 30 feet. The slurry wall was keyed 2 feet into the underlying bay mud.

On June 11, 1986, the RWQCB requested a proposal from the Navy to address the problem of ponding at the site. In November 1986, the Navy submitted to the RWQCB interim grading plans (revision dated November 10, 1986) for prevention of ponding. HLA and the Navy would oversee the work. In January 1987, the Navy informed the RWQCB that the remedial work to prevent ponding had been completed on December 15, 1986. As-built drawings were submitted dated December 1986.

During 1987 and 1988, the Navy communicated with the RWQCB concerning the possibility of depositing dredge spoils from nearby projects as cover for the West Beach Landfill. Testing programs for permeability and chemical

analyses have been performed, but no dredge spoils have been deposited at the landfill due to execution schedule and funding problems of the dredging projects.

On June 11, 1987, the RWQCB notified the Navy of the SWAT requirements at the landfill.

Historical aerial photographs of the site since 1978 have been provided in Appendix C. These include photographs dated September 14, 1979; June 21, 1983; May 15, 1985; and March 30, 1988. As-built drawings of the closure work which has been completed are presented in Appendix D.

At the present time the West Beach Landfill is surrounded by an earthen berm approximately 15 feet wide and 5 feet above the surface of the landfill. San Francisco Bay lies approximately 30 feet beyond the berm. During recent site visits no exposed areas of organic fill were apparent. A number of piles of construction debris were apparent, and dredge spoils were exposed in the constructed wetlands in the landfill area.

The area is moderately to well vegetated, primarily by grasses. The area supports a diverse wildlife and is known to provide nesting areas for birds.

1.7 Certification

I, Richard J. Greenwood, certify that the information contained in this SWAT proposal is complete and accurate, and that the proposals herein are in accordance with accepted practice.

REGISTERED PROFESSIONAL ENGINEER
RICHARD JOHN GREENWOOD
No. C 041338
CIVIL
STATE OF CALIFORNIA

Richard J. Greenwood
California Registered Civil Engineer
License Number C041338

Mr. Greenwood's resume is presented in Appendix E.

2.0 SITE INFORMATION

2.1 Site Construction Details

No detailed as-built plans, specifications, or descriptions of the original construction of the landfills are available for submittal with the SWAT proposal. However, a summary of known construction procedures at the sites will be presented in two sections which follow.

2.1.1 Construction of the 1943-1956 Disposal Area

Information concerning construction of the 1943-1956 Disposal Area is limited. It is apparent from historical aerial photographs and early maps and nautical charts that the area occupied by both of the landfill sites was covered by the waters of San Francisco Bay prior to 1940 (Figures 2-3 through 2-6 and Figure C-1 in Appendix C). The rock seawall, which today lies along the southern edge of the Oakland Inner Harbor estuary at the northern perimeter of the landfill, has been in place since some time prior to 1915 (Figure 2-3). The seawall was originally a jetty which protected the harbor entrance and included railroad tracks along its length and piers at the western end, approximately at the northwest corner of the present 1943-1956 Disposal Area site.

The area of NAS Alameda just east of the landfill areas, where the main runways are located today, was also originally under water. This area was filled in with dredge spoils during the late 1930s. A historical aerial photograph dated February 18, 1939 (Figure C-1, Appendix C) shows this fill operation nearing completion. The end of the jetty is also visible in this photograph, extending out into the area at the northern perimeter of what would become the landfill.

Nautical charts from 1937 and 1942 show that the water depth in the vicinity of the future 1943-1956 Disposal Area varied from 4 to 18 feet relative to mean lower low water shortly before construction of the landfill began. The 1943-1956 Disposal Area was originally filled in with dredge spoils during the early 1940s, beginning with the northern part of the landfill area next to the jetty. An aerial photograph taken some time during World War II shows disposal operations in the northern half of the site, but filling of the southern half with dredge spoils was still under way. Aerial photographs dated March 24, 1947 (Figure C-2, Appendix C) and September 6, 1949 show disposal operations in the northern half, but no evidence of disposal in the southern half of the site.

The disposal method at the site reportedly consisted of digging trenches in the fill soil to the water table, filling them with waste, and compacting the material with a bulldozer. Cover material was applied on an irregular basis (E&E, 1983).

The landfill was partly covered in 1952 when the runways were extended to their present configuration. An aerial photograph dated August 14, 1953 shows the completed runways, but disposal operations were apparently continuing in the western and northern portion of the site in the areas which had not been covered by the runways. There is no sign in the 1953 photograph that filling work had begun in the West Beach Landfill.

Disposal operations at the site ended in the mid-1950s. Closure activities are described in Section 1.6.1.

2.1.2 Construction of the West Beach Landfill

According to a report produced by the Navy staff, filling of the West Beach Landfill began in 1956 with construction of the seawall on the south and west sides and hydraulic placement of 15 to 20 feet of sand fill (Cristi, 1973). According to nautical charts dated 1937 and 1942, the water depth

in the area in 1937 and 1938 ranged from 8 feet to 20 feet below the mean lower low water datum (Figures 2-5 and 2-6). The fill operations in the area can be seen in progress in the historical aerial photograph dated May 3, 1957 (Figure C-3, Appendix C).

According to the 1978 Harding-Lawson study of the site (HLA, 1978), the landfill has been divided into three areas, designated as Areas A, B, and C on Plate 1 of Appendix F. After the initial filling of the landfill area with sand, clayey and sandy dredge spoil was added in Areas B and C.

The HLA study concluded that the disposal of the wastes described in Section 1.4.2 was limited to Areas A and B. Area B was originally limited to disposal of dredge spoil material, but during the late 1970s some refuse was disposed of in this area. Areas B and C were diked and used for the disposal of dredge spoil material in 1970 and 1973. Most of this material came from the Navy pier areas, turning basin, and entrance channel, and it is possible that some chemical contamination was present in the dredged material.

According to the Harding-Lawson study, disposal operations consisted of excavating about 20 feet of the hydraulic sand fill, filling the excavation with waste materials and excavated sand, and covering the fill with the remaining sand (HLA, 1978). Operations during the late 1970s were described by HLA as consisting of excavation of trenches to just above the ground water surface, depositing the waste at the working face of the excavation, spreading and compacting the waste with a bulldozer, collecting the cover material (on-site dredge slurry sands and bay mud) by dragline and front-end loader, spreading the cover with a scraper, and track-rolling the cover with bulldozers (HLA, 1978). This latter description of disposal operations corresponds to the description provided in the IAS (E&E, 1983). The IAS also provided a diagram of where wastes had been disposed at the site (Figure 6-7 in Appendix F), but this diagram was based on incomplete information and should only be used for general guidance.

A study of historical photographs reveals some additional information. Several photographs from the late 1960s show a large area of water extending eastward into the landfill area from the rock seawall about midway up the site area from the southern perimeter. This can be clearly seen in the aerial photograph dated May 19, 1969 (Figure C-4, Appendix C). Disposal operations were proceeding around the edges of this water area. During this period there was a culvert through the seawall and this area of surface water was open to tidal action. After 1968 a flap-gate was installed on the culvert to stop the tidal action. The area had apparently been filled by the time of the aerial photographs dated May 19, 1971 and April 30, 1973 (Figure C-5, Appendix C).

Disposal operations at the site were discontinued in March 1978. Closure activities at the site are described in Section 1.6.2. The aerial photograph dated September 14, 1979 (Figure C-6, Appendix C) shows the site about one year after disposal operations were halted.

Several studies of the site have been performed since disposal operations were discontinued. These included soil borings which provide an indication of the depth of the fill material at the site. Discussions of these studies are presented in Section 2.2.2, and copies of boring logs are provided in Appendix B.

2.2 Existing Chemical Data

The two landfills under study had no leachate collection and removal systems, and there are therefore no recent analyses of leachate available for submittal with the SWAT proposal. There have been, however, several investigations of the landfill areas since the late 1970s which have collected samples for analysis. A summary of these data on physical and chemical parameters is presented in the two sections which follow.

2.2.1 Previous Investigations at the 1943-1956 Disposal Area

The 1943-1956 Disposal Area (Figure 1-2) was investigated by Wahler Associates (Wahler) during the Verification Step Confirmation Study (Wahler, 1985), prepared under the NACIP program. Five permanent ground water monitoring wells were installed along the western perimeter of the disposal area as shown on Figure 2-1. The following analyses were performed on both the soil and ground water samples:

- Purgeable hydrocarbons;
- Base-neutral extractable organics;
- Seventeen metals;
- Radiation (gross alpha and gross beta).

Results of chemical analyses for inorganic and organic constituents in soil and ground water from the 1943-1956 Disposal Area are presented in Table 1 of Appendix A.

The soil samples test data for inorganic analyses show that in most of the samples, 11 of the 17 metals tested for were detected, with copper, zinc, and lead levels at high concentrations. The organic analysis results of the soil samples from Well WA-3 show that it contained a number of polynuclear aromatic hydrocarbons (PAHs) which were not detected in the other samples.

The most significant findings of the ground water analyses were the trichloroethylene (TCE), and trans-1,2-dichloroethylene (trans-1,2-DCE) levels that were detected in samples from Wells WA-1, WA-2, and WA-3. Benzene was detected at a concentration of 9 parts per billion (ppb) which

exceeds the Maximum Contaminant level of 1 ppb for drinking water constituents. Metals were detected in only two of the water samples: zinc was found in Well WA-1 and molybdenum was found in Well WA-3.

Low levels of radiation were detected in most of the soil and water samples.

2.2.2 Previous Investigations at the West Beach Landfill

A Sanitary Landfill Site Study was conducted by Harding-Lawson Associates (HLA, 1978) for the West Beach Landfill.

Test borings were drilled and subsurface conditions were investigated (Figure 2-2). It was concluded that the subsurface water generally flows across the site from the north and east boundaries to the south and west. Data regarding the influence of tidal action on the fluctuation of water levels in the observation wells was collected and is contained in Table 2, Appendix A. Water quality was tested from water samples taken from selected points, and results of the sample analyses are contained in Table 3, Appendix A. The water quality tests indicated that chemicals were present in the water and that leachate was seeping into San Francisco Bay from the landfill, but the concentrations were not significantly greater than those found in the bay waters adjacent to the site.

The report stated that the adequacy of the site cover material to prevent surface water infiltration was questionable.

During the study, soil gas was monitored at several observation wells. It was found that the landfill was generating methane and that in some of the borings the gas concentration was at combustible levels. Data from the soil gas study is contained in Tables 4, 5, and 6 of Appendix A.

As part of their Confirmation Study, HLA (1983) recommended and performed water sampling on 6 of the original 15 observation wells. Samples were taken for laboratory testing using chain-of-custody procedures. The testing included gas chromatograph scans for the EPA's list of 129 priority pollutants. A copy of these test data is presented in Appendix A. Comparison of this data with their data from the 1978 monitoring well tests indicated that the heavy metals concentrations were about the same as they were in 1977 (less than one part per million). No volatile or base neutral fractions were detected; the acid fraction contained only a trace of phenol; the total identifiable chlorinated hydrocarbon (TICH) fraction indicated a slight trace of PCB; and phenols ranged from 10 to 30 ppb. Based on this analysis, HLA concluded that it did not appear that significant amounts of materials were present in the landfill at hazardous levels. In response to the recommendations of the IAS (E&E, 1983), HLA included in their Confirmation Study the installation of six additional monitoring wells (Figure 2-2). Samples were taken in these new wells and also from the several existing monitoring wells constructed in 1976. Additional test data and results are presented in Appendix A. From analysis of these samples, HLA concluded that there did not appear to be significant amounts of hazardous materials in the ground water, and that the landfill should be closed as a Class II site.

3.0 SOLID WASTE ASSESSMENT MONITORING PROPOSAL: SAMPLING PLAN

3.1 Objectives and Procedures

3.1.1 Objectives

The sampling and monitoring plan described in this proposal is designed to meet the objectives of both the SWAT report which must be prepared and the RI/FS program which is under preparation for NAS Alameda, as described in Section 1.0.

The specific objectives of the plan are the following:

1. Determine whether there is a radiation exposure hazard to base personnel from buried radioactive material in the landfill areas.

2. Determine whether there is an exposure hazard to station personnel from improperly covered contaminants, especially in the fleet recreation area within Site 1, the 1943-1956 Disposal Area.

3. Determine the hydrogeologic and physical characteristics of the soils at the two sites so that monitoring facilities and remedial alternatives can be developed.

4. Determine the nature and concentrations of contaminants in the ground water which is leaving the two landfill areas, and estimate the rate of flow of ground water from the sites into San Francisco Bay.

5. Determine the tidal influence on ground water flow and direction.

3.1.2 Procedures

As discussed in Section 1.0, all of the procedures outlined in the Health and Safety Plan (Canonie, 1988b) and the QAPP (Canonie, 1988c) volumes of the RI/FS Work Plan for NAS Alameda will be followed during the work described in this SWAT proposal. These volumes include detailed descriptions of drilling, monitoring well construction, sampling, sample custody, and laboratory procedures.

Some of the important procedures which will be followed at the landfill sites are summarized in the following sections.

3.1.2.1 Decontamination Station

A decontamination area will be established on the western side of the base during the work at the landfill sites. This will include a facility of the type shown on Figure 3-9 for collecting wash water used for decontamination.

The decontamination of equipment is necessary to safeguard worker health, minimize the possibility of spreading of contamination, and protect the accuracy of analytical results of samples collected with the equipment. All personnel and hand-held monitoring and sampling equipment will be decontaminated at each site. (Refer to the Health and Safety Plan for decontamination procedures.)

The wash waters used for decontamination will be collected and stored in Department of Transportation (DOT) approved 55-gallon drums for later disposal. These drums will be stored either in the controlled equipment storage area or at a hazardous waste storage generator accumulation point designated by the Navy Project Coordinator. The choice of the appropriate storage area is subject to approval by the Navy Project Coordinator. Samples of wash water will be analyzed to determine whether the liquids can be disposed of on-site or whether they will require off-site disposal.

3.1.2.2 Drilling Procedures

All on-site drilling will be conducted using mobile drilling trucks capable of augering, mud rotary drilling, air rotary drilling, or angle boring, and of advancing and retrieving split spoons and core barrels. A continuous flight, hollow-stem auger will be used to advance all borings on-site. If this method does not prove feasible, then either the mud rotary or air rotary method shall be used.

The drilling trucks, augers, drilling rods, bits, pumps, tubs, circulation hoses, and any other equipment which will be used during subsurface investigations will be steam cleaned prior to its use at the site. All equipment used during the drilling of a borehole will be steam cleaned prior to its reuse at any other boring location.

3.1.2.3 Sampling Procedures

Soil samples from unpaved sites which require only shallow sampling (less than 3-foot depth) will be collected using a hand-held auger and an 18-inch or 12-inch split spoon sampler. Samples will be collected using the procedures described in Section 5.3.2 of the Quality Assurance Project Plan (QAPP). Surface soil samples collected from depths of 0 to 6 inches below ground surface will be collected by driving brass tubes into the soils or by collecting loose soil from the surface.

Soil samples from exploratory borings and monitoring well locations will be continuously obtained using a combination of a split spoon sampler (2-inch inside diameter, 24-inches long) and an NX-sized or 94-millimeter diameter core sampler. If the geologic conditions appear to be similar throughout the site, soil samples will be continuously collected to a depth of at least 50 feet, but below 50 feet may be collected at five-foot intervals and/or at each distinct change in lithology. Split spoon samples will be obtained by advancing the sampler ahead of the hollow-stem augers and driving the sampler into undisturbed soil below the mouth of the augers.

The sampler is driven into the ground with a 140 pound hammer which is repeatedly raised 30 inches and dropped onto the top of the sampler. The sampler is advanced to a predetermined depth, and then withdrawn and opened to retrieve the soil sample. The depth intervals where split spoon samples are collected will be determined on a site-by-site basis. Soil samples can be obtained from the desired depth interval using this method.

The core sampler can be used with either hollow stem auger or rotary drilling methods. Where the hollow stem auger is used, this sampler rests inside the hollow section of the auger and is advanced simultaneously into undisturbed soils with the penetration of the auger during drilling. This device will be used for lithologic purposes and between areas where split spoon samples are obtained.

After the split spoon or core sampler is retrieved and opened, the sample recovery will be measured and recorded. The physical characteristics of the soils will be described on the field boring log using the Unified Soils Classification System.

The soil samples will be retained in labeled core boxes except for those samples which are sent to the laboratory for analysis. The samples will be retained in the core boxes until the RWQCB accepts and approves the SWAT Report. Soil samples from borings which are determined by the analytical laboratory to be contaminated will be disposed of in 90 days.

At the depth intervals where soil samples for chemical analysis are required, the split spoon will be loaded with brass tubes. During drilling activities, the Organic Vapor Analyzer (OVA) and observations of the other soil characteristics such as discoloration will be used to determine which samples will be sent to the laboratory.

Upon sample recovery, the brass tubes containing the soil sample will be removed from the split spoon, the ends sealed with aluminum foil and plastic end caps, and then securely taped closed. Once collected, the

samples will be marked with a unique sample number, logged onto a chain-of-custody form, placed on ice in a cooler, and sent to a State of California approved laboratory for analysis. Chain-of-custody procedures are identified in Section 6.1.2 of the QAPP.

After the collection of each sample, the samplers will be decontaminated prior to reuse. The primary decontamination process will be steam cleaning. An alternative decontamination process consists of placing the samplers into a washtub containing Alconox detergent and tap water, and cleaning the them with a brush. Next, the samplers will be rinsed with tap water to remove all soap, and rinsed with hexane to remove any residual contaminants. The waste hexane will be collected and containerized for proper disposal. The samplers will be thoroughly rinsed with deionized water and allowed to air dry.

Thin-walled tube samplers, if feasible, will be used to collect undisturbed soil samples for engineering parameter analysis. An undisturbed soil sample will be collected by hydraulically advancing a 24-inch long, 3-inch outside diameter, thin-walled sampler ahead of the augers. After the sample has been retrieved, the ends of the sampler will be sealed with aluminum foil and taped to retain the soil sample and to preserve the water content in the soil. The outside of the tube will be indelibly marked with the site name, boring number, and depth at which collected. The samples will be recorded using chain-of-custody procedures and sent to the appropriate soils laboratory for analyses.

Surface water samples will be collected using either Method III-1: Sampling Surface Waters Using a Dipper or Other Transfer Device or Method III-2: Use of Pond Sampler For the Collection of Surface Water Samples. Method III-1 employs the use of a stainless steel or Teflon container which can be used to transfer liquid samples from their source to a sample bottle. Using this method prevents unnecessary contamination of the outer

surface of the sample bottle that occurs when the bottle is placed directly into the liquid medium. This method also allows a sample to be taken by a technician without the technician physically contacting the sampling medium.

Method III-2 is a modification of Method III-1. This method utilizes the same type of container as Method III-1 and adds an extension handle which allows retrieval of samples from areas beyond the normal reach of a technician. This method can be useful when water samples are collected from piers or the deck of a floating sampling platform.

Ground water samples will be collected from wells using the methods described in Section 5.3.3 of the QAPP.

All sampling equipment will be decontaminated before use and prior to reuse. The decontamination procedure to be used employs the steps described in the decontamination of split spoons.

3.1.2.4 Monitoring Well Construction

The construction of monitoring wells is described in detail in Section 4.0 of the QAPP. Figures 3-4 through 3-7 shows the generalized well construction features.

All monitoring wells will be surveyed and tied into existing benchmarks to provide proper elevation control. This will allow an evaluation of ground water flow patterns and tidal influences.

3.2 Site 1: 1943-1956 Disposal Area Monitoring Proposal

3.2.1 Site Reconnaissance

A site reconnaissance will be performed at the 1943-1956 Disposal Area to familiarize field personnel with the work area, identify all potential work hazards and obstructions, locate and designate specific sampling locations, and define site-specific health and safety procedures.

A radiation survey will be conducted at the 1943-1956 Disposal Area to determine whether any exposure hazard to personnel working at the landfill exists. A sampling grid with a 200-foot spacing will be established (Figure 3-1) and a Geiger-Muller detector will be used to record measurements taken at each of the nodes. The field crew will carry a Geiger-Muller detector and flame ionization detector (FID) device during the establishment of the grid, and measurements will be taken and recorded as the grid is established. Any reading above acceptable levels with either device will cause immediate cessation of activity in that area. During the radiation survey, the Geiger-Muller detector will also obtain continuous readings along each grid line between each nodal point for the purpose of detecting potentially higher radiation readings between these points. (Refer to the RI/FS Health and Safety Plan for acceptable working levels.) If no dangerous anomalies are detected, then the area will be cleared for work.

Soil boring and monitoring well locations will be identified and marked with numbered wooden stakes. Personnel and equipment decontamination areas will be selected during this phase. The equipment decontamination pit (Figure 3-9), or an equivalent design, will be constructed before drilling activities begin.

3.2.1.1 Geophysical Surveying

Geophysical surveys will be conducted at the 1943-1956 Disposal Area to initially characterize subsurface conditions. These surveys will also be used to locate buried waste chemical drums and to delineate the boundaries of the drum disposal areas. These surveys will be implemented throughout the disposal area with the exception of the NAS Alameda runways and other restricted areas. The geophysical field methods that are most applicable for identifying subsurface anomalies in landfill areas include magnetometry, electromagnetics (EM), and ground penetrating radar (GPR). However, because of the highly variable, heterogeneous nature of fill materials within the landfill area and underlying subsurface conditions, the most feasible methods for defining these anomalies will be magnetometry and electromagnetics. At this time, ground penetrating radar is not considered a feasible geophysical tool because of several site-specific influencing factors, such as the shallow ground water table, and the shallow depth and highly conductive nature of the bay mud.

Both magnetometry and electromagnetics methods will be performed using portable instrumentation without any direct ground contact. Survey points for each field measurement will be established along a grid system with regularly-spaced intervals. Data obtained during these surveys will be temporarily stored in a portable data logger system and then reduced, interpreted, and presented in the form of magnetic intensity and/or magnetic gradient contour maps. These maps will illustrate the locations of any buried drums and/or other subsurface anomalies.

The grid spacing interval for each geophysical method used will be designed by a specialist in geophysical surveying after a review of the data concerning past waste disposal practices and the data from previous soil borings.

After the results of the geophysical testing program have been examined, further investigation of the interior landfill areas will be considered.

Additional methods which may be judged appropriate include the installation of monitoring wells and trenching to evaluate subsurface conditions in certain areas.

3.2.2 Soil Sampling

3.2.2.1 Sampling of Surface Soils

As stated in Section 1.6.1, the western edge of the 1943-1956 Disposal Area was developed in the mid-1950s as the West Beach Fleet Recreation Area. Activities that occur in the area include baseball, picnicking, and jogging. If surface contaminants are present, significant direct contact exposure to surface soils could occur while engaging in these activities. The disposal area was reportedly covered with soil after landfilling operations had ceased; however, the depth of cover and the source of the soil are not documented. From the past disposal practices and the nature of wastes deposited at the site, the potential for residual contamination exists. Sampling and analysis of surface soils are necessary to determine whether contaminants such as metals, PAHs, and PCBs, all of which adsorb strongly to soil particulates, are present in the surface soils.

The radiation survey grid established during the site reconnaissance phase (Figure 3-1) will be utilized to conduct a surface soil sampling program. Surface soil samples from zero to six inches in depth will be collected at the node points of the grid, except at node points which are located in paved areas. These samples will be analyzed for the parameters listed in Table 3-1 to determine whether the surface soils in this area present a hazard to the people using this area for recreational purposes. In addition, surface soil samples will be collected at the location of each soil boring prior to the set-up of drilling equipment at the location.

3.2.2.2 Soil Borings and Soil Sampling

Monitoring wells, which are discussed in Section 3.2.3, will be located in sets of two or three adjacent wells at a series of locations which form a ring around both the 1943-1956 Disposal Area and the West Beach Landfill immediately outside the perimeter of the landfills (Figure 3-3).

Prior to well installation, two exploratory borings will be drilled at the northern corners of the 1943-1956 Disposal Area to evaluate the Merritt Sand Formation and provide data for designing the deep monitoring wells. Soil samples for sieve analysis will be collected during these borings, and the results of these analyses will be reported with the boring logs. Additional exploratory borings will be considered, if additional geologic information is needed. The locations of the exploratory borings, including two additional locations, are shown on Figure 3-3.

At least one soil boring for the purpose of soil sampling will be completed at each of the locations of a set of monitoring wells before the monitoring wells are installed. Wherever practical, upon completion of drilling, the soil sample boring will be converted immediately into one of the monitoring wells planned for that location.

Actual monitoring well and boring locations will be determined in the field during the site reconnaissance phase. All preparation work (see Section 3.2.1) must be completed before field sampling can begin.

Soil sample borings and monitoring wells will be placed to facilitate the detection of contaminants leaching from the disposal area. At each location where a set of three monitoring wells is planned, the soil sample boring will be advanced to the bottom of the Merritt Sand Formation, which lies beneath the bay mud. At locations where a set of two monitoring wells is planned, the deeper well will be screened in the upper portion of the Merritt Sand Formation. The soil sample borings at these locations will penetrate the Merritt Sand Formation, but may not extend to the bottom of

that formation. At two of the monitoring well locations proposed in the upgradient well area (Figure 3-3), only one well is planned, and this well will be screened in the uppermost water bearing zone. At these two locations the soil sample boring will be advanced only until the bay mud is encountered. Since detailed lithologic logs will be required, continuous soil samples for physical characterization will be collected during each soil sample boring. At the depth intervals where samples for chemical analysis are required, brass tubes will be loaded into the sampler.

Particle size analyses, including the sieve analysis and hydrometer methods using the ASTM Method 422-63 protocol, will be performed on each distinct lithologic unit at each boring location for soil classification and well design purposes. The design of well filter packs and screen slot widths will consider the results of the particle size analyses of soil samples from previous soil borings.

Sampling activities will also be performed immediately offshore along the west side of the landfill to check for contamination within the bay sediments. If the chemical analyses reveal signs of contamination, then bioassay testing will also be performed.

Split spoon samplers loaded with brass tubes will be used to collect soil samples for contaminant analyses. Sample preparation is described in Section 3.1.2.3. Thin-walled tube samplers, if feasible, will be used to collect undisturbed soil samples for physical property analyses. The types of chemical analyses to be performed on soil samples are presented in Table 3-1. The samples will be analyzed according to the methods listed in Table 3-3.

All drilling activities at the 1943-1956 Disposal Area will be monitored with an OVA meter, a combination oxygen and lower explosive limit detector, and a Geiger-Muller detector. (Refer to the Health and Safety Plan for more detailed information.)

3.2.3 Monitoring Well Installation

Monitoring wells will be installed at locations approximately 500 feet apart forming a ring around both the 1943-1956 Disposal Area and the West Beach Landfill (Figure 3-3). This ring will be located just outside the estimated perimeter of the landfill areas. At each of these locations, at least two monitoring wells will be installed: one extending down to the bay mud and screened within the uppermost water bearing zone (Figure 3-4) and one extending through the bay mud into the second water bearing zone (the Merritt Sand Formation) and screened only within the upper portion of that second zone (Figure 3-5). At a minimum of four of the well locations, a third monitoring well will be installed and screened within the lower portion of the Merritt Sand (Figure 3-6). A cross section showing these various well types is provided on Figure 3-8, and well locations are shown on Figure 3-3.

For the purposes of aquifer testing, at least four 4-inch diameter monitoring wells will also be installed along the landfill perimeters and upgradient of the landfills. These wells will be screened throughout the Merritt Sand (Figure 3-7). The locations of these wells are shown on Figure 3-3.

Before installing each deep monitoring well, the upper water-bearing zone in each well will be sealed off by the placement of a conductor casing. After the conductor casing is positioned into the borehole, the annulus between the casing and borehole will be sealed with a cement-bentonite grout using tremie methods. Illustrations of the casing are shown on Figures 3-5 through 3-7.

The wells will be installed to allow continuing monitoring of ground water levels and collection of ground water samples. Specific well construction materials and procedures are described in the QAPP. Generalized well construction diagrams are presented on Figures 3-4 through 3-7. The actual depth of screen placement will be determined in the field based on the

hydrogeologic characteristics revealed by the soil sample borings at each location. (See Section 3.2.2.2.)

The rationale for monitoring well locations and depths is presented in Section 3.5.

3.2.4 Ground Water Sampling

Ground water samples will be collected from each of the wells installed at the locations shown on Figure 3-3. Samples from the wells around the 1943-1956 Disposal Area will be analyzed for the parameters listed in Table 3-1 according to the methods listed in Table 3-3. The analytical results of these samples will be evaluated to determine whether any contamination is present in the ground water in that area.

Ground water samples will be collected from monitoring wells after the well has been installed, developed, and allowed a sufficient recovery time. Water level measurements will be taken and recorded at each well prior to purging and sampling. A sufficient number of water samples will be collected to allow for the analysis of the ground water parameters listed on Table 3-1. Refer to the QAPP for information regarding well purging and sample collection procedures. The types of samples to be collected and the preservation method for these samples are also listed in the QAPP.

As required by the SWAT Guidance document, ground water samples will be collected and analyzed on a quarterly basis for four consecutive quarters.

A series of pressure transducers placed in certain monitoring wells will be employed to measure the tidal influences in the landfill. These transducers will be connected to a data logger to record systematic water level measurements. Measurements will be recorded for two 48-hour periods, once during a period of the monthly high tides and a second time during a period of the monthly low tides.

3.3 Site 2: West Beach Landfill Monitoring Proposal

3.3.1 Site Reconnaissance

A site reconnaissance will be performed at the West Beach Landfill to familiarize field personnel with the work area, identify all potential work hazards and obstructions, locate and designate specific sampling locations, and define site-specific health and safety procedures.

A radiation survey will be conducted at the West Beach Landfill to determine whether any exposure hazard to personnel working at the landfill exists. A sampling grid with a 200-foot spacing (Figure 3-2) will be established and a Geiger-Muller detector will be used to record measurements taken at each of the nodes. The field crew will carry a Geiger-Muller detector and FID device during the establishment of the grid, and measurements will be taken and recorded as the grid is established. Any reading above the acceptable levels identified in the Health and Safety Plan with either device will cause immediate cessation of activity in that area. Refer to the Health and Safety Plan for the specific action levels. If no dangerous anomalies are detected, then the area will be cleared for work.

Soil boring and monitoring well installation locations will be identified and marked with numbered wooden stakes. Personnel and equipment decontamination areas will be selected during this phase. The equipment decontamination pit (Figure 3-9) will be constructed before drilling activities begin.

3.3.1.1 Geophysical Surveying

Geophysical surveys will be conducted at the West Beach Landfill to locate any buried waste chemical drums or other subsurface anomalies and to delineate the boundaries of such areas. These surveys will be implemented in suspected areas of earlier drum disposal, reportedly located, in the

northern and eastern portions of the landfill, as shown on Figure 6-7 in Appendix F. The geophysical field methods that are most applicable in identifying buried drum locations include magnetometry, electromagnetics (EM), and ground penetrating radar (GPR). However, because of the highly variable, heterogeneous nature of fill materials within the landfill area and subsurface conditions, the most feasible methods for locating these drums are magnetometry and electromagnetics. Ground penetrating radar is not considered a feasible geophysical reconnaissance method because of several influencing factors, such as the shallow ground water table, and the shallow depth and highly conductive nature of the bay mud.

Both magnetometry and electromagnetics methods will be performed using portable instrumentation without any direct ground contact. Survey points for each measurement will be established using a grid system with regularly-spaced intervals. Data obtained during these surveys will temporarily stored in a portable data logger system and then reduced, interpreted, and presented in the form of magnetic intensity and/or magnetic gradient contour maps. These maps will illustrate the locations of the buried drums and/or other subsurface anomalies.

The grid spacing interval for each geophysical method used will be designed by a specialist in geophysical surveying after a review of the data concerning past waste disposal practices and the data from previous soil borings. A more concentrated grid system with smaller intervals will be used in areas where disposal of chemical drums and inert ordnance has been reported, as shown in Figure 6-7 in Appendix F.

After the results of the geophysical testing program have been examined, further investigation of the interior landfill areas will be considered. Additional methods which may be judged appropriate include the installation of monitoring wells and trenching to evaluate subsurface conditions in certain areas.

3.3.2 Soil Borings and Soil Sampling

Monitoring wells at the West Beach Landfill will be installed in sets of two adjacent wells at a series of locations which form a ring around both landfills. This is described in Sections 3.2.3 and 3.3.3 and locations are shown on Figure 3-3.

Surface soil samples will be collected at the location of each soil boring prior to set-up of drilling equipment at the location.

Prior to well installation, two exploratory borings will be drilled at the southern corners of the West Beach landfill to evaluate the Merritt Sand Formation and provide data for designing the deep monitoring wells. Soil samples for sieve analysis will be collected during these borings, and the results of these analyses will be reported with the boring logs. Additional exploratory borings will be considered, if additional geologic information is needed. The locations of the exploratory borings, including two additional locations, are shown on Figure 3-3.

At least one soil boring for the purpose of soil sampling will be completed at each of the locations of a set of monitoring wells before the monitoring wells are installed. Wherever practical, upon completion of drilling, the soil sample boring will be converted immediately into one of the monitoring wells planned for that location.

Actual monitoring well and boring locations will be determined in the field during the site reconnaissance phase. All preparation work (see Section 3.3.1) must be completed before field sampling can begin.

Soil sample borings and monitoring well pairs will be placed immediately outside the landfill berm to facilitate the detection of contaminants leaching from the landfill. Sampling will follow the procedures described in Section 3.2.2.2.

Sampling activities will also be performed immediately offshore along the west side of the landfill to check for contamination within the bay sediments. If the chemical analyses reveal signs of contamination, then bioassay testing will also be performed.

The types of chemical analyses to be performed on soil samples is presented in Table 3-2. The samples will be analyzed according to the methods listed in Table 3-3.

All boring activities at the West Beach Landfill will be monitored with an OVA meter, a combination oxygen and lower explosive limit detector, and a Geiger-Muller detector. Refer to the Health and Safety Plan for more detailed information.

3.3.3 Monitoring Well Installation

Installation of monitoring wells at the West Beach landfill will follow the same procedures described for the 1943-1956 Disposal Area in Section 3.2.3.

Monitoring wells will be installed at locations which form a ring around both landfills (Figure 3-3). This ring will be located just outside the perimeter of the landfill. On the west and south perimeters the monitoring wells will be located between the dike and the rock seawall.

At each of these locations, the monitoring wells will be installed as described in Section 3.2.3 and shown on Figures 3-3 through 3-8. The actual depth of screen placement will be determined in the field from the hydrogeologic characteristics revealed by the soil sample borings at each location.

The rationale for monitoring well locations and depths is presented in Section 3.5.

3.3.4 Ground Water Sampling

Ground water samples will be collected from each of the wells installed at the locations shown on Figure 3-3. Samples from wells around the West Beach landfill will be analyzed for the parameters listed in Table 3-2 according to the methods listed in Table 3-3. The analytical results of these samples will be evaluated to determine if any contamination is present in the ground water in that area.

Ground water samples will be collected from monitoring wells after each well has been installed, developed, and allowed a sufficient recovery time. Water level measurements will be taken and recorded at each well prior to purging and sampling. A sufficient number of water samples will be collected to allow for the analysis of the ground water parameters listed on Table 3-2. Refer to the QAPP for information regarding well purging and sample collection procedures. The types of samples to be collected and the preservation method for these samples are also listed in the QAPP.

As required by the SWAT Guidance document, ground water samples will be collected and analyzed on a quarterly basis for four consecutive quarters.

A series of pressure transducers placed in certain monitoring wells will be employed to measure the tidal influences in the landfill. These transducers will be connected to a data logger to record systematic water level measurements. Measurements will be recorded for two 48-hour periods, once during a period of the monthly high tides and a second time during a period of the monthly low tides.

3.3.5 Surface Water and Sediment Sampling

Surface water and sediment samples will be collected for chemical analysis from all wetlands ponds in the West Beach Landfill area. The purpose for evaluating the surface water quality and sediments in this area is to determine the potential risks to wildlife populations that live or feed in

these wetlands. These samples will be analyzed for the parameters listed in Table 3-3.

The flat hydraulic gradient at the landfill sites indicates that ground water seepage is probably at a slow rate of flow. Further, observations of tidal action in monitoring wells over 100 feet inside the seawalls indicate that the mixing of ground water and tidal flows is taking place well inside the seawall. Finally, conditions next to the seawalls, including strong wave action and tidal currents, will produce rapid mixing at the seawall face.

No sampling of the surface water and sediments in the offshore areas north, west, and south of the landfills has been planned as a specific element of the SWAT investigation. Previous sampling of surface water next to the rock seawalls has indicated that no significant difference was evident between water samples taken next to the seawalls and samples of San Francisco Bay water collected farther offshore in the vicinity (HLA, 1978). However, extensive sampling of surface water and sediments has been planned for these offshore areas as part of the RI/FS activities, as described in the Sampling Plan, Volume 1 of the RI/FS Work Plan.

3.3.6 Bioassays and Bioaccumulation Studies

Bioassays and bioaccumulation studies will be performed on sediments from the wetland area if elevated levels of contaminants with high bioaccumulation factor (eg, organochlorine pesticides, PCBs, and metals) are found during the initial analyses of the sediments. Elevated levels refer to specific levels that exceed Ambient Water Quality Criteria. Bioassays are needed to evaluate potential impacts on the ecological communities of the area and are also useful for determining if chemicals

present at the site are at concentrations that are toxic to species inhabiting the NAS Alameda area. Bioassays are indicated on Table 3-3.

3.3.7 Tissue Residue Analyses

Tissue residue analyses will be performed to evaluate if chemicals associated with the site are accumulating in the food chain. Several of the chemicals potentially present at the site are known to bioaccumulate in benthic species to concentrations much higher than those in the surrounding water. Animals feeding on benthic life that has bioaccumulated chemicals could potentially receive high doses of chemicals in food even if concentrations in the surrounding wastes are low or undetectable. The species at greatest risk from such food chain exposure are those near the top of the food chain, including California least terns and brown pelicans, and other species of shorebirds.

The tissue residue analyses will be accomplished by collecting benthic species from the West Beach Landfill wetland area for chemical analyses. Background samples of similar species will also be collected from nearby wetland areas along the bay margin. Whole body chemical concentrations and concentrations in edible tissues will be measured for the human health assessment and will be reported as dry weight. The lipid content and moisture percentage will also be measured. The size and age of the benthic species will be determined.

3.4 Upgradient Monitoring Wells

The one-mile radius from the two landfill sites is shown on Figure 1-3. Monitoring wells are proposed at eleven locations upgradient from the sites within this radius, at the locations shown on Figure 3-3. At each of these locations, a set of two monitoring wells will be installed as described in Section 3.2.3 and shown on Figure 3-8. One soil sample boring will be completed to the bottom of the Merritt Sand Formation at each of these locations prior to monitoring well construction.

Surface soil samples will be collected at the location of each soil boring prior to the set-up of drilling equipment at the location. Soil borings at these locations will also serve for the collection of background soil samples.

Soil and water sampling at these locations will be conducted as described in Sections 3.2.2 and 3.2.4, and as summarized in Tables 3-1 and 3-3.

As required by the SWAT Guidance document, ground water samples will be collected and analyzed on a quarterly basis for four consecutive quarters.

No pressure transducers for measuring tidal influences are proposed for these locations.

In addition to providing wells for determining background water quality, these locations will also aid in determining the ground water flow directions near the vicinity of the landfills.

3.5 Monitoring Program Rationale

3.5.1 Monitoring Well Locations

There is no dispute that hazardous materials have been deposited in the 1943-1956 Disposal Area (Site 1) and the West Beach Landfill (Site 2). While additional information about the nature and quantities of these wastes would be of value, this proposal does not include drilling within the landfill areas. To identify and delineate the interior areas of the landfills, the landfills will be initially characterized using surface geophysical reconnaissance tools, as described in Sections 3.2.1.1 and 3.3.1.1. Summaries of previous sampling within the landfills have been provided in Sections 2.2.1 and 2.2.2, on Figures 2-1 and 2-2, and in Appendix A. It is anticipated that soil borings and/or monitoring wells may be required after the preliminary data from geophysical surveys and perimeter sampling have been evaluated.

Among the materials which were disposed of in the West Beach Landfill was inert ordnance. While there is no evidence to indicate that actual explosives were buried in the landfill, this possibility will be investigated, and chemical analyses for nitrates will be performed. Detection of elevated levels of nitrates will be considered an indicator for the possible presence of explosives, and more specific tests for compounds such as TNT or RDX can be performed as required.

The monitoring program presented in this SWAT proposal has concentrated on determining the types and amounts of any contaminants leaching from the landfill. The sites will be ringed with monitoring wells located just outside the landfill areas to detect emanating plumes. Tidal influence will also be evaluated.

At most of the monitoring well locations a set of two adjacent wells will be installed. The first of these two wells will be screened within the uppermost water bearing zone, and the bottom of this well will be positioned at the top of the bay mud (Figure 3-4).

The second monitoring well will be screened within the upper portion of Merritt Sand Formation or second water-bearing zone underlying the bay mud (Figure 3-5). The bay mud should act as an aquitard between the uppermost water bearing zone and the second water bearing zone. This second deeper well will provide a means of sampling the second water bearing zone separately, because of the sealing of the upper water bearing zone.

As described in Section 3.2.3, a third monitoring well will be installed at a minimum of four of the monitoring well pair locations. This third well will be screened within the lower portion of the second water bearing zone (Figure 3-6).

A minimum of four 4-inch diameter monitoring wells that will be specifically designed for aquifer testing will be installed at locations

along and upgradient of the landfill boundaries. The wells will be screened throughout the second water bearing zone (Figure 3-7).

3.5.2 Hydrogeology at NAS Alameda

3.5.2.1 Regional Geology

The San Francisco Bay region is tectonically dominated by many thrusts, reverse faults, and folds of Pliocene-Quaternary age which exist within what is now a dominant strike-slip environment (Hart, Hirschfeld, and Schulz, 1982).

Subsidence of the structural trough containing San Francisco Bay occurred in the Pleistocene and Holocene epochs, and probably continues today. Uplift and erosion of the Coastal Range during the late Cenozoic time contributed to much of the nonmarine deposits underlying bay mud.

The Franciscan melange, the bedrock underlying the site area, consists of a matrix of sheared rock material containing blocks of various rock types: sandstone, greenstone, chert, and serpentinite. This melange is, in some areas, overlain by metamorphosed volcanic rocks and deposits of chert or sandstone (Rice, Smith, and Strand, 1976).

Covering the Franciscan Assemblage is a veneer of younger, relatively undeformed sedimentary soil formations. These younger sediments range in age from late Cretaceous to Quaternary. These sediments are partially derived from the Franciscan Assemblage and frequently include Franciscan metamorphosed chert as part of their clastic component. Other major components of these sediments originated inland and were carried into the Bay by the Sacramento and San Joaquin Rivers.

The sedimentary formations in the Bay region can be divided into five distinct units. The oldest and deepest of these are the Alameda, San Antonio, and Posey Formations which are dominated by stiff clays but which

also contain layers of silts and sands. These three formations are collectively referred to as Old Bay Clays. Sea level fluctuations of as much as 300 feet, due to as many as three glacial cycles of advance and retreat during the deposition of these Old Bay Clays, resulted in dense consolidation.

Sea level lowering subsequent to the deposition of the Old Bay Clays resulted in erosion of these exposed deposits. The eroded valleys were then largely infilled by the windblown Merritt Sand, which also blanketed many areas between the eroded valleys.

Subsequent to the deposition of the aeolian Merritt Sand Formation, the sea level gradually rose to its present elevation, flooding the Bay and resulting in the deposition of a marine deposit. This marine deposit, also known as Young Bay Mud, covers much of the bay basin to depths of as much as 120 feet, and its deposition continues today.

3.5.2.2 Site Geology

The site lies adjacent to the San Francisco Bay and is underlain by at least part of all five formations, as outlined in Section 3.5.2.1. However the major formations of interest are the artificial fill, the Bay Mud, and the Merritt Sand. A regional geologic map is shown on Figure 3-11. A geologic cross section is shown in Figure 3-12.

3.5.2.2.1 Artificial Fill

The site was claimed from Bay waters by placing fill consisting of refuse, bay mud, and sand. The composition varies from location to location. Because of the source of fill material, it is often difficult to distinguish the fill from the Bay Mud or the Merritt Sand. In most locations the fill is underlain by bay mud.

3.5.2.2.2 Bay Mud

The uppermost natural soil at the site is bay mud, which extends to depths of approximately 25 feet. The Bay Mud Formation is composed of dark gray to olive gray low to moderate organic clay that is frequently water saturated, highly plastic, highly sensitive due to the saline depositional environment, and often has a strong odor. The deposit is generally interlayered with silt and sand lenses.

3.5.2.2.3 Old Alluvial Deposits

Before deposition of the Bay Mud, the sea level was at a much lower elevation. During this period the region received a substantial amount of alluvial and even more aeolian deposition in nonuniform layers. As they exist under this site, these deposits consist of silty clay to clayey sand and are probably part of the Merritt Sand Formation.

3.5.2.2.4 Old Bay Clays

This unit was deposited during several interglacial periods. This unit as it exists under the site probably consists of three commonly known formations: the Posey; the San Antonio; and the Alameda. These deposits range from clayey sand to sandy clay. Because of large fluctuations in sea level, the clay was exposed, resulting in desiccation overconsolidation (Goldman, 1967).

The uppermost layer of Old Bay Clay is the Posey Formation. This layer is generally considered to have the highest degree of overconsolidation and consists of a sandy silty clay with moderately low permeability (Radbruch, 1957).

The San Antonio Formation, which is the middle layer of the Old Bay Clays, is a moderately stiff silty clay. This layer is generally considered to be a competent aquitard between the Merritt Sand Formation and the underlying Alameda Formation (HLA, 1988).

The Alameda Formation, which is the bottom layer of the Old Bay Clays, is generally considered an aquifer. It consists of green to gray sand, sandy clay, and clay with some fine gravel. The sand and sandy clay alternate in distinct continuous members. The lowest part of this formation is possibly continuous with the Santa Clara Formation in the South Bay (HLA, 1988).

3.5.2.2.5 Franciscan Bedrock

Bedrock under the site is comprised of an assemblage of altered volcanics, meta-sandstones and a melange of sandstone, shale, chert, and sepentinite of the Franciscan Assemblage as outlined in Section 3.5.2.1. These rocks have a low moisture content and have been highly sheared.

The Franciscan Assemblage outcrops at Yerba Buena Island and exists at a depth of approximately 500 feet below the site as indicated in the log of the Pan Am Well (Figure 3-10).

3.5.2.3 Hydrogeology

Three water bearing units are located beneath NAS Alameda: The shallow artificial fill, the Merritt Sand, and the Alameda Formation. The artificial fill and the Merritt Sand are separated by a layer of the Bay Mud approximately 25 feet thick, but perhaps as thick as 70 feet on the western edge of the site. The Merritt Sand and Alameda Formations are separated by the San Antonio and Posey Formations with a total thickness beneath the site of as much as approximately 250 feet.

Due to the large thickness of aquitard underlying the Merritt Sand, the Old Bay Clays will not be investigated at this time. All monitoring wells to be installed will investigate the water quality and aquifer properties in the Merritt Sand or the artificial fill.

Monitoring wells to be installed in the artificial fill are expected to be screened from 1 foot above the highest tide to an elevation between -5 feet and -10 feet relative to mean sea level. In addition, those wells to be installed in the Merritt Sand are expected to be screened between an elevation of -40 feet and -100 feet.

Based upon the information gathered from these monitoring wells to be installed, the final SWAT report will include aquifer properties, piezometric heads, water quality data, and a more accurately defined cross section of the various geologic contact layers.

4.0 SOLID WASTE ASSESSMENT MONITORING PROPOSAL: CHEMICAL ANALYSES

The monitoring plan proposed for the SWAT program is based upon information that has been obtained from previous site investigations. These investigations have included chemical analyses of soil and water samples from the sites, surveys of the limited written records available, and interviews with long-term site personnel.

These previous studies enable the SWAT program to be targeted to site-specific parameters. This information indicates that the parameters required in the SWAT Guidance document (SWRCB, 1988) should be broadened to include additional analyses.

As discussed in Section 1.0, this SWAT proposal is also designed to serve as the sampling plan for the two landfill sites under the RI/FS program for NAS Alameda which is under preparation. Therefore, the program of sampling analysis which is proposed must also be planned to generate data useful during the formulation of remedial measures for confirmed sites. Accordingly, this proposal specifies the soil and ground water tests necessary to support formulation of remedies within the general response actions described in Volume 1 of the RI/FS Work Plan (Canonie, 1988a). The data generated are directly related to engineered solutions. Data needs have been identified consistent with the EPA guidance document, "Data Needs for Selecting Remedial Action Technologies" (EPA, 1987d).

The sample types and analyses proposed for the sites are listed in Tables 3-1 and 3-2. The methods of analysis are listed in Table 3-3. These methods meet the requirements of the SWAT Guidance document.

5.0 BACKGROUND WATER QUALITY

5.1 Well Location

Background water quality data based upon quarterly upgradient well sampling data is unavailable. Several wells exist (Figure 5-1) from which it may be possible to develop background data from a future monitoring program. It will be necessary to obtain ground water samples from the water-bearing zones overlying and underlying the bay mud layer.

Sampling of the deeper water bearing zone may be possible at the Pan American Well (Well BG-1, Figure 5-1). This is a 500-foot deep well located approximately 1,500 feet east of the 1943-1956 Disposal Area. This well is out of service, but it may be feasible to reactivate the well for sampling. Assuming that the deeper water bearing zone gradient is coincident with the general gradient of the uppermost water bearing zone (ie, ground water flow is in a westerly direction), this well is suitably located for background analysis of water migrating into the landfill sites.

Another well, shown on the Alameda County well inventory as Well 2S/4W,3E1, also known as the Army Well, is located approximately 8,000 feet east of the West Beach Landfill (Well BG-2, Figure 5-1). This well is 353 feet deep and its water is presently used for landscape irrigation.

The well shown on the Alameda County inventory as 2S/4W,3F1 is located east of the Army Well and approximately 9,500 feet east of the West Beach Landfill (Well BG-3, Figure 5-1). This well is 376 feet deep and is abandoned; therefore its use as a background sample source is uncertain.

Background water sampling of the uppermost water bearing zone may be performed from two existing monitoring wells located approximately 1,200 and 6,200 feet east of the West Beach Landfill (Wells BG-4 and BG-5, Figure 5-1). These two wells are 9 and 13 feet deep, respectively. It is

uncertain whether the closer of these two wells is still in existence. The more distant of these two wells is located within 100 feet of the Oakland Inner Harbor waterfront, and the samples may not be representative of the quality of water entering the landfill.

In addition to these existing wells, new monitoring wells have been proposed in Section 3.4 at eleven locations within the one-mile radius. Descriptions of these wells are provided in Section 3.2.3. These new wells will also provide data on background water quality.

5.2 Sampling and Testing

Background water samples will be taken quarterly from each well where sampling is possible and judged suitable to represent background conditions. During each quarterly sampling event, at least one sample will be taken from each well and a minimum of four samples will be taken from the system. A separate analysis will be conducted on each sample.

Background samples will be tested for the same chemical constituents as the samples taken from well locations at the landfill perimeters (Tables 3-1 and 3-2).

6.0 UNSATURATED ZONE MONITORING

The SWAT Guidance document requires that the monitoring program be designed to detect waste constituents which may escape from waste sites before such constituents reach ground water, and therefore requires that the monitoring program include an unsaturated zone monitoring system (SWRCB, 1988). Elsewhere, however, the guidance document notes that where justified by a qualified opinion and the concurrence of the local RWQCB, some of the monitoring requirements may be waived, and specific mention is made of the example of no vadose zone at the site.

There is no unsaturated zone below the two landfills at NAS Alameda. The ground water surface is located only a few feet below the ground surface and is above the bottoms of the landfills. This estimate is based on water level data and estimates of the base of fill beneath the 1943-1956 Disposal Area (Wahler, 1985, Table 1) and the West Beach Landfill (HLA1, 1978, Table 3). The elevation of the ground water surface is maintained by the immediate proximity of the open water surface of San Francisco Bay.

Based on these considerations, no unsaturated zone monitoring program is being proposed.

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TABLES

FINAL SAMPLING PLAN
SOLID WASTE ASSESSMENT TEST (SWAT)
PROPOSAL ADDENDUM

DATED 01 FEBRUARY 1990

TABLE 3-1

SAMPLE TYPES AND ANALYSES/RATIONALE FOR 1943-1956 DISPOSAL AREA

Sample Matrix	Analysis	Rationale
Soils		
Surface Soil Samples	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Metals	Scrap metals
	Gross Alpha and Beta	Radiological waste
	RADIUM ~~U226~~ and ~~U228~~	Radiological waste
	Gradation	Disposal Treatment Isolation
	Permeability	Describe fate and transport
Split Spoon Samples	VOA	Solvents/cleaning compounds
	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Metals	Scrap metals
	Gross Alpha and Beta	Radiological waste
	RADIUM ~~U226~~ and ~~U228~~	Radiological waste
	Asbestos	
	Mercury	
	pH	
	TOC	
Thin-Walled Tube Samples	Gradation	Disposal Treatment Isolation
	Atterberg limits	Disposal Treatment Isolation
	Modified Proctor compaction	Evaluate disposal options
	Water content/Dry density	Affects treatment method
	Specific gravity	Indicates density
	One-dimensional consolidation	Evaluate disposal options
	Permeability	Describe fate and transport
Ground Water	VOA	Solvents/cleaning compounds
	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Oil and Grease	Waste oils
	Metals	Scrap metals
	Mercury	Detected in Pan Am well
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
	Chemical oxygen demand (COD)	Likely that significant chemical concentrations exist
	Asbestos	Building construction waste
	General Minerals	Evaluate potable water and sea water intrusion
	Chloride	Indicator parameter
	Nitrate	Indicator parameter
	Fluoride	Indicator parameter
	Cyanide	Indicator parameter
	Hardness	Affects treatment method

TABLE 3-1

SAMPLE TYPES AND ANALYSES/RATIONALE FOR 1943-1956 DISPOSAL AREA
(Continued)

Sample matrix	Analysis	Rationale
Ground Water (Continued)	Alkalinity	General treatment information
	Total dissolved solids (TDS)	General treatment information
	Total organic carbon (TOC)	Evaluate treatment options
	Dissolved oxygen	Describe fate and transport
	Acidity	General treatment information
	Specific conductance	Describe fate and transport
	Temperature	Indicator parameter
	pH	Indicator parameter
	Salinity	Indicator parameter
Air	VOA	Solvents/cleaning compounds
	BNA extractables	Paints
	Metals	Scrap metals

Note: VOAs will only be analyzed in split spoon samples obtained below surface soils.

TABLE 3-2

SAMPLE TYPES AND ANALYSES/RATIONALE FOR WEST BEACH LANDFILL

Sample Matrix	Analyses	Rationale
Soils		
Surface Soil Samples	BNA extractables	Paints
	Pesticides/PCBs	Waste oils
	Metals	Scrap metals
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
	Gradation	Disposal Treatment Isolation
	Permeability	Describe fate and transport
Split Spoon Samples	VOA	Paint strippers
	BNA extractables	Paint strippers
	Pesticides/PCBs	Pesticides/PCB waste oil
	Metals	Industrial waste
	Gross Alpha and Beta	Radiological waste
	U226 and U228	Radiological waste
	Asbestos	
	Mercury	
	pH	
	TOC	
Thin-Walled Tube Samples	Gradation	Disposal treatment isolation
	Atterberg Limits	Disposal treatment isolation
	Modified Proctor compaction	Evaluate disposal options
	Water content/Dry density	Affects treatment method
	Specific gravity	Indicates density
	One-dimensional consolidation	Evaluate disposal options
	Permeability	Describe fate and transport
Ground Water	VOA	Paint strippers
	BNA extractables	Paint strippers
	Pesticides/PCBs	Pesticides/PCB waste oil
	Oil and Grease	Waste oils
	Metals	Industrial Waste
	Mercury	Detected in Pan Am well
	Gross Alpha and Beta	
	Asbestos	
	Cyanide	
	Chemical oxygen demand (COD)	Indicator parameter
	General Minerals	Evaluate potable water and sea water intrusion
	Chloride	Indicator parameter
	Nitrate	Indicator parameter
	Hardness	Affects treatment method
	Alkalinity	General treatment information
	Total dissolved solids (TDS)	General treatment information
	Total organic carbon (TOC)	Evaluate treatment options

TABLE 3-2

SAMPLE TYPES AND ANALYSES/RATIONALE FOR WEST BEACH LANDFILL
(Continued)

Sample Matrix	Analyses	Rationale
Ground Water (Continued)	Acidity	General treatment information
	Specific conductance	Describe fate and transport
	Temperature	Indicator parameter
	pH	Indicator parameter
	Salinity	Indicator parameter
	Dissolved oxygen	Describe fate and transport

Note: VOAs will only be analyzed in split spoon samples obtained below surface soils.

TABLE 3-3

SAMPLE TYPES AND ANALYSES/RATIONALE FOR WEST BEACH LANDFILL WETLAND AREA

Sample Matrix	Analyses	Rationale
Sediment	VOA BNA extractables Metals Pesticides/PCBs Oil and grease TOC Bioassays Bioaccumulation studies	To determine the potential risks to wildlife population that live or feed in wetland areas
Surface Water	VOA BNA extractables Metals Pesticides/PCBs Oil and grease General minerals Hardness Salinity pH TOC Dissolved oxygen	To determine the potential risks to wildlife population that live or feed in wetland areas
Benthic Species	VOA BNA extractables Pesticides/PCBs Metals	Due to the hazardous character of the waste streams entering the lagoon

Notes:

1. VOA indicates volatile organic analysis.
2. BNA indicates base, neutral, and acid.
3. TOC indicates total organic carbon.

TABLE 3-4

ANALYTICAL METHODS

Chemical Class	Matrix	Method	Reference
Volatile Organics	Water	624 (Initial only)	(1)
		601	(2)
	Soil	8240 (Initial only)	
		8010	
Base/Neutrals and Acid Extractables	Water	625 (Initial only)	(1)
		602	(2)
	Soil	8270 (Initial only)	
		8020	
Pesticides/PCBs	Water	608	(1)
	Soil	8080	(2)
Oil and Grease	Water	413.1	(4)
Metals (except Mercury and Selenium)	Water	200.7	(4)
	Soil	6010	(2)
Mercury	Water	245.1	(4)
	Soil	7471	(2)
Selenium	Water	270.2	(4)
	Soil	7740	(2)
Gross Alpha & Beta Radioactivity	Water	900.0	(5)
	Soil	9310	(2)
Uranium 226 and 228	Water	706/7	(5)
	Soil	706/7	(5)
Cyanide	Water	335.3	(4)
COD	Water	410.1	(4)
Chloride	Water	300	(6)

TABLE 3-4

ANALYTICAL METHODS

Chemical Class	Matrix	Method	Reference
Fluoride	Water	340.2	(4)
Nitrate	Water	300	(6)

Notes:

1. Federal Register, Vol. 49, No. 209, Friday, October 26, 1984.

2. SW-846, Test Methods for Evaluating Solid Waste, 3rd Edition, U.S. EPA, Office of Solid Waste and Emergency Response, Washington, DC, July 1982. Revised November 1986.

3. Standard Methods for the Examination of Waste and Wastewater, American Public Health Association, Washington, DC, 16th Edition.

4. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, U.S. EPA, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979. Revised March 1984.

5. Prescribed Procedures for the Measurement of Radioactivity in Drinking Water, EPA 600/4-80-032, U.S. EPA, Environmental Monitoring and Support Laboratory, Las Vegas, 1982.

6. Test Methods, The Determination of Inorganic Anions in Water by Ion Chromatography - Method 300, U.S. EPA, 600/4-84-017, March 1984.

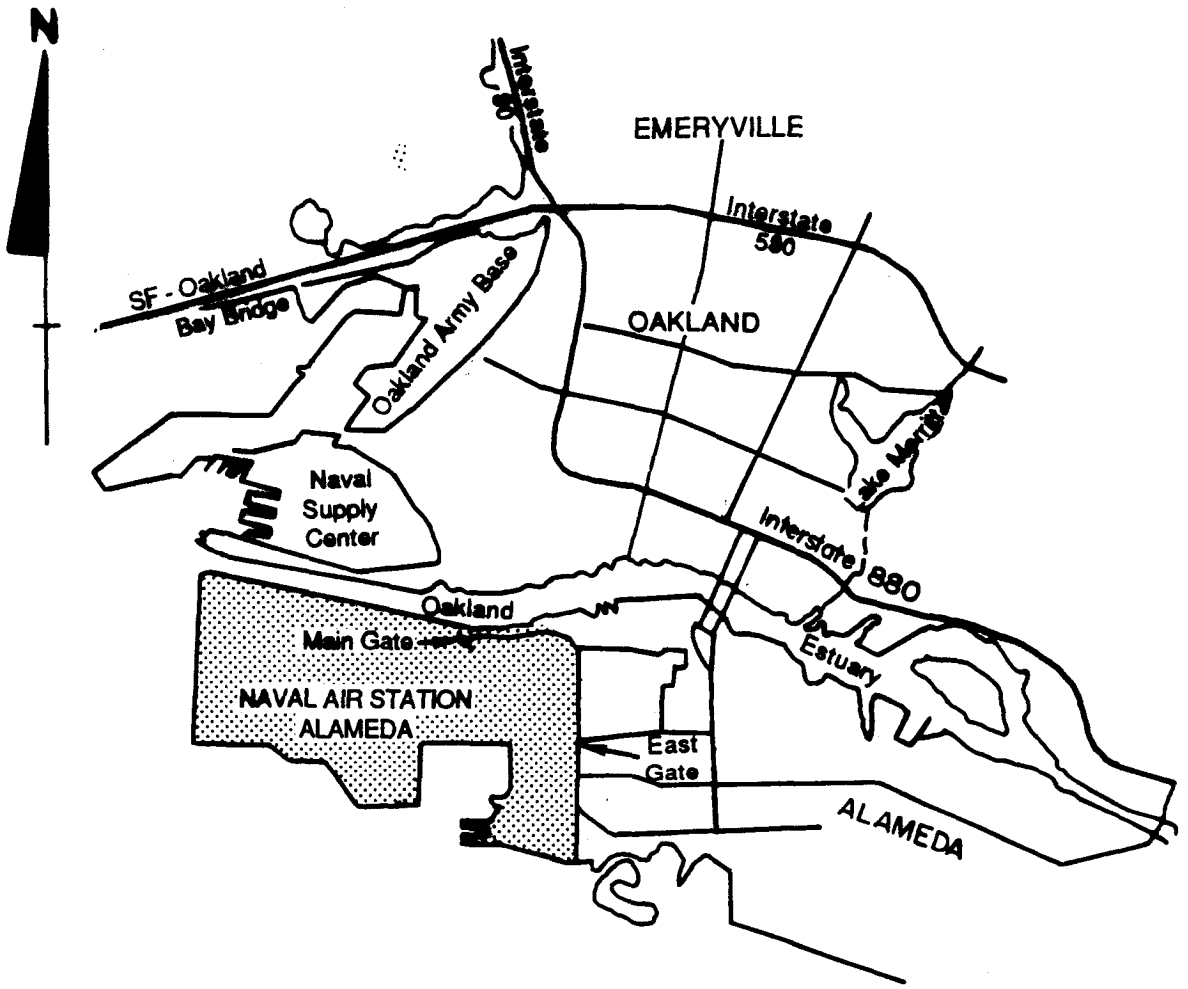
N00236.000786
ALAMEDA POINT
SSIC NO. 5090.3

FIGURES

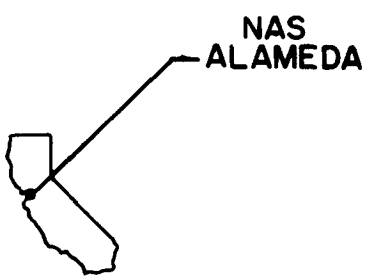
FINAL SAMPLING PLAN
SOLID WASTE ASSESSMENT TEST (SWAT)
PROPOSAL ADDENDUM

DATED 01 FEBRUARY 1990

113525



SITE LOCATION



SCALE

6000 0 6000 FEET

SITE LOCATION PLAN
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

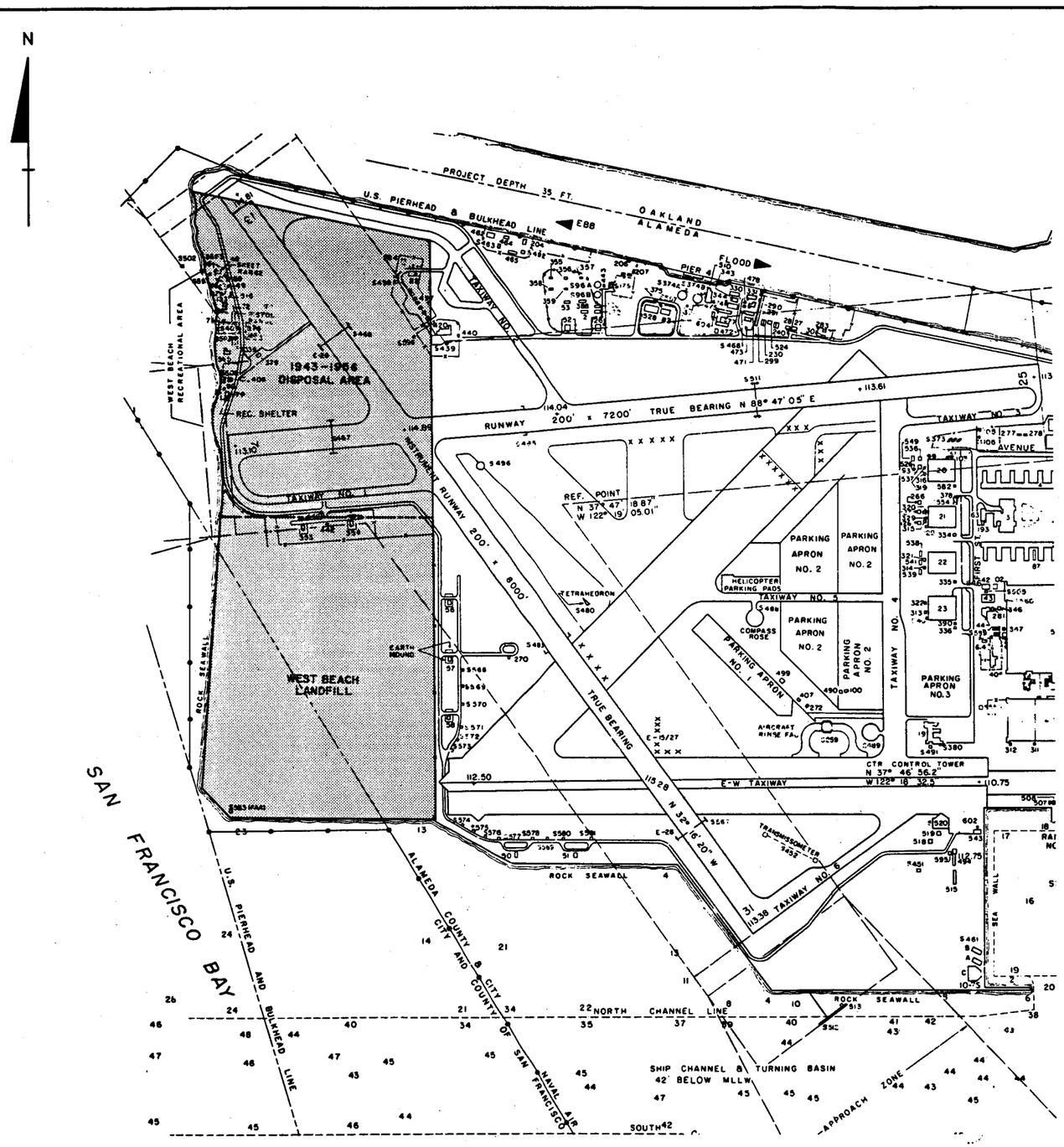
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

CanonieEnvironmental

DATE: 5-4-88	FIGURE 1-1	DRAWING NUMBER
SCALE: AS SHOWN		86-018-A1

REVISIONS	NO.	DATE	DRAWN BY	LEH	5-4-88	CHECKED BY	APPROVED BY	10-25-88	DRAWING NUMBER	86-018-A1



REFERENCE:
U.S. NAVY MAP

SCALE
500 0 500 1,000 FEET

SITE PLAN
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

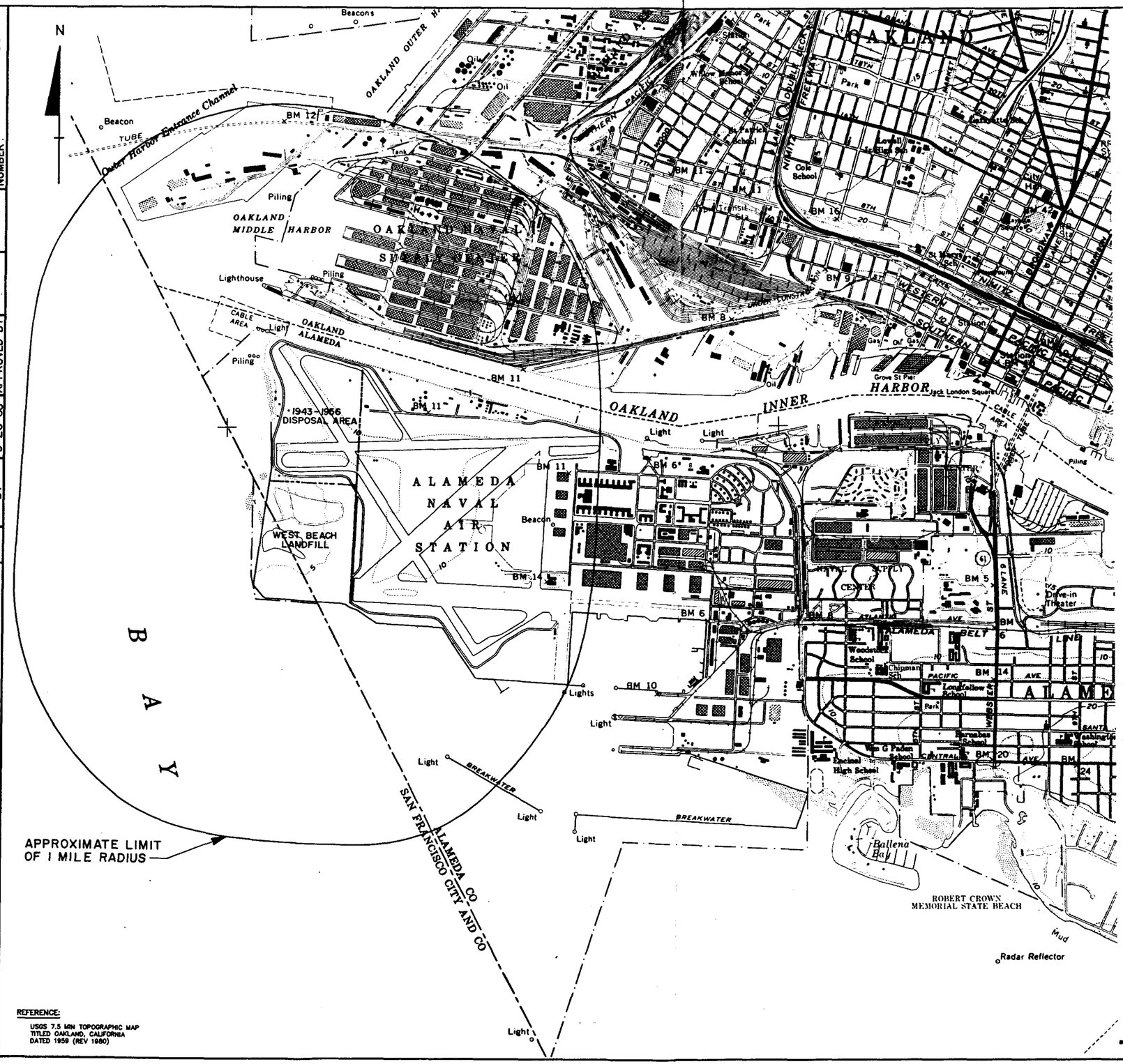
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

Canonie Environmental

DATE: 9-14-88	FIGURE 1-2	DRAWING NUMBER 86-018-E19
SCALE: AS SHOWN		

REVISIONS	NO.	DATE	DRAWN BY	LEA 9-14-88	CHECKED BY		DRAWING NUMBER 86-018-E19
					APPROVED BY		



REFERENCE:
USGS 7.5 MIN TOPOGRAPHIC MAP
TITLED OAKLAND, CALIFORNIA
DATED 1959 (REV 1980)

TOPOGRAPHIC MAP WITH 1 MILE RADIUS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

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NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

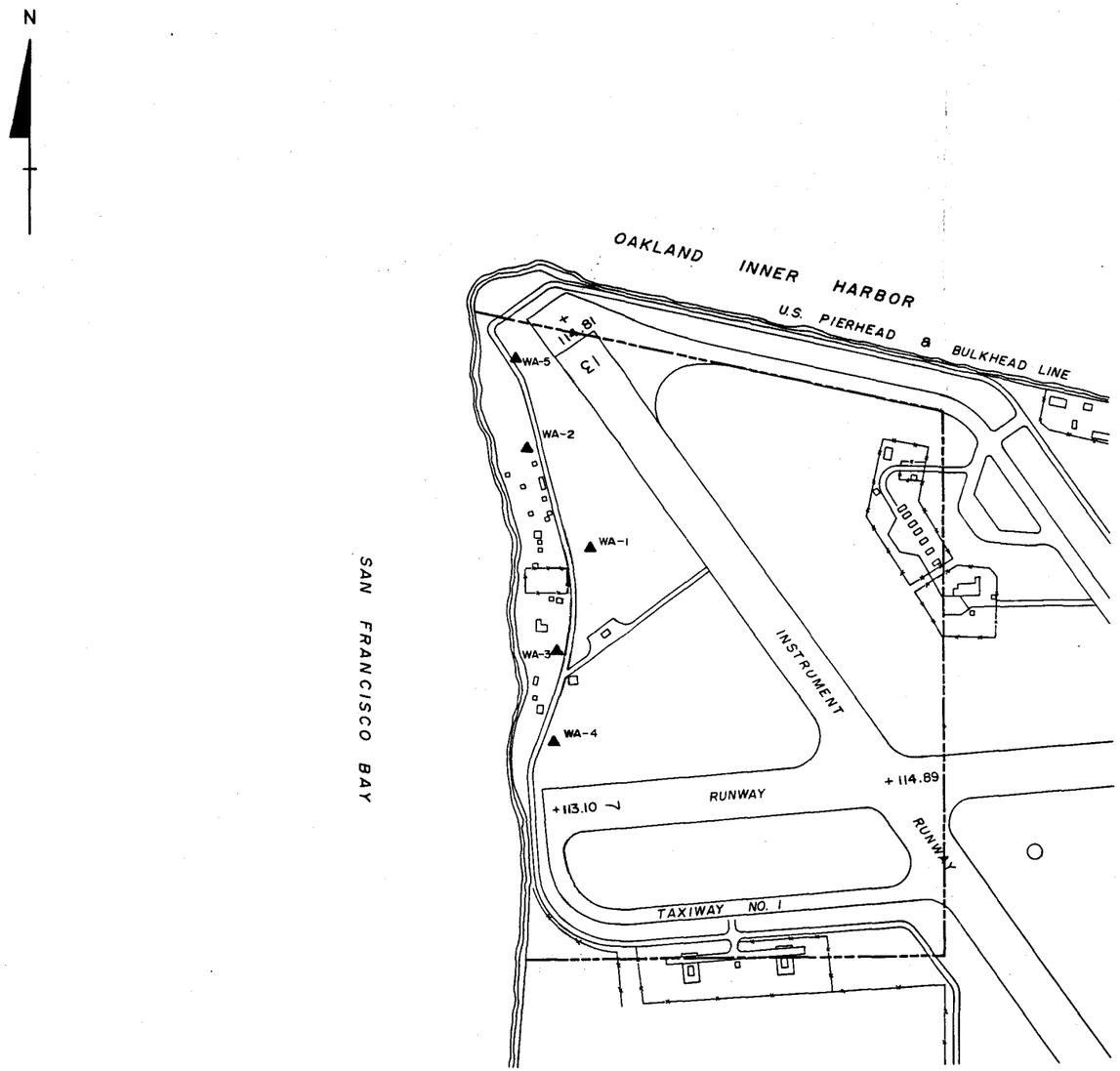
Canonie Environmental

DATE: 9-20-88	FIGURE 1-3	DRAWING NUMBER 86-018-E26
SCALE: AS SHOWN		

REVISIONS	NO.	DATE

DRAWN BY	LEA	9-20-88
CHECKED BY	CCW	10-25-88
APPROVED BY		

DRAWING NUMBER 86-018-E26



LEGEND:

▲ EXISTING WELL LOCATIONS (WAHLER, 1985)

------ LIMIT OF DISPOSAL AREA

SCALE

300 0 300 600 FEET

EXISTING WELL LOCATIONS
1943-1956 DISPOSAL AREA
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

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SAN BRUNO, CALIFORNIA

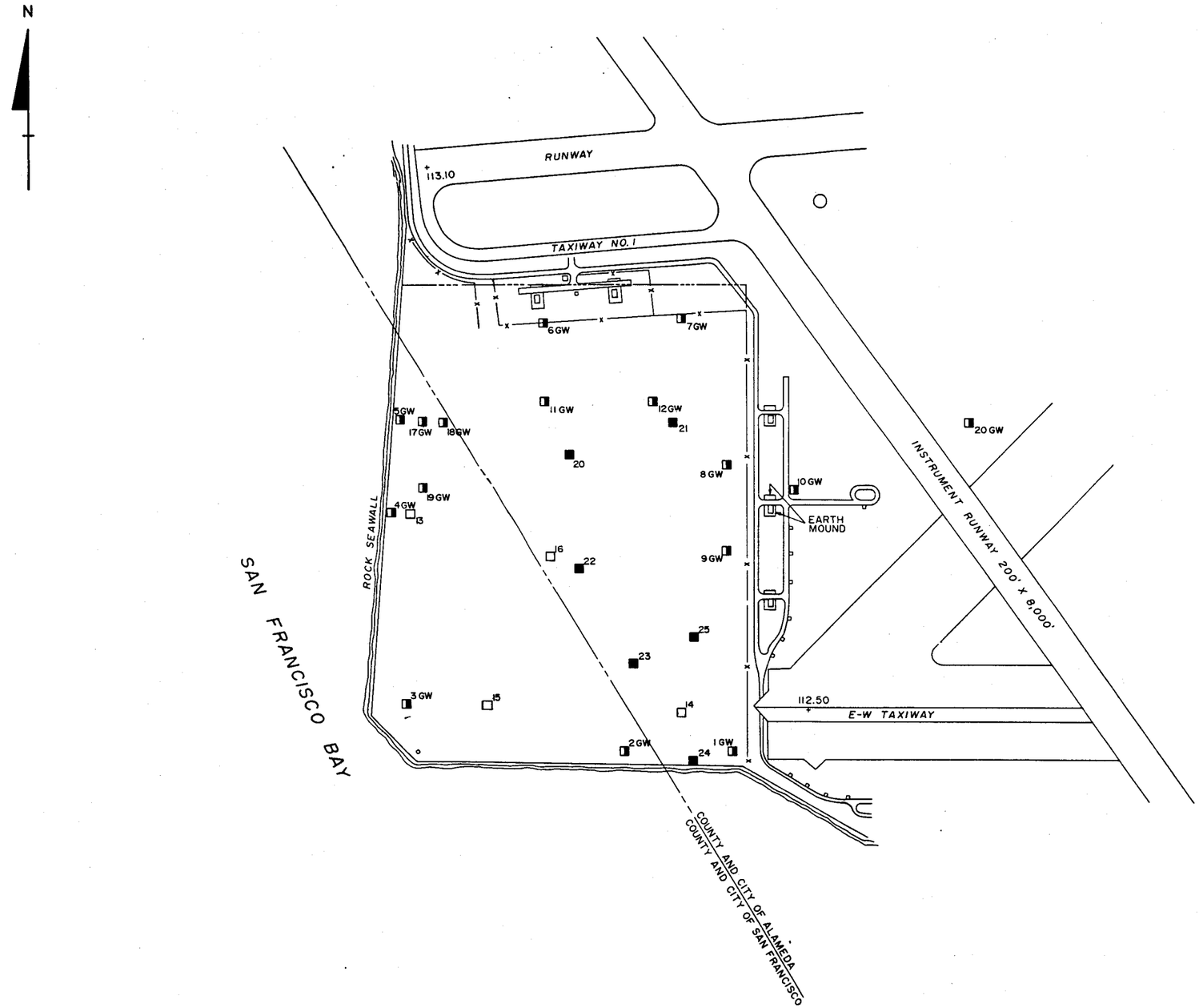
Canonie Environmental

DATE: 9-19-88 SCALE: AS SHOWN	FIGURE 2-1	DRAWING NUMBER 86-018-E23

DRAWN BY	VZC 9-19-88	CHECKED BY	CCW	10-25-88	DRAWING NUMBER 86-018-E23
		APPROVED BY			

REVISIONS

NO.	DATE



LEGEND:

- ☐ EXISTING TEST BORING DRILLED WITH HAND AUGER (HLA, 1978)
- ◧ EXISTING TEST BORING DRILLED WITH TRUCK-MOUNTED RIG CONVERTED TO OBSERVATION WELLS (HLA, 1978)
- ■ EXISTING MONITORING WELL LOCATION (HLA, 1983)

SCALE
300 0 300 600 FEET

EXISTING BORING LOCATIONS
WEST BEACH LANDFILL
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-16-88	FIGURE 2-2	DRAWING NUMBER 86-018-E21
SCALE: AS SHOWN		

REVISIONS	NO.	DATE

DRAWN BY	J. WADE 9-16-88	CHECKED BY	CCW	10-25-88	DRAWING NUMBER 86-018-E21
		APPROVED BY			

REFERENCE:

U.S.G.S., CALIFORNIA
SAN FRANCISCO QUADRANGLE,
EDITION OF JUNE 1915, REPRINTED 1947.

PORTION OF U.S.
GEOLOGIC SURVEY MAP, 1915
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

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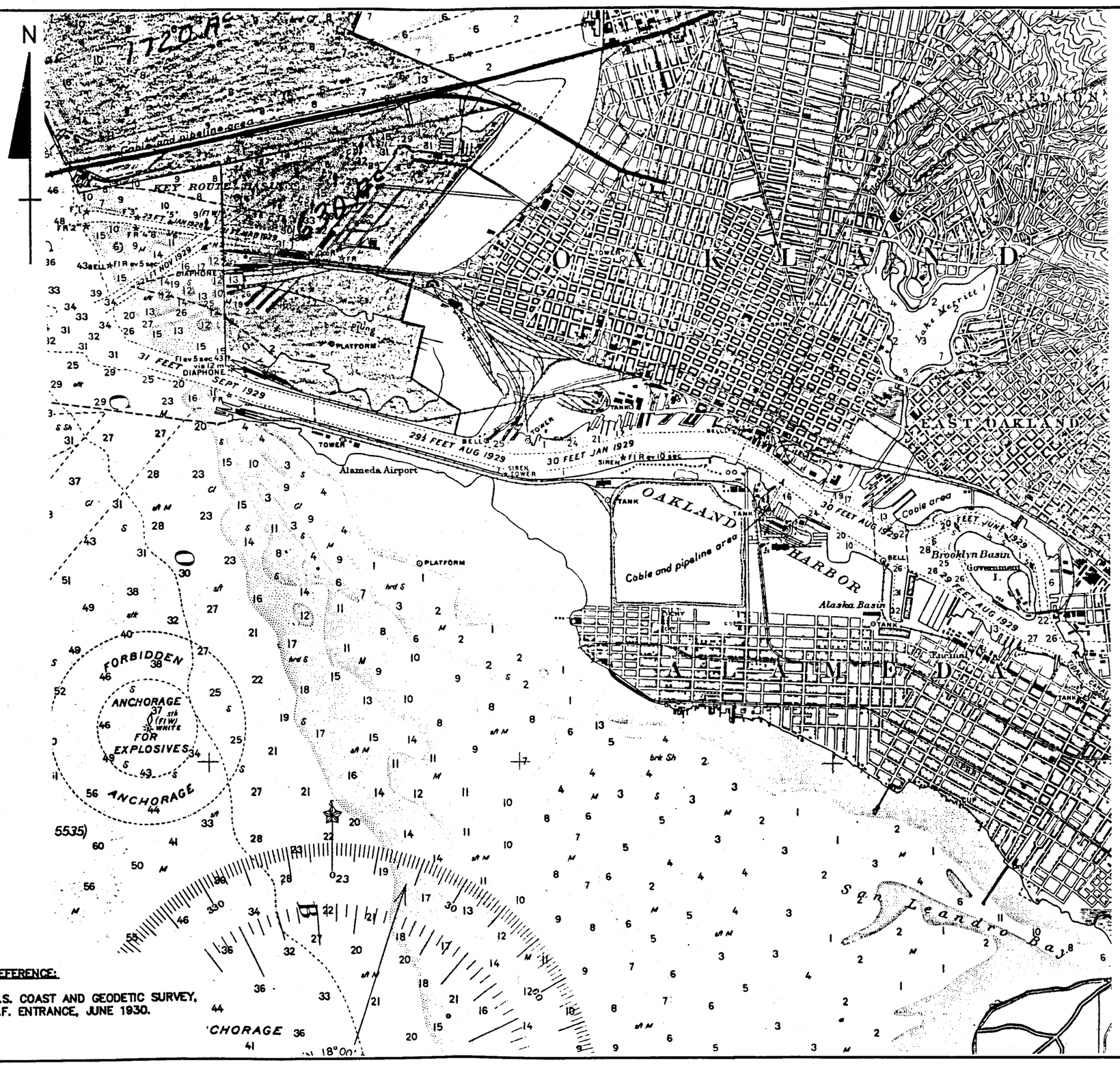
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-27-88	FIGURE 2-3	DRAWING NUMBER
SCALE: NTS		86-018-B36

REVISIONS	NO.	DATE	DRAWN BY	BJH	9-27-88	CHECKED BY	CCW	10-25-88	DRAWING NUMBER	86-018-B36
						APPROVED BY				



REFERENCE:

U.S. COAST AND GEODETIC SURVEY, S.F. ENTRANCE, JUNE 1930.

PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1930
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

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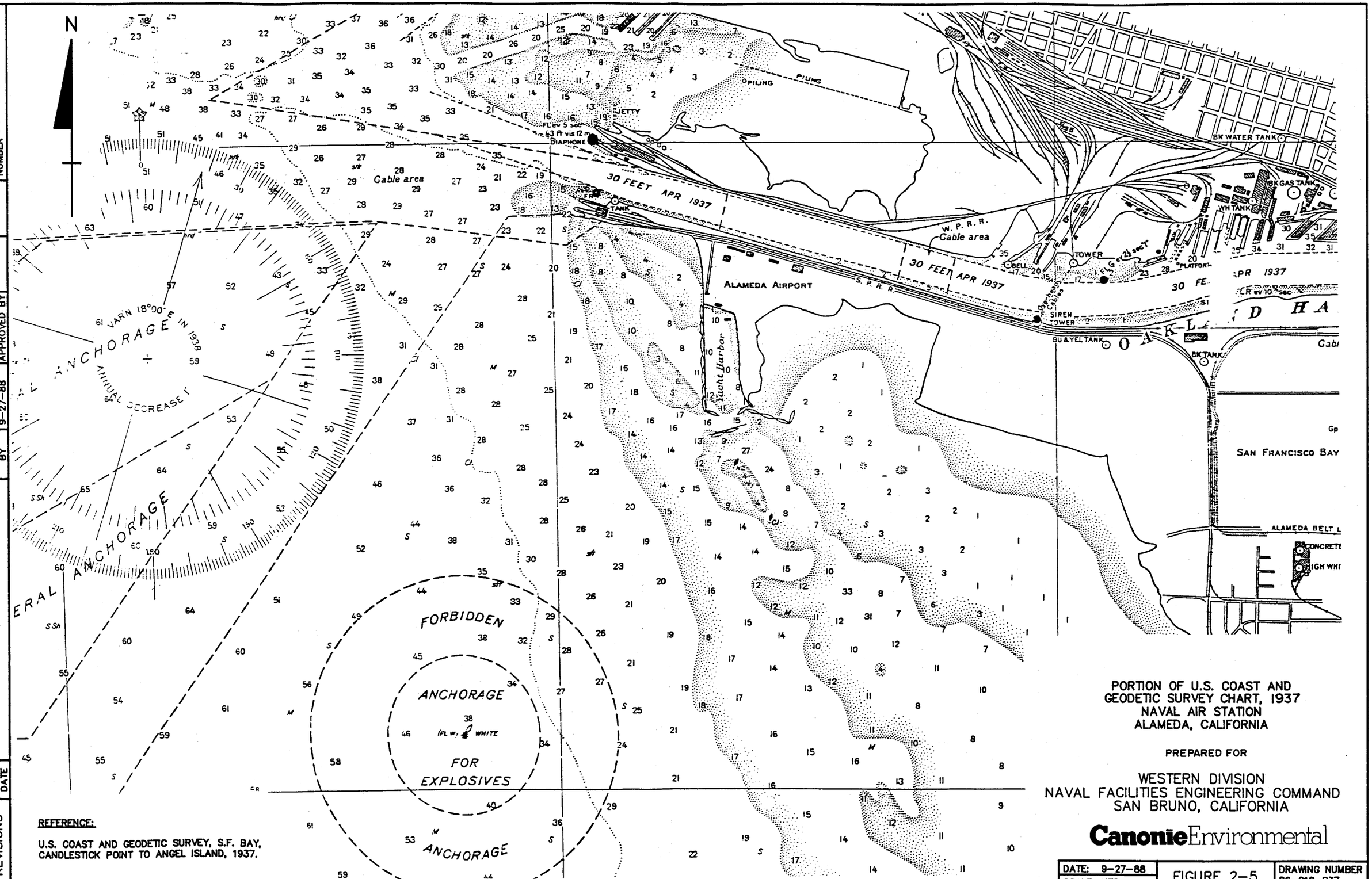
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-27-88	FIGURE 2-4	DRAWING NUMBER 86-018-B34
SCALE: NTS		

REVISIONS	NO.	DATE	DRAWN BY	BJH	CHECKED BY		DRAWING NUMBER 86-018-B34
				9-27-88	APPROVED BY		



REFERENCE:

U.S. COAST AND GEODETIC SURVEY, S.F. BAY, CANDLESTICK POINT TO ANGEL ISLAND, 1937.

PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1937
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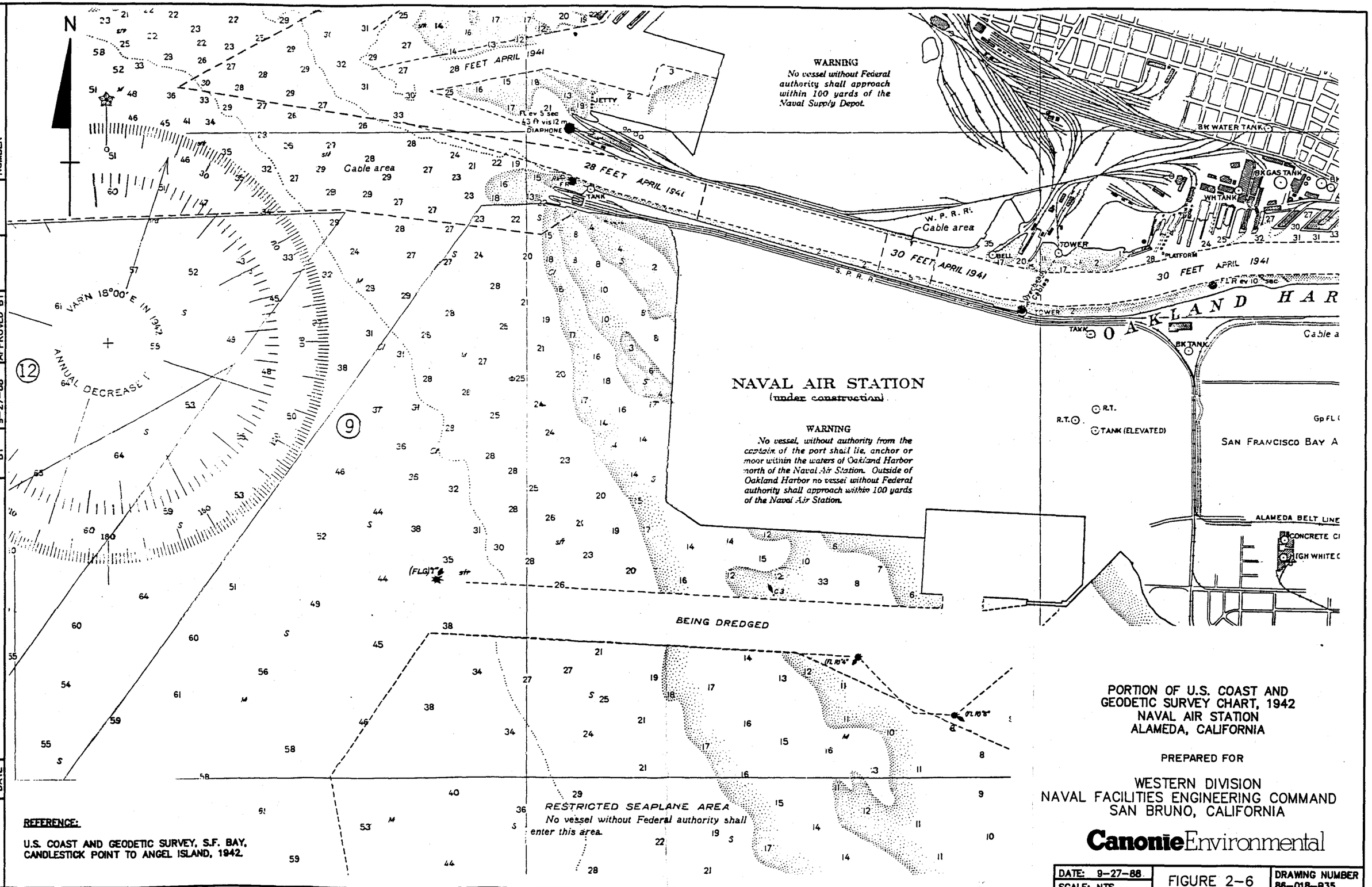
Canonie Environmental

DATE: 9-27-88	FIGURE 2-5	DRAWING NUMBER 86-018-B37
SCALE: NTS		

DRAWN BY	BJH 9-27-88	CHECKED BY	CCM	DRAWING NUMBER	86-018-B37
		APPROVED BY			

REVISIONS	NO.	DATE



REFERENCE:

U.S. COAST AND GEODETIC SURVEY, S.F. BAY, CANDLESTICK POINT TO ANGEL ISLAND, 1942.

PORTION OF U.S. COAST AND GEODETIC SURVEY CHART, 1942
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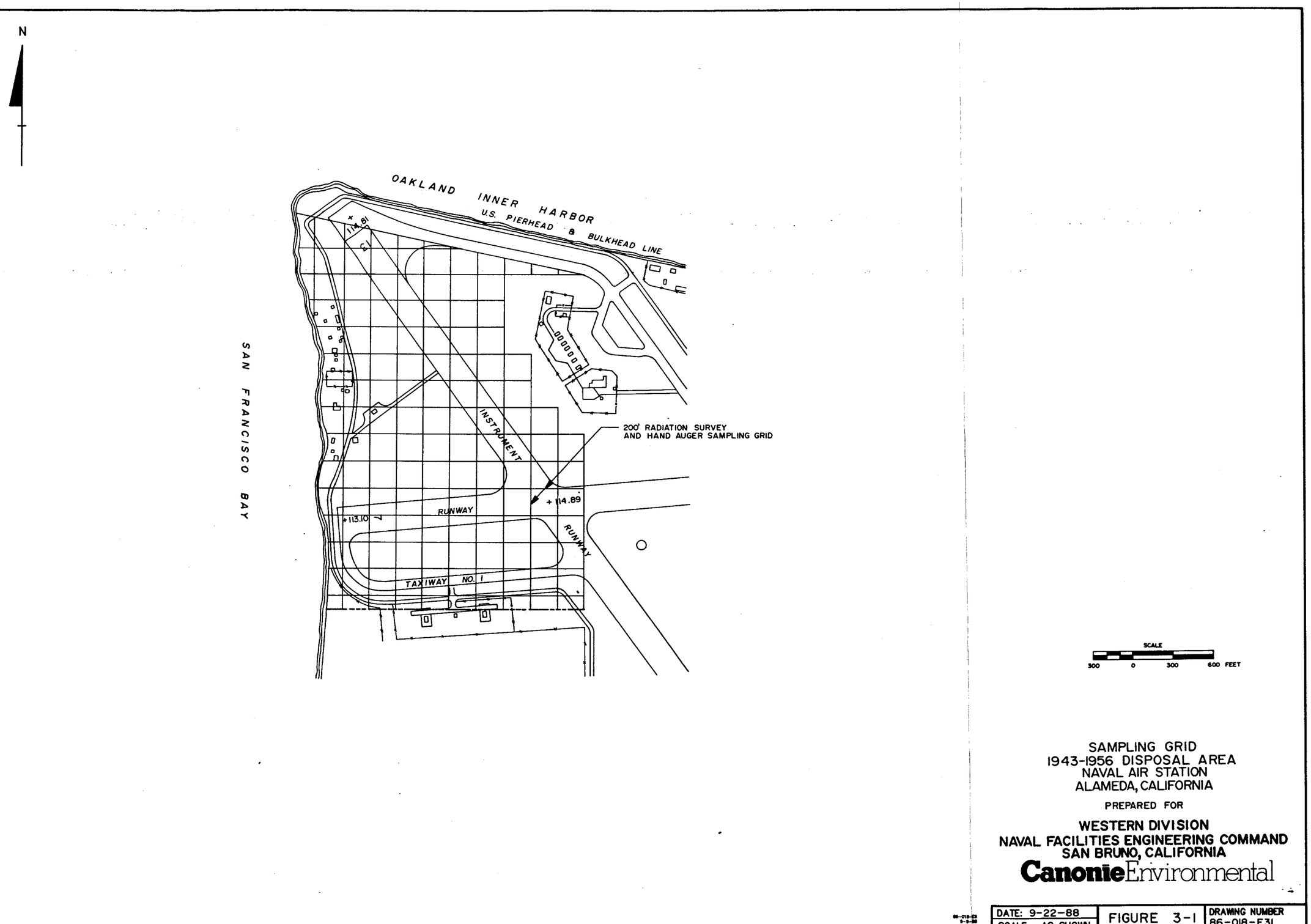
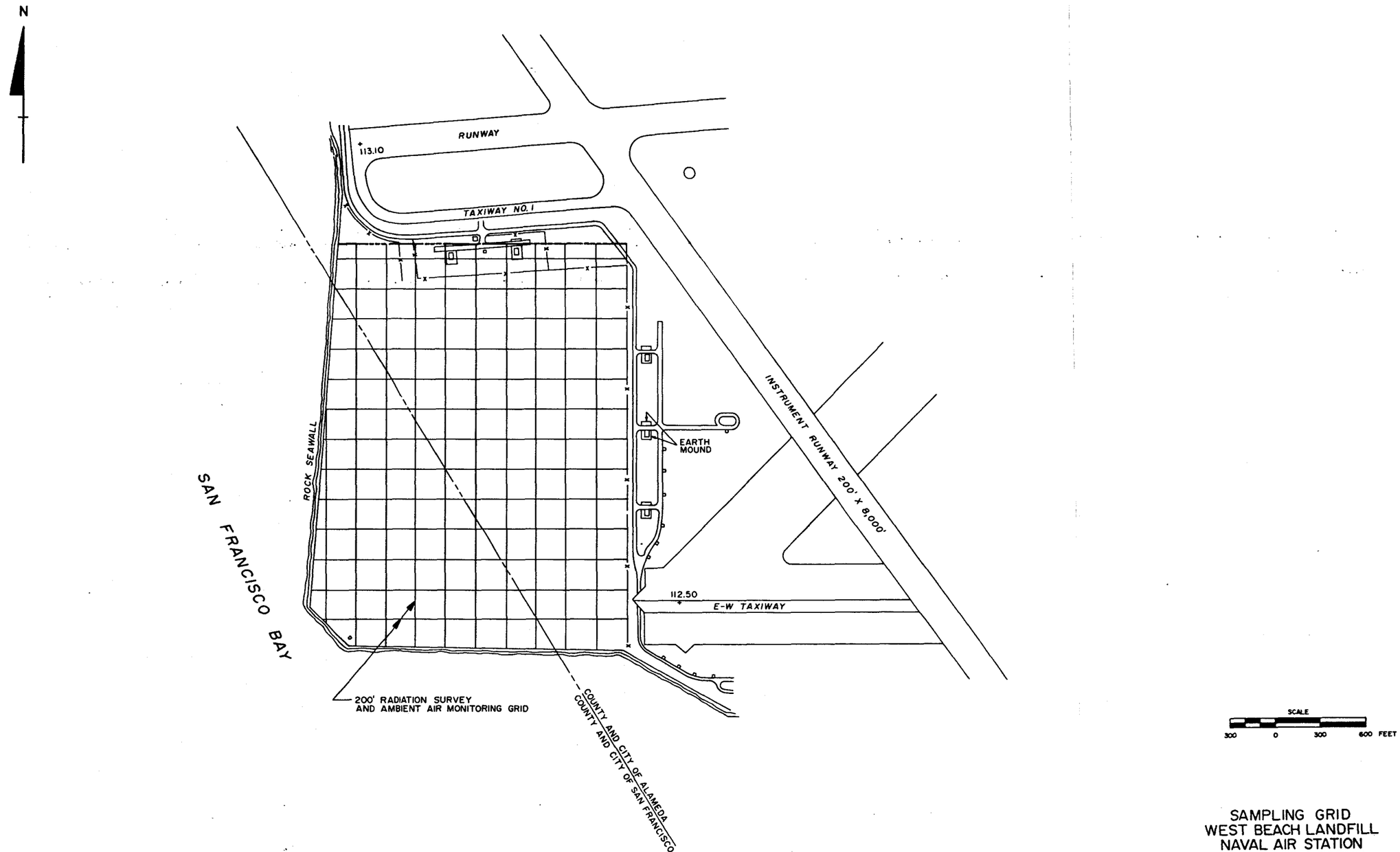
CanonieEnvironmental

DATE: 9-27-88	FIGURE 2-6	DRAWING NUMBER
SCALE: NTS		86-018-B35

DRAWN BY	BJH	CHECKED BY		DRAWING NUMBER	86-018-B35
	9-27-88	APPROVED BY			

NO.	DATE	REVISIONS


N
OAKLAND INNER HARBOR
U.S. PIERHEAD & BULKHEAD LINE
SAN FRANCISCO BAY
INSTRUMENT
RUNWAY
RUNWAY
TAXIWAY NO. 1
+113.10
+114.89
200' RADIATION SURVEY
AND HAND AUGER SAMPLING GRID
SCALE
300 0 300 600 FEET
SAMPLING GRID
1943-1956 DISPOSAL AREA
NAVAL AIR STATION
ALAMEDA, CALIFORNIA
PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA
CanonieEnvironmental
DATE: 9-22-88
SCALE: AS SHOWN
FIGURE 3-1
DRAWING NUMBER
86-018-E31
DRAWN BY VZC 9-22-88
CHECKED BY
APPROVED BY
DRAWING NUMBER 86-018-E31
REVISIONS
NO.
DATE



SAMPLING GRID
WEST BEACH LANDFILL
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

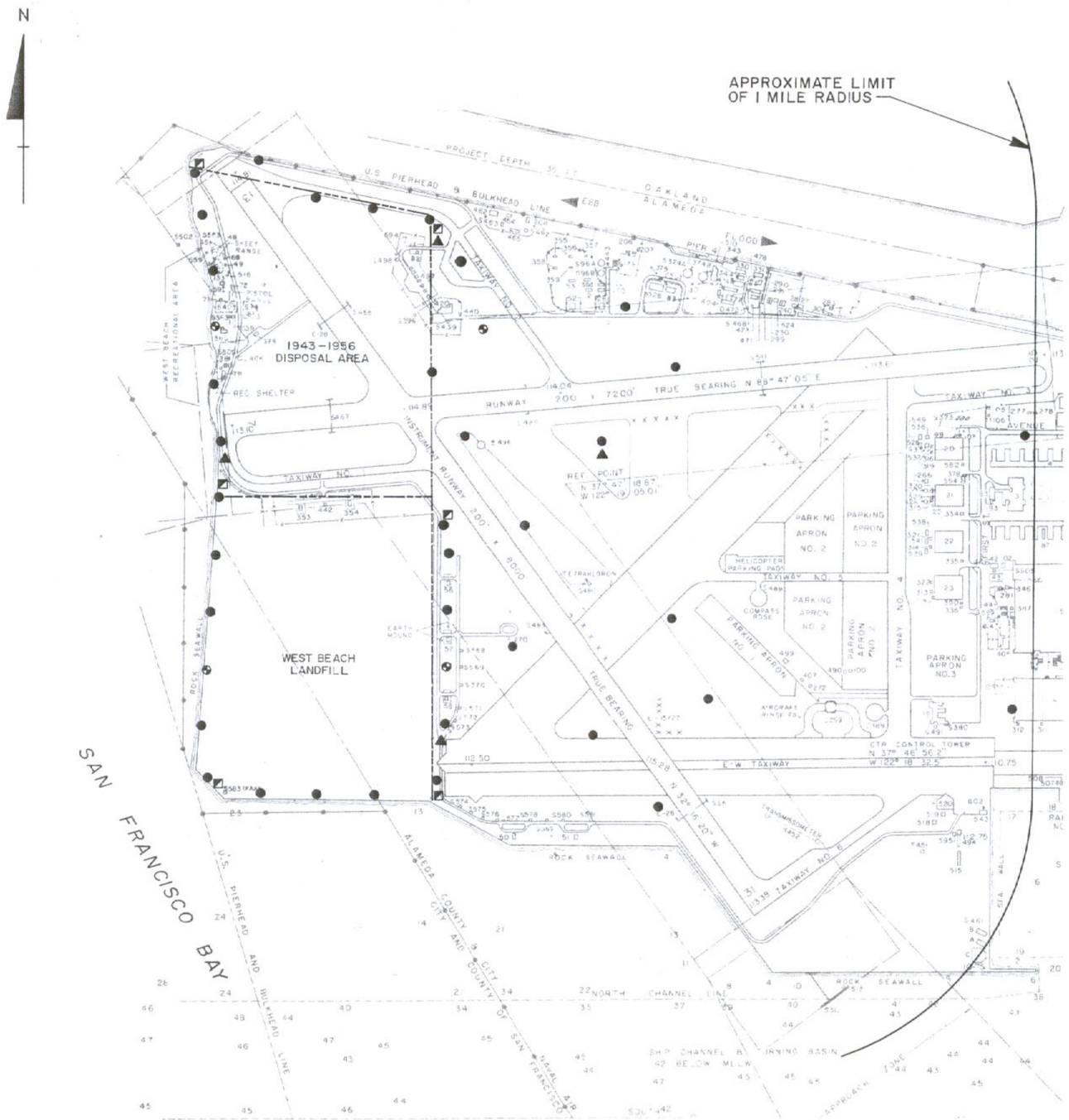
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-22-88 SCALE: AS SHOWN	FIGURE 3-2	DRAWING NUMBER 86-018-E30

REVISIONS	NO.	DATE

DRAWN BY	VZC	CHECKED BY	CCW	10-25-88	DRAWING NUMBER	86-018-E30
	9-22-88	APPROVED BY				



LEGEND:

- ● PROPOSED MONITORING WELL LOCATIONS, EACH LOCATION TO HAVE TWO WELLS: ONE WELL SCREENED WITHIN THE UPPERMOST WATER BEARING ZONE, ONE WELL SCREENED WITHIN THE SECOND WATER BEARING ZONE
- ◩ PROPOSED DEEP EXPLORATION BORING LOCATION
- ◕ PROPOSED MONITORING WELL LOCATIONS, EACH LOCATION TO HAVE THREE WELLS: ONE WELL SCREENED WITHIN THE UPPERMOST WATER BEARING ZONE, TWO WELLS SCREENED WITHIN THE UPPER AND LOWER PORTIONS OF THE SECOND WATER BEARING ZONE.
- ▲ PROPOSED MONITORING WELL LOCATION, ONE WELL SCREENED THROUGHOUT THE SECOND WATER BEARING ZONE.

REFERENCE:
U.S. NAVY MAP

GROUND WATER SAMPLING LOCATIONS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

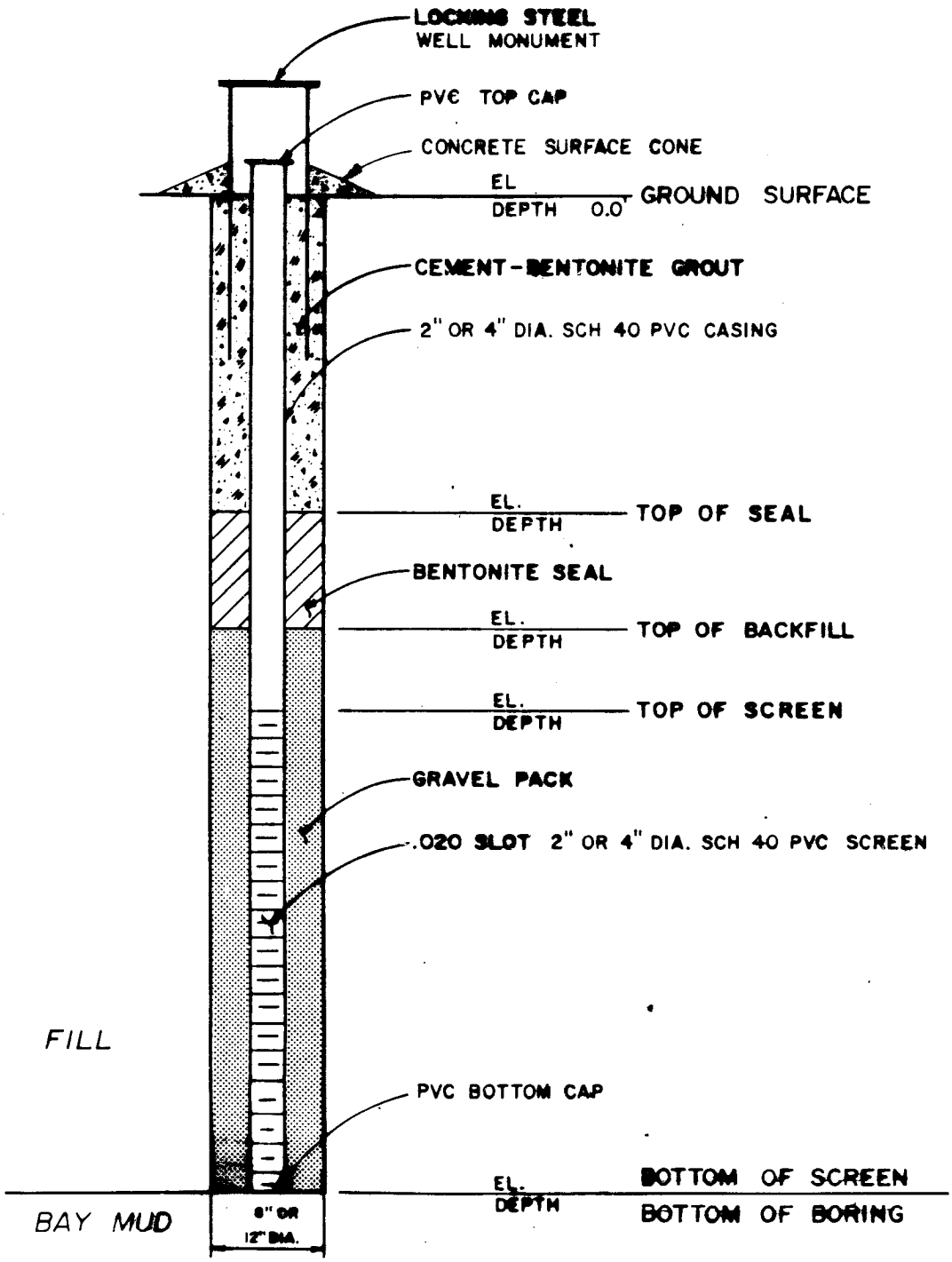
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-20-88	FIGURE 3-3	DRAWING NUMBER 86-018-E25
SCALE: AS SHOWN		

REVISIONS	NO.	DATE	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
	1	2-14-89	LEA	CCW		86-018-E25
	2	10-12-89	9-20-88	10-25-89		
	3	1-22-90				



NOTES:

1. NOT DRAWN TO SCALE.
2. WELL SCREEN WITHIN FILL DEPOSITS

GENERALIZED MONITORING WELL CONSTRUCTION DIAGRAM

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

Canonie Environmental

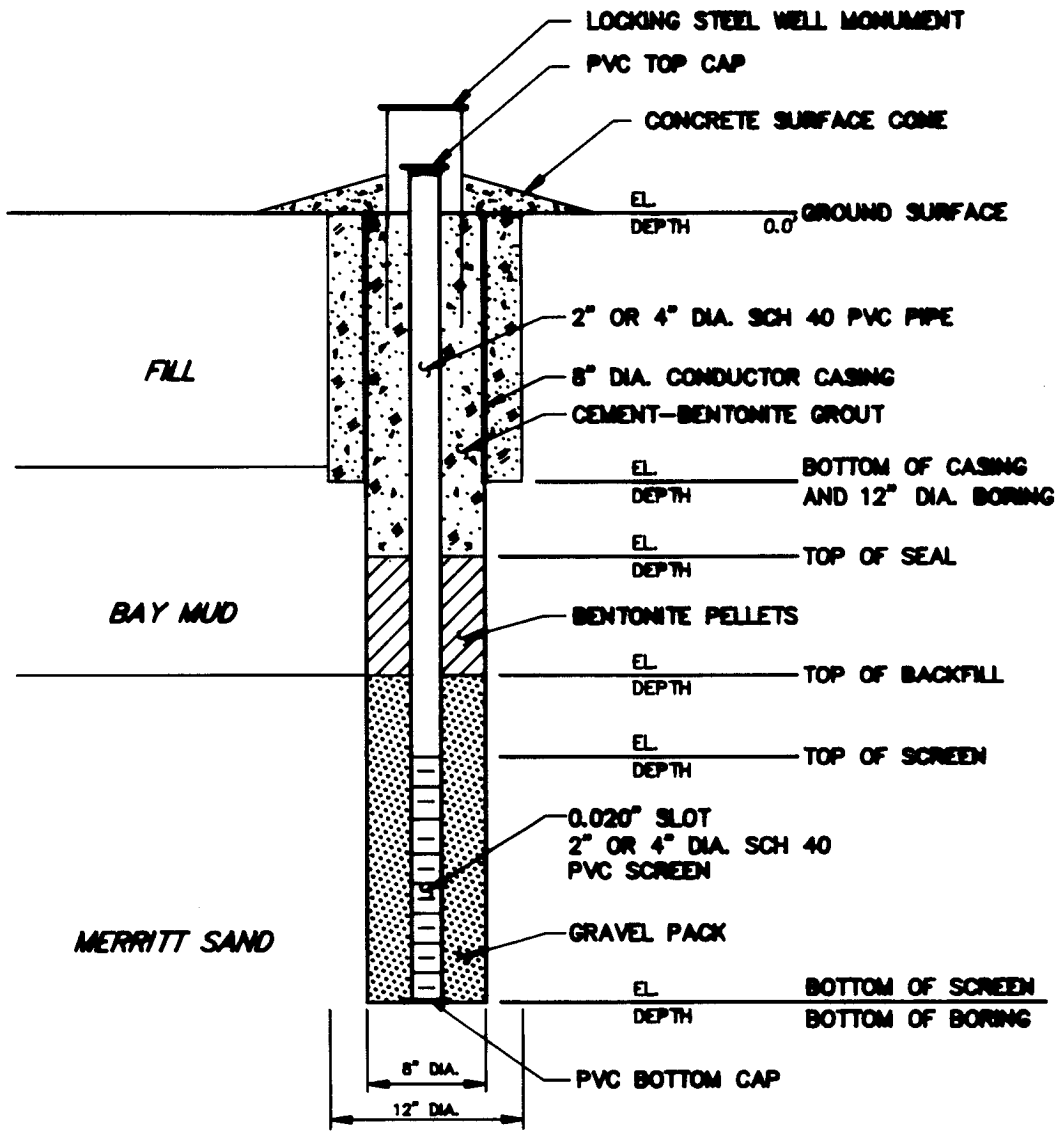
DATE: 9-23-88	FIGURE 3-4	DRAWING NUMBER
SCALE: AS SHOWN		86-018-A29

DRAWN BY	LEA	9-23-88
CHECKED BY	CCW	10-25-88
APPROVED BY	GWB	2-16-89

DRAWING NUMBER 86-018-A29

REVISIONS

NO.	DATE



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN WITHIN UPPER PORTION OF MERRITT SAND

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

CanonieEnvironmental

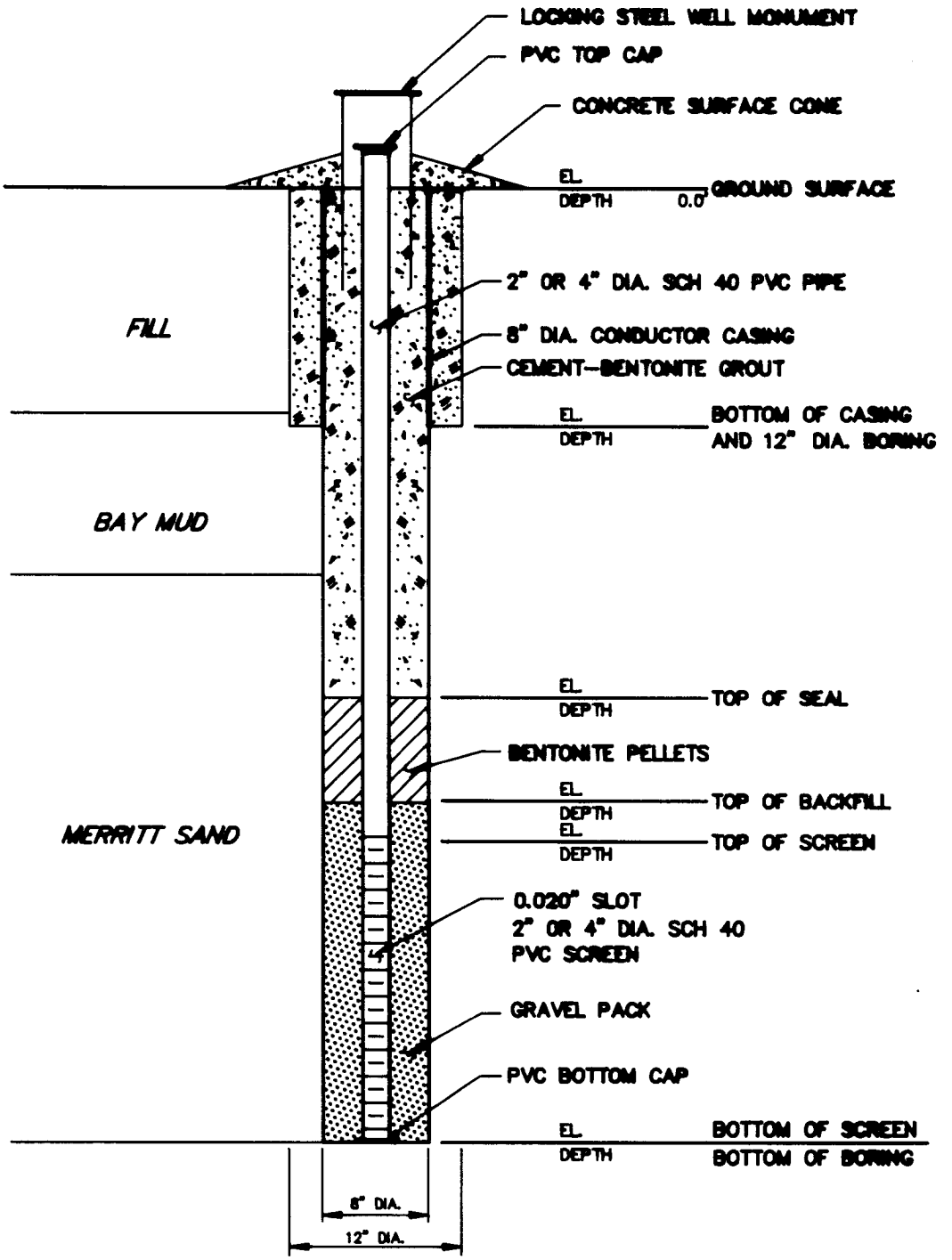
DATE: 2-14-89	FIGURE 3-5	DRAWING NUMBER 86-018-A54
SCALE: NTS		

DRAWN BY	JWV	2-14-89	CHECKED BY	TBB	2-16-89
			APPROVED BY		2-16-89

DRAWING NUMBER 86-018-A54

REVISIONS

NO.	DATE



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN WITHIN BOTTOM PORTION OF MERRITT SAND

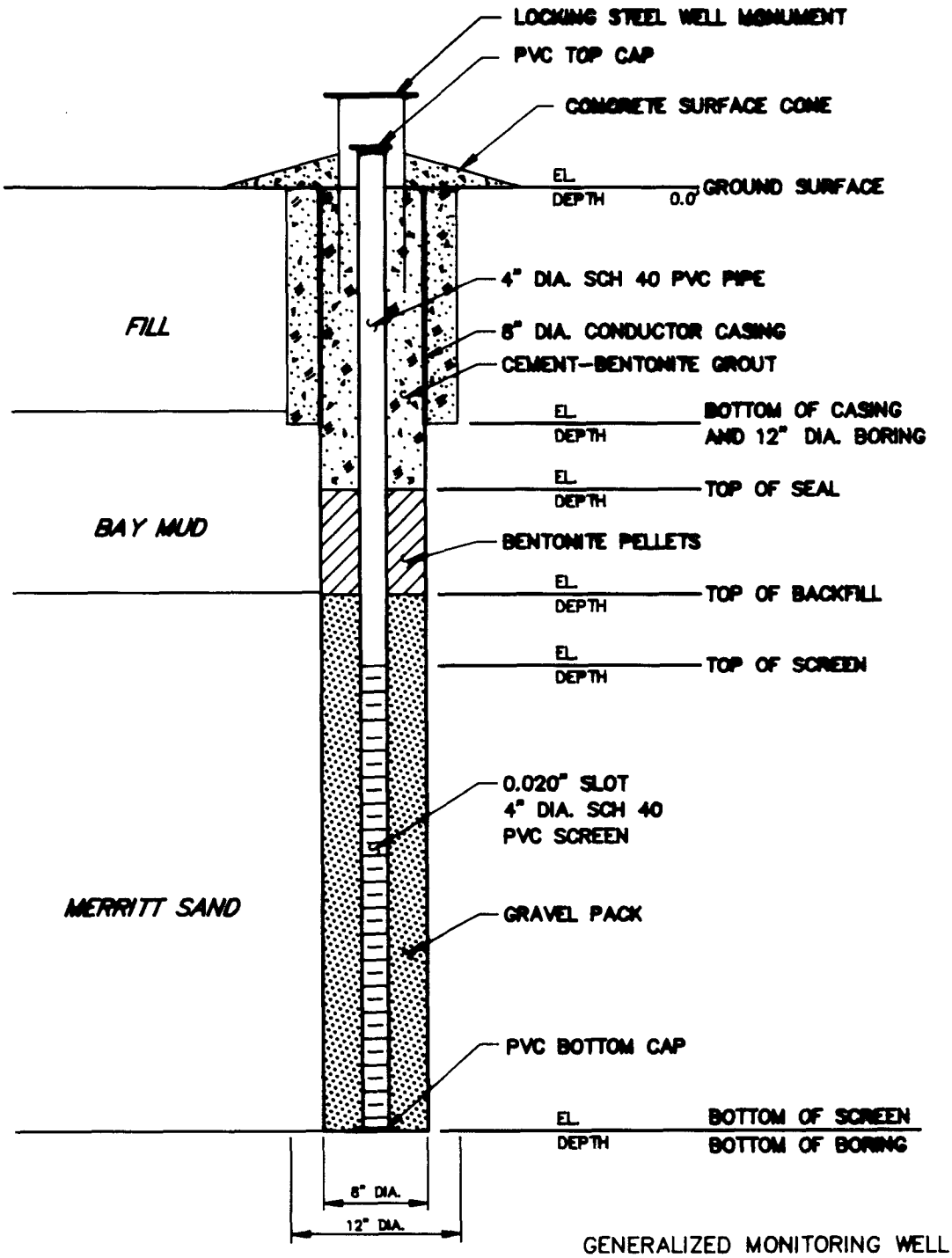
PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

CanonieEnvironmental

DATE: 2-14-89	FIGURE 3-6	DRAWING NUMBER 86-018-A53
SCALE: NTS		

REVISIONS	NO.	DATE

DRAWN BY	JWV	2-14-89
CHECKED BY	TGB	2-16-89
APPROVED BY	[illegible]	2-16-89
DRAWING NUMBER	86-018-A53	



GENERALIZED MONITORING WELL
CONSTRUCTION DIAGRAM
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

NOTES:

1. NOT DRAWN TO SCALE
2. WELL SCREEN THROUGHOUT MERRITT SAND

PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

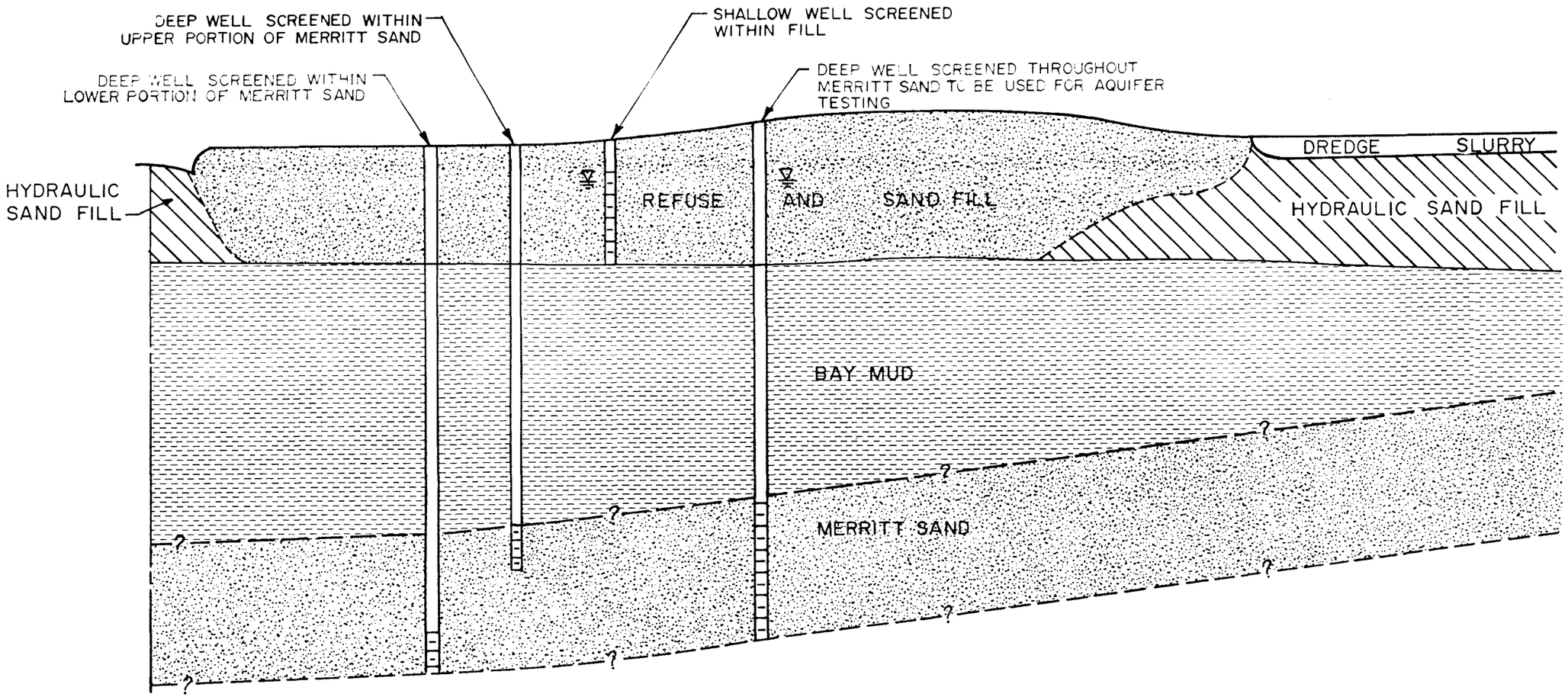
CanonieEnvironmental

DATE: 2-14-89	FIGURE 3-7	DRAWING NUMBER 86-018-A52
SCALE: NTS		

DRAWING NUMBER	86-018-A52
	2-16-89
CHECKED BY	TGB
APPROVED BY	
DRAWN BY	J.W.V.
	2-14-89

REVISIONS	
NO.	DATE

113525



GENERALIZED
MONITORING WELL CLUSTER
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

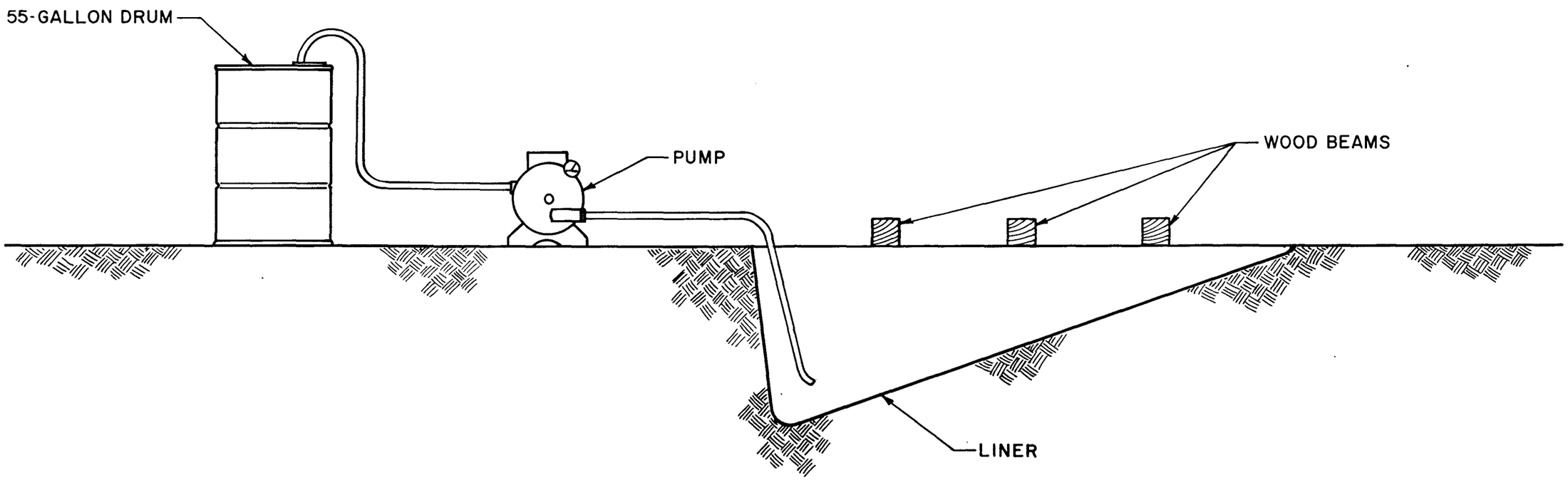
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

Canonie Environmental

DATE: 9-23-88	FIGURE 3-8	DRAWING NUMBER
SCALE: NTS		86-018-B32

REVISIONS	NO.	DATE	DRAWN BY	VZC	9-23-88	CHECKED BY	CCW	9-23-88	DRAWING NUMBER 86-018-B32
						APPROVED BY		10-16-87	

113525



DECONTAMINATION PIT
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING
COMMAND

Canonie Environmental

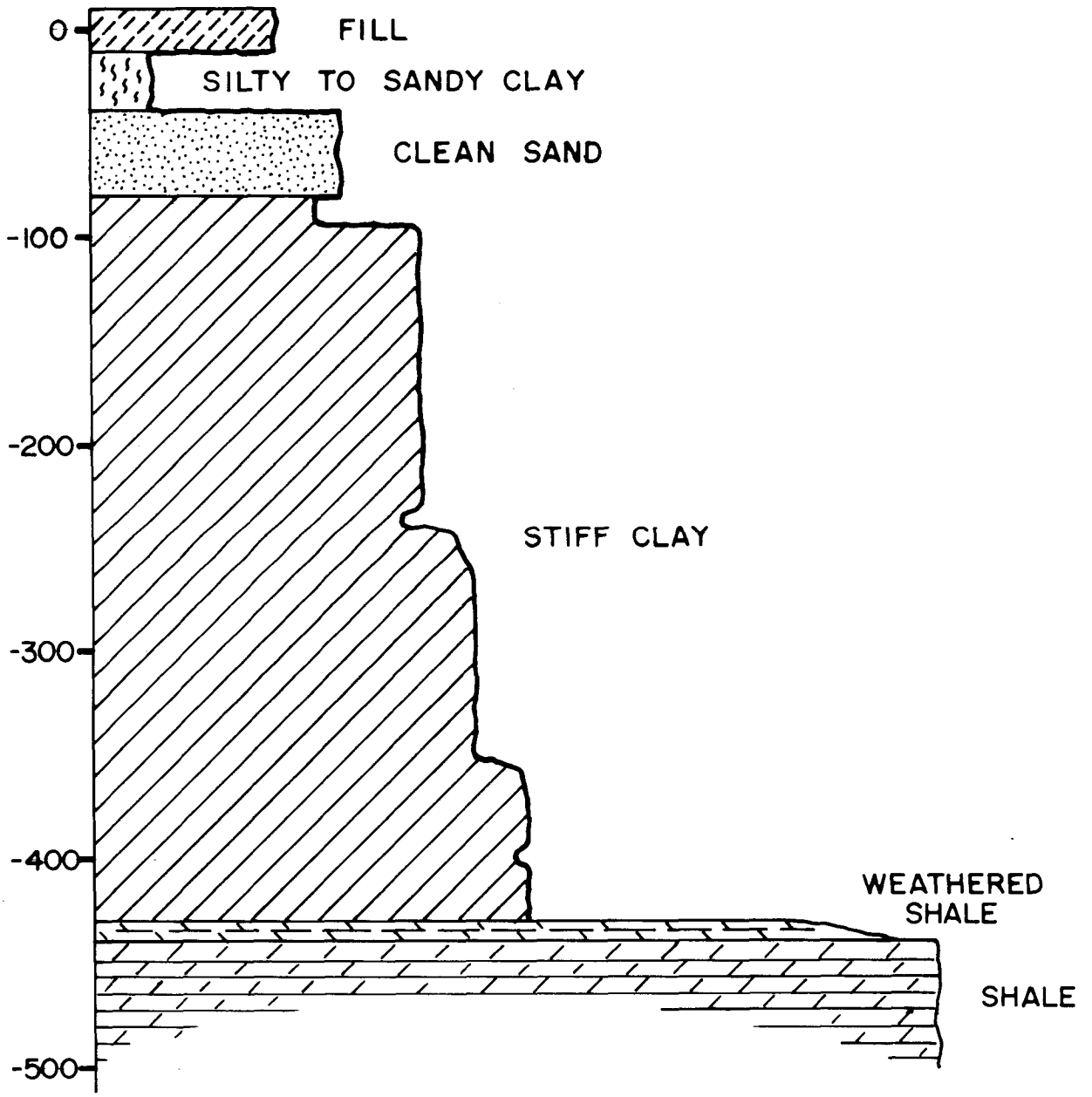
DATE: 9-24-88	FIGURE 3-9	DRAWING NUMBER 86-018-B33
SCALE: N.T.S.		

DRAWN BY	LEA 9-24-88	CHECKED BY	SCW 10-25-88	DRAWING NUMBER	86-018-B33
		APPROVED BY	2-16-89		

REVISIONS

NO.	DATE

113525



PAN AM WELL
STRATIGRAPHIC COLUMN

PREPARED FOR
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

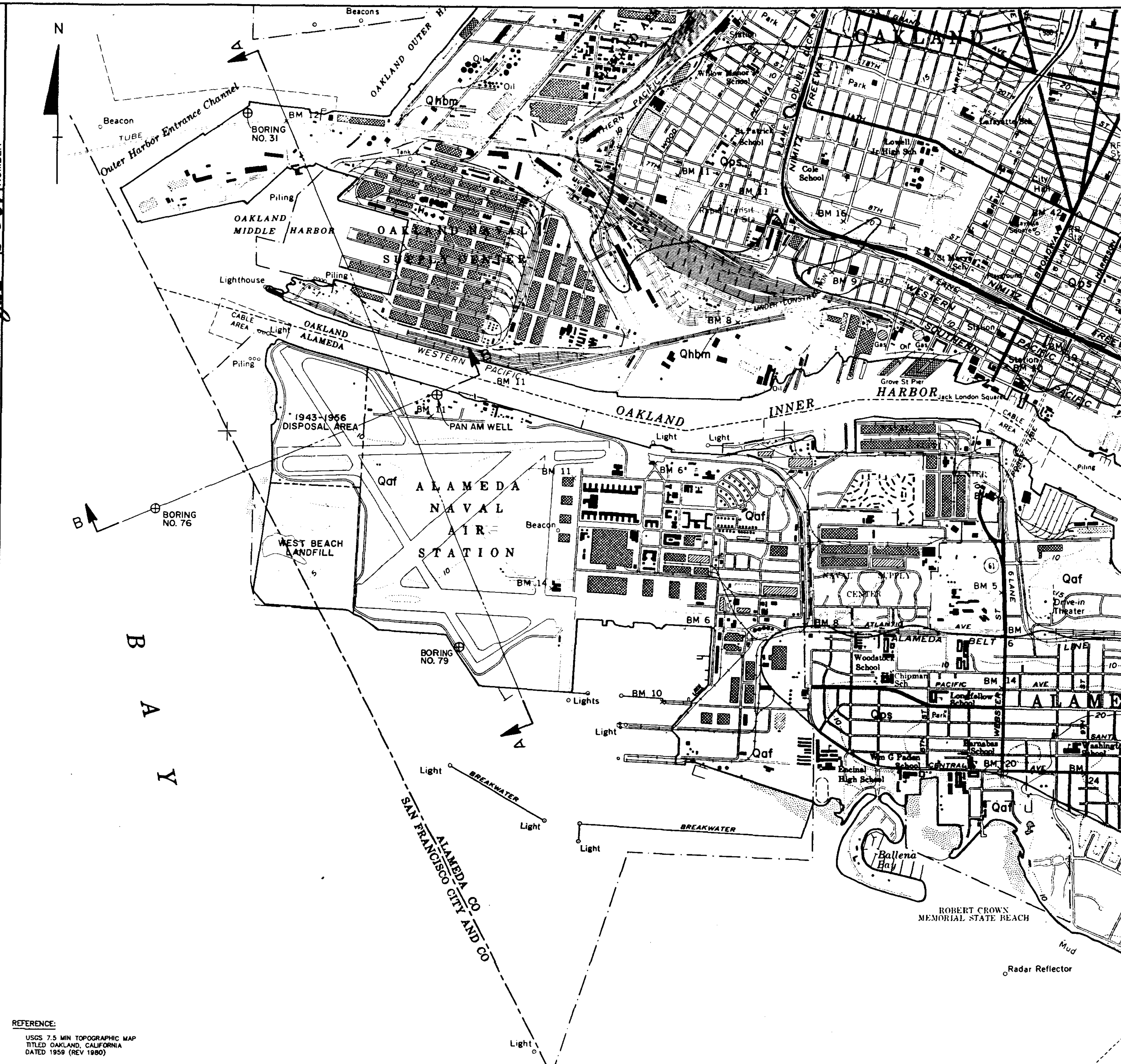
CanonieEnvironmental

DATE: 10-26-88	FIGURE 3-10	DRAWING NUMBER
SCALE: AS SHOWN		86-018-A45

DRAWING NUMBER	86-018-A45
	10/27/88
	2/16/87
CHECKED BY	DKC
APPROVED BY	
J. WADE	
10-26-88	
DRAWN BY	

NO. | DATE

REVISIONS



LEGEND:

SEDIMENTARY DEPOSITS

QUATERNARY — HOLOCENE

ARTIFICIAL DEPOSITS

Qaf	ARTIFICIAL FILL – CONSISTS OF MISCELLANEOUS REFUSE, BAY MUD, OR SAND DREDGED FROM BAY; COMPOSITION VARIES FROM PLACE TO PLACE; MAY BE DIFFICULT TO DISTINGUISH FROM NATURAL BAY MUD OR MERRITT SAND. IN MOST PLACES OVERLIES BAY MUD

ALLUVIAL DEPOSITS

Qhac	COARSE-GRAINED ALLUVIUM – UNCONSOLIDATED, MODERATELY SORTED PERMEABLE SAND AND SILT WITH COARSE SAND AND GRAVEL; MORE ABUNDANT TOWARD FAN HEADS
Qham	MEDIUM-GRAINED ALLUVIUM – UNCONSOLIDATED, MODERATELY SORTED PERMEABLE FINE SAND, SILT, AND CLAYED SILT WITH A FEW THIN BEDS OF COARSE SAND
Qhaf	FINE-GRAINED ALLUVIUM – UNCONSOLIDATED PLASTIC MODERATELY TO POORLY SORTED CARBONACEOUS SILT AND CLAY

ESTUARINE DEPOSITS

Qhbm	BAY MUD – UNCONSOLIDATED WATER-SATURATED DARK PLASTIC CARBONACEOUS CLAY AND SILTY CLAY

10,000 YEARS B.P.

PLEISTOCENE

Qps	PLEISTOCENE BEACH AND DUNE SAND DEPOSITS (MERRITT SAND) – LOOSE WELL – SORTED FINE TO MEDIUM SAND
Qpa	LATE PLEISTOCENE ALLUVIUM – WEAKLY CONSOLIDATED SLIGHTLY WEATHERED POORLY SORTED IRREGULARLY INTERBEDDED CLAY, SILT, SAND AND GRAVEL

1.8 MILLION YEARS B.P.

⊕ SOIL BORING FROM DOROTHY H. RADBRUCK, 1957

SCALE: 1,000 0 1,000 2,000 FEET

REGIONAL GEOLOGIC MAP
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

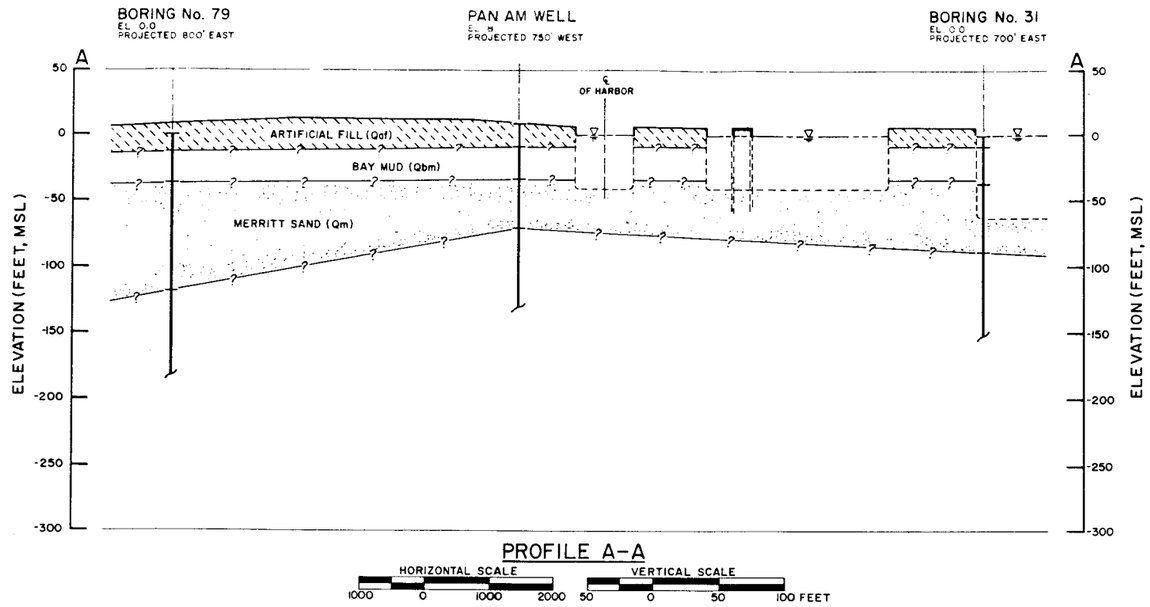
WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

Canonie Environmental

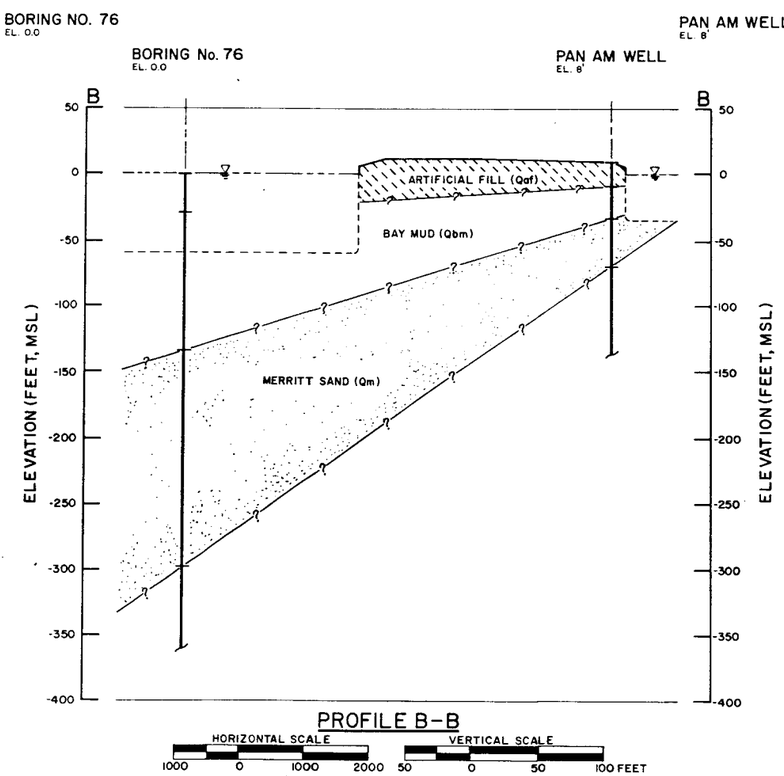
REFERENCE:
USGS 7.5 MIN TOPOGRAPHIC MAP TITLED OAKLAND, CALIFORNIA DATED 1959 (REV 1980)

DATE: 9-22-88 SCALE: AS SHOWN	FIGURE 3-11	DRAWING NUMBER 86-018-E28

REVISIONS	NO.	DATE	DRAWN BY	LEA 9-22-88	CHECKED BY	CCW 10-25-88	APPROVED BY	2-16-89	DRAWING NUMBER	86-018-E28



PROFILE A-A



PROFILE B-B

GEOLOGIC CROSS SECTIONS
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

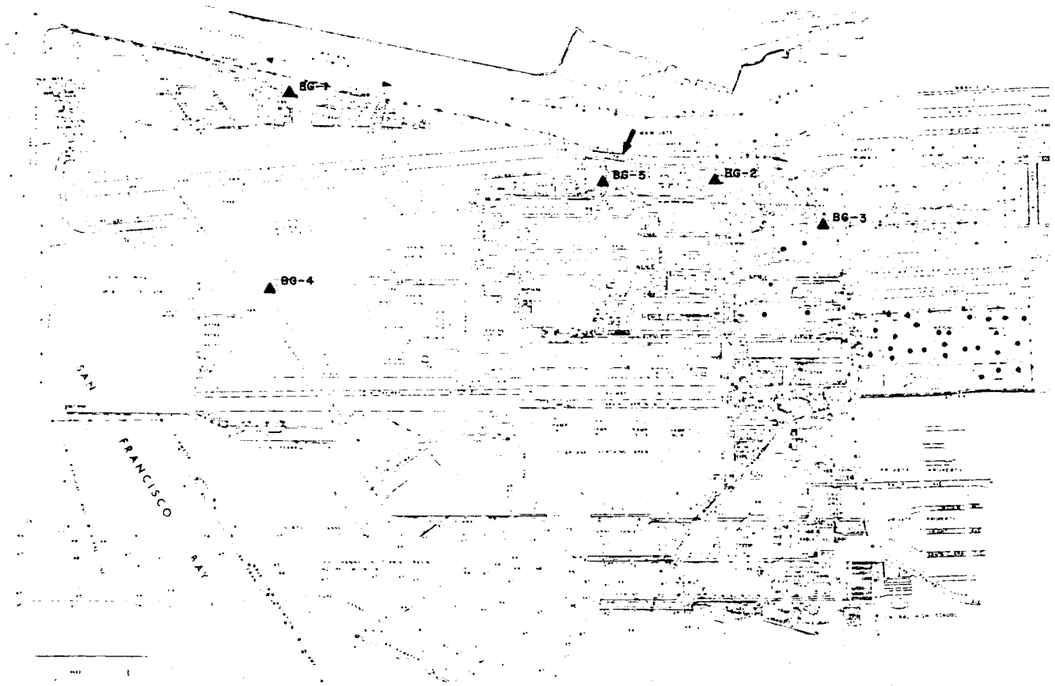
CanonieEnvironmental

DATE: 9-27-88	FIGURE 3-12	DRAWING NUMBER
SCALE: AS SHOWN		86-018-E38

DRAWN BY	LEA 9-27-88	CHECKED BY	CCW 10-25-88	DRAWING NUMBER	86-018-E38
		APPROVED BY	JWB 2-16-89		

REVISIONS

NO.	DATE



N

LEGEND:

▲ EXISTING WELL

SCALE
1000 0 1000 2000 FEET

BACKGROUND WELL LOCATION SITES
NAVAL AIR STATION
ALAMEDA, CALIFORNIA
PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

DATE: 9-21-88	FIGURE 5-1	DRAWING NUMBER 86-018-E27
SCALE: AS SHOWN		

86-018-E2

REFERENCE:
U.S. NAVY MAP

REVISIONS				
NO.	DATE			
E2				
DRAWN BY	LEA 9-21-88	CHECKED BY	CCW	10-25-88
		APPROVED BY		

DRAWING NUMBER 86-018-E27

86-018-E2

APPENDIX A

SAMPLING DATA FROM PREVIOUS STUDIES

TABLE 1

1943-1956 DISPOSAL AREA SOIL AND GROUND WATER TEST RESULTS

Constituent Concentrations, mg/kg = mg/l = ppm, Except as Noted

	Soil Samples - Well Number					Ground Water Samples - Well Number				
	WA-1	WA-2	WA-3	WA-4	WA-5	WA-1	WA-2	WA-3	WA-4	WA-5
Date sampled	10/12/84	10/12/84	10/15/84	10/17/84	10/19/84	1/21/85	1/21/85	1/21/85	1/21/85	1/22/85
Sample depth, feet	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	16	17	16	16	15
Screened depth, feet						5-25	6-20	6-16	5-25	4-24
Static water, feet										
depth						3.16	5.73	4.13	3.69	4.47
elevation						107.45	107.06	106.73	106.72	106.99
Combustible gas in casing, as hexane, max. obs.*										
before pumping,						95%	240 ppm	140 ppm	65 ppm	130 ppm
after pumping						100%	5%	12%	125 ppm	185 ppm
pH (no units)	8.8	8.0	7.9	8.4	8.0	7.6	7.6	7.4	7.4	6.7
Electrical conductivity umhos/cm	240	580	330	210	60	1080	3200	11800	7000	750
Gross alpha, pCi/g or l	4.4±3.3	8.0±5.4	0.1±4.8	9.6±7.2	45.7±10.8	7.2±6.6	5.5±10.8	NR	NR	0.4±2.8
Gross beta, pCi/g or l	31.7±4.4	16.1±4.4	10.5±3.3	17.6±4.2	11.2±3.5	69.3±31.6	33.8±57.4	NR	NR	50.4±16.8
Antimony ,Sb	-5.	-5.	-5.	-5.	-5.	-1.	-1.	-1.	-1.	-1.
Arsenic ,As	-5.	-5.	5.3	-5.	9.1	-1.	-1.	-1.	-1.	-1.
Barium ,Ba	80.	49.	250.	13.	57.	-0.5	-0.5	-0.5	-0.5	-0.5
Beryllium ,Be	-0.5	-0.5	-0.5	-0.5	-0.5	-0.05	-0.05	-0.05	-0.05	-0.05
Cadmium ,Cd	24.	1.6	19.	0.65	1.0	-0.1	-0.1	-0.1	-0.1	-0.1
Chromium ,Cr	90.	29.	56.	21.	49.	-0.1	-0.1	-0.1	-0.1	-0.1
Cobalt ,Co	3.8	6.4	8.2	3.7	9.4	-0.1	-0.1	-0.1	-0.1	-0.1
Copper ,Cu	160.	31.	330.	7.8	57.	-0.1	-0.1	-0.1	-0.1	-0.1
Lead ,Pb	1100.	38.	700.	-5.	6.5	-0.1	-0.1	-0.1	-0.1	-0.1
Mercury ,Hg	0.1	0.14	2.3	-0.1	-0.1	-1.	-1.	-1.	-1.	-1.
Molybdenum ,Mo	-10.	-10.	-10.	-10.	-10.	-0.01	-0.01	0.77	-0.01	-0.01
Nickel ,Ni	70.	28.	53.	18.	68.	-0.1	-0.1	-0.1	-0.1	-0.1
Selenium ,Se	-1.	-1.	-1.	-1.	-1.	-0.5	-0.5	-0.5	-0.5	-0.5
Silver ,Ag	-2.	-2.	-2.	-2.	-2.	-0.5	-0.5	-0.5	-0.5	-0.5
Thallium ,Tl	-5.	-5.	-5.	-5.	-5.	-1.	-1.	-1.	-1.	-1.
Vanadium ,V	7.5	22.	17.	14.	21.	-0.5	-0.5	-0.5	-0.5	-0.5
Zinc ,Zn	420.	64.	1800.	16.	49.	0.13	-0.1	-0.1	-0.1	-0.1

CONTINUED ON NEXT PAGE

NOTES: *) Maximum observed reading within the casing - may represent multiple readings at different times or days.
1) "NR" = not reportable because of excessive noise due to high salt content.
2) Metals by inductively-coupled plasma emission spectroscopy, after strong acid digestion ("total metals" basis) of soils.
3) Data reported on a moist-sample-weight (as-received) basis.
4) "-" = "less than"

SOURCE: WAHLER ASSOCIATES, 1985

TABLE 1 (CONTINUED)

1943-1956 DISPOSAL AREA SOIL AND GROUND WATER TEST RESULTS

Constituent Concentrations, mg/kg = mg/l = ppm, Except as Noted

	Soil Samples - Well Number					Ground Water Samples - Well Number				
	WA-1	WA-2	WA-3	WA-4	WA-5	WA-1	WA-2	WA-3	WA-4	WA-5
Date sampled	10/12/84	10/12/84	10/15/84	10/17/84	10/19/84	1/21/85	1/21/85	1/21/85	1/21/85	1/22/85
Sample depth, feet	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	6.0-6.5	16	17	16	16	15
Screened depth, feet						5-25	6-20	6-16	5-25	4-24
Static water, feet										
depth						3.16	5.73	4.13	3.69	4.47
elevation						107.45	107.06	106.73	106.72	106.99
trichloroethylene	-0.001	-0.001	-0.001	-0.001	-0.001	0.291	0.005	-0.001	-0.001	-0.001
trans-1,2-dichloroethylene	-0.001	-0.001	-0.001	-0.001	-0.001	0.957	0.246	0.008	-0.001	-0.001
benzene	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	0.009
acetone	0.058	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010
other purgeable organics	None detected at detection limits generally below 0.001 ppm									
bis(2-ethylhexyl) phthalate	-0.040	0.625	-0.040	-0.100	-0.001	0.060	-0.001	-0.001	-0.001	-0.001
di-n-butyl phthalate	2.700	0.665	-0.040	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
acenaphthene	-0.040	-0.040	2.030	-0.100	-0.001	-0.001	0.064	-0.001	-0.001	-0.001
acenaphthylene	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	0.005	-0.001	-0.001	-0.001
napthalene	-0.040	-0.040	5.200	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(a)anthracene	-0.040	-0.040	0.370	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(b)fluoranthene	-0.040	-0.040	0.580	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(ghi)perylene	-0.040	-0.040	0.440	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
benzo(a)pyrene	-0.040	-0.040	1.330	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
ideno(1,2,3-cd)pyrene	-0.040	-0.040	1.000	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
pyrene	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	0.043	-0.001	-0.001	-0.001
chrysene	-0.040	-0.040	0.470	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
fluorene	-0.040	-0.040	1.840	-0.100	-0.001	-0.001	0.016	-0.001	-0.001	-0.001
phenanthrene	-0.040	-0.040	0.200	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
dibenzofuran	-0.040	-0.040	1.360	-0.100	-0.001	-0.001	0.014	-0.001	-0.001	-0.001
2-methylnapthalene	-0.040	-0.040	0.800	-0.100	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
2-cyclohexen-1-one*	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	-0.001	0.010	-0.001	-0.001
2,5-diethyltetrahydrofuran*	-0.040	-0.040	-0.040	-0.100	-0.001	-0.001	-0.001	0.043	-0.001	-0.001
unidentified, non-priority pollutants	one	two	several	four	none	none	none	none	none	none
other acid and base/neutral extractable organics	None detected at detection limits generally below 0.040 ppm (soils) or 0.001 ppm (water)									

NOTES: *) Estimated concentrations, tentative identification.
1) Analyses by EPA Method 624 and 625 - all statistically significant peaks reported, even if unidentified.
2) Data reported on a moist-sample-weight (as-received) basis.
3) "-" = "less than".

SOURCE: WAHLER ASSOCIATES, 1985

TABLE 2. WATER LEVEL READINGS

Observation Well (Boring)	Elevation*		11/9/76		11/15/76		12/3/76		12/17/76			3/10/77	3/16/77		3/21/77	3/22/77
Number	Top of Pipe	Ground Surface	1200 to 1330	1600 to 1650	1045 to 1130	1430 to 1505	1415 to 1515	1530 to 1630	0845 to 1600	1325 to 1345	1517 to 1545	1400 to 1530	0900 to 0945	1330 to 1350	1330 to 1600	0945 to 1330
1	116.5	115.5	105.2	105.5	105.3	105.3	105.7	105.3	105.9	105.6	105.2	---	105.8	---	105.9	105.7
2	114.4	113.4	105.4	105.4	105.4	105.4	105.4	---	105.4	105.4	105.4	104.8	105.2	---	105.1	105.0
3	112.2	111.4	105.3	105.2	105.2	105.2	105.3	105.2	105.5	105.1	105.1	104.9	105.0	---	104.6	104.6
4	110.4	110.7	108.2	105.5	105.9	105.9	103.8	103.5	108.4	103.7	103.1	---	---	---	105.7	105.7
5	109.8	110.1	106.6	105.9	105.6	105.6	105.1	104.9	106.8	104.9	104.5	106.7	106.8	105.8	---	105.2
6	108.1	108.2	106.2	106.2	106.2	106.2	106.2	---	106.2	---	106.2	106.8	---	107.1	107.1	107.1
7	109.2	109.9	106.2	106.2	106.2	106.2	106.2	---	106.2	---	106.2	106.7	---	107.7	106.7	106.7
8	114.8	114.0	106.6	106.6	106.6	106.6	106.7	---	106.7	---	106.6	107.8	107.2	---	---	---
9	114.3	113.8	107.3	107.3	107.3	107.3	107.3	---	107.3	---	107.3	108.1	107.9	---	---	108.1
10	111.9	112.0	108.0	108.0	108.0	108.0	---	---	108.0	---	108.0	---	---	---	109.5	109.6
11	112.6	112.5	---	---	---	---	106.3	---	106.3	---	106.3	106.5	---	106.7	106.6	106.6
12	113.1	113.0	---	---	---	---	106.2	---	106.2	---	106.2	106.4	---	106.5	106.9	106.7
13	109.0	109.5	---	---	106.0	106.0	---	---	105.7	---	105.7	108.7	---	---	---	109.3
17	111.7	110.3	Borings installed 3/16/77										No initial readings taken		105.2	106.4
18	111.8	110.0													104.9	106.4
19	110.4	109.8													105.3	106.3
20	115.3	114.5	Boring installed 10/6/77													
Bay Tide	---	---	107.9	104.9	103.9	104.4	104.1	103.1	108.2	102.4	101.4	104.9	107.2	103.4	105.8	varies
High Tide	---	---	107.9 at 1230		106.1 at 1800		107.7 at 0930		108.3 at 0815			106.1 at 1645	107.5 at 0945		106.7 at 1330	106.4 at 1415
Low Tide	---	---	100.9 at 1930		103.5 at 1230		101.2 at 1615		100.7 at 1530			101.2 at 0945	101.0 at 1615		102.5 at 1900	101.7 at 0745
Rainfall since last reading (in.)			0		1.07		0		0			3.93	1.42		0	0
Cumulative rainfall (in.)			0		1.07		1.07		1.07			5.00	6.42		6.42	6.42

*All elevations are in feet, based on the Alameda Naval Air Station Datum

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

TABLE 2. (CONTINUED)

Observation Well (Boring)	Elevation*		4/4/77				4/7/77						
Number	Top of Pipe	Ground Surface	0745 to 1000	1000 to 1315	1320 to 1430	1430 to 1440	0800 to 0950	0950 to 1040	1050 to 1110	1150 to 1240	1250 to 1310	1350 to 1410	1450 to 1550
1	116.5	115.5	103.2	103.7	104.2	---	104.4	104.4	---	104.9	104.6	104.7	104.8
2	114.4	113.4	103.9	103.9	---	---	105.0	105.0	---	105.0	---	---	105.0
3	112.2	111.4	103.3	103.6	103.7	---	104.1	104.1	---	104.1	---	---	104.1
4	110.4	110.7	103.9	106.8	105.7	---	103.2	103.2	103.4	104.1	105.1	106.2	106.4
5	109.8	110.1	104.0	106.0	106.7	106.3	105.4	104.2	104.7	105.3	105.8	106.2	106.3
6	108.1	108.2	106.9	106.9	---	---	106.8	---	---	106.8	---	---	106.8
7	109.2	109.9	106.5	106.5	---	---	106.6	---	---	106.6	---	---	106.6
8	114.8	114.0	106.4	106.4	---	---	107.3	---	---	107.3	---	---	107.3
9	114.3	113.8	---	---	---	---	108.0	---	---	108.0	---	---	108.0
10	111.9	112.0	---	---	---	---	109.1	---	---	---	---	109.1	---
11	112.6	112.5	106.5	106.5	---	---	106.7	---	---	106.7	---	---	106.7
12	113.1	113.0	106.5	106.2	106.3	---	106.6	---	---	106.6	---	---	106.6
13	109.0	109.5	---	---	---	---	109.0	---	---	109.0	---	---	109.0
17	111.7	110.3	104.6	105.3	105.2	105.3	106.4	106.4	106.4	106.4	106.4	106.4	106.4
18	111.8	110.0	105.4	---	105.3	105.3	106.4	106.4	106.4	106.4	106.4	106.4	106.4
19	110.4	109.8	105.2	105.3	105.4	105.4	106.3	106.3	106.3	106.3	106.3	106.3	106.3
20	115.3	114.5											
Bay Tide	---	---	103.7	105.9	106.2	105.7	100.8	102.2	102.7	104.0	104.5	105.4	105.8
High Tide	---	---	107.1 at 1245				106.7 at 1530						
Low Tide	---	---	101.0 at 0600; 102.1 at 1800				100.4 at 0830						
Rainfall since last reading (in.)			0.49				0						
Cumulative rainfall (in.)			6.91				6.91						

*All elevations are in feet, based on the Alameda Naval Air Station Datum

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

TABLE 2. (CONTINUED)

Observation Well (Boring)													
	Elevation*		4/13/77	4/18/77								7/15/77	10/14/77
Number	Top of Pipe	Ground Surface	1230 to 1400	1000 to 1045	1100 to 1115	1130 to 1145	1200 to 1250	1300 to 1315	1330 to 1345	1400 to 1415	1430 to 1445	0930 to 1100	1000 to 1115
1	116.5	115.5	---	104.2	104.7	104.7	104.8	105.0	105.0	105.1	105.0	104.2	104.5
2	114.4	113.4	---	---	---	---	---	---	---	---	---	104.7	105.0
3	112.2	111.4	---	104.0	---	---	104.4	---	---	---	104.3	104.4	104.7
4	110.4	110.7	---	104.8	105.7	106.1	106.4	106.5	106.4	106.1	105.1	103.6	106.6
5	109.8	110.1	105.2	---	106.1	106.2	106.3	106.3	106.3	106.2	106.2	104.8	105.8
6	108.1	108.2	106.8	---	---	---	---	---	---	---	---	106.1	106.0
7	109.2	109.9	---	---	---	---	---	---	---	---	---	106.0	106.0
8	114.8	114.0	---	---	---	---	---	---	---	---	---	106.4	106.0
9	114.3	113.8	---	---	---	---	---	---	---	---	---	107.3	107.0
10	111.9	112.0	---	---	---	---	---	---	---	---	---	107.9	107.5
11	112.6	112.5	---	---	---	---	---	---	---	---	---	105.9	105.9
12	113.1	113.0	---	---	---	---	---	---	---	---	---	105.8	105.7
13	109.0	109.5	-	---	---	---	---	---	---	---	---	---	---
17	111.7	110.3	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
18	111.8	110.0	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
19	110.4	109.8	106.2	106.3	---	---	106.3	---	---	---	106.3	105.8	105.8
20	115.3	114.5											108.5
Bay Tide	---	---	102.7	104.6	105.0	105.4	106.1	106.5	106.1	105.8	105.4	104.0	105.6
High Tide	---	---	06.7 at 0845	106.5 at 1300								105.8 at 1345	107.4 at 1345
Low Tide	---	---	01.4 at 1445	101.2 at 0600; 102.9 at 1745								100.7 at 0630	102.8 at 0715
Rainfall since last reading (in.)			0	0								66	.89
Cumulative rainfall (in.)			6.91	6.91								7.57	8.46

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

*All elevations are in feet, based on the Alameda Naval Air Station Datum

TABLE 3 WATER QUALITY TEST RESULTS

	Column 1 - Bay Waters										Column 2 - Perimeter Wells			
	Low Tide		High Tide		Bay Averages		Well #1				Well #2			Well #3
Parameters Analyzed (Units)	3/77	7/77	3/77	7/77	3/77	7/77	11/76	3/77	7/77	10/77	11/76	3/77	7/77	11/76
Oil and grease (mg/l)	5.5	0.73	7.40	0.73	6.45	0.73	2.2	8.5	3.27	3.8	11	6.3	1.47	11
Sulfide (mg/l)	<0.02	0.01	<0.02	0.01	<0.02	0.01	3.9	12	6.6	0.01	0.10	0.026	0.02	0.27
Total Hardness (mg $CaCO_3$/l)	5,800	6,100	5,600	6,100	5,700	6,100	3,700	2,000	3,300	2,200	5,500	5,300	5,600	5,200
Total Dissolved Solids (mg/l)	3,500	39,000	34,000	30,000	18,750	34,500	--	11,000	15,000	13,000	--	2,800	26,000	--
Calcium (mg/l)	300	300	310	300	305	300	380	110	240	200	620	370	560	560
Chloride (mg/l)	18,000	19,000	13,000	19,000	15,500	19,000	3,100	5,200	7,400	6,300	12,000	14,000	14,000	12,000
COD (mg/l)(1)	1,500	2,200	270	1,900	885	2,050	240	140	460	400	140	1,000	1,400	200
pH	8.4	8.3	8.4	8.2	8.4	8.2	6.7	7.3	6.1	7.5	6.7	7.6	6.1	6.6
Iron (mg/l)	1.6	0.15	0.34	0.07	0.97	0.11	51	32	10	51	70	20	0.34	200
Magnesium (mg/l)	1,100	1,200	1,100	1,200	1,100	1,200	820	330	550	440	560	950	890	600
Nitrate Nitrogen (mg N/l)	0.55	0.21	0.25	0.40	0.4	0.34	0.22	0.25	1.7	2.8	0.42	3.9	2.9	0.34
Potassium (mg/l)	420	270	410	270	415	270	340	260	140	98	300	340	170	220
Sodium (mg/l)	10,000	6,200	9,200	780	9,600	3,490	4,000	5,700	2,000	3,300	15,000	8,000	4,200	8,000
Sulfate (mg/l)	2,500	3,200	2,100	2,700	2,300	2,950	1,600	380	1,600	460	2,000	13,000	1,400	1,100
Mercury (μg/l)	<1	<1.0	<1	<1.0	<1	<1.0	1.0	1.0	1.3	1	2	<1.0	3.4	1.0
Lead (mg/l)	0.36	<0.02	0.34	<0.04	0.35	<0.03	0.22	0.16	0.16	0.37	0.25	0.36	<0.04	0.37
Total Phosphate (mg P/l)	0.22	0.18	0.18	0.16	0.20	0.17	1.6	1.8	5.7	1.8	0.20	0.45	2.0	0.10
Total Kjeldahl Nitrogen (mg N/l)	1.40	1.7	2.80	6.9	2.1	4.3	5.8	9.6	18	15	10	0.80	2.4	5.2
Total Chromium (mg/l)	0.02	0.03	0.06	0.03	0.04	0.03	0.12	0.02	0.26	0.32	0.25	<0.01	0.05	0.42
Cadmium (mg/l)	0.038	<0.01	0.028	<0.01	0.033	<0.01	0.02	0.014	0.04	0.01	0.28	0.052	<0.01	0.12
Turbidity (JTU)(2)	14	28	1.30	2.6	7.65	2.7	15	74	500	6.7	42	150	150	15
Ca Hardness (mg $CaCO_3$/l)	750	750	770	750	760	750	--	270	600	500	--	920	750	--
Mg Hardness (mg $CaCO_3$/l)	4,500	4,900	4,500	4,900	4,500	4,900	--	1,400	580	800	--	3,900	3,700	--

(1) Chemical oxygen demand
(2) Jackson turbidity units

*Located east of landfill

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

SOURCE: HARDING-LAWSON, 1978

TABLE 3 WATER QUALITY TEST RESULTS (CONTINUED)

											Column 3 - Interior Wells			
	Well #4			Well #5				Well #6			Well #7			
Parameters Analyzed (Units)	11/76	3/77	7/77	11/76	3/77	7/77	10/77	11/76	3/77	10/77	11/76	3/77	7/77	10/77
Oil and grease (mg/l)*	1.6	8.2	3.27	2.0	6.8	7.34	4.6	2.8	7.2	4.9	9.7	7.9	2.80	6.2
Sulfide (mg/l)	3.3	1.1	1.0	< 0.08	0.061	0.01	< 0.01	2.5	< 0.02	< 0.01	4.9	2.1	0.40	< 0.01
Total Hardness (mg $CaCO_3$/l)	3,500	6,200	3,700	4,300	1,600	1,800	1,700	2,500	1,300	4,500	3,400	2,800	3,400	5,300
Total Dissolved Solids (mg/l)	--	16,000	17,000	--	9,700	10,000	11,000	--	7,200	6,700	--	16,000	13,000	18,000
Calcium (mg/l)	260	140	150	180	86	110	160	500	110	110	380	160	160	220
Chloride (mg/l)	16,000	8,000	9,000	6,200	5,000	5,300	5,300	7,100	3,700	3,200	12,000	8,400	14,000	7,700
COD (mg/l)(1)	390	230	600	400	3,100	690	540	220	240	150	220	72	280	410
pH	7.1	7.7	8.[illegible]	6.6	7.2	7.9	7.3	7.2	7.7	7.7	6.9	7.6	8.6	7.6
Iron (mg/l)	14	3.6	3.4	3.6	2.6	1.7	190	13	6.6	7.5	22	8.0	0.90	9.7
Magnesium (mg/l)	350	460	470	460	180	290	300	240	180	180	350	480	410	570
Nitrate Nitrogen (mg N/l)	0.0[illegible]	0.25	0.59	0.25	0.38	0.99	1.4	0.01	1.4	0.75	0.40	1.6	1.3	1.7
Potassium (mg/l)	290	310	160	310	220	130	100	130	134	43	220	200	110	86
Sodium (mg/l)	4,000	5,500	2,400	5,500	1,000	1,000	3,000	2,000	1,800	1,800	4,000	5,200	1,600	4,300
Sulfate (mg/l)	660	68	228	68	60	< 2.0	< 10	340	160	160	960	700	500	520
Mercury (μg/l)	6	< 1.0	1.3	< 1.0	< 1.0	< 1.0	< 0.5	< 1.0	< 1.0	< 0.5	2	< 1.0	< 1.0	< 0.5
Lead (mg/l)	0.65	0.16	< 0.04	0.35	0.16	0.4	0.32	0.20	0.12	0.28	0.62	0.19	0.52	0.39
Total Phosphate (mg P/l)	0.95	1.3	1.3	0.18	0.75	1.6	0.9	2.8	1.2	1.0	0.34	0.51	1.6	0.75
Total Kjeldahl Nitrogen (mg N/l)	0.43	29	18	46	28	69	100	10	1.6	8.2	18	1.8	3.2	12
Total Chromium (mg/l)	1.0	< 0.01	0.03	0.10	< 0.01	0.20	0.11	0.08	< 0.01	0.11	0.45	< 0.02	0.04	0.11
Cadmium (mg/l)	0.08	0.016	0.01	0.18	0.019	0.46	0.024	0.13	0.014	0.009	0.03	0.025	0.01	0.011
Turbidity (JTU)(2)	12	24	27	15	42	60	290	8	37	0.83	18	32	67	3.3
Ca Hardness (mg $CaCO_3$/l)	--	350	370	--	210	270	400	--	270	270	--	400	400	550
Mg Hardness (mg $CaCO_3$/l)	--	1,900	1,900	--	1,200	1,200	1,200	--	740	740	--	2,000	1,700	2,100

(1) Chemical oxygen demand
(2) Jackson turbidity units

*Located east of landfill

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

SOURCE: HARDING-LAWSON, 1978

TABLE 3 WATER QUALITY TEST RESULTS (CONTINUED)

										Column 4 - Outside Wells*				
	Well #8	Well #9	Well #11		Well #17		Well #18				Well #10			Well #20
Parameters Analyzed (Units)	11/76	11/76	3/77	7/77	3/77	10/77	3/77	7/77	10/77	11/76	3/77	7/77	10/77	10/77
Oil and grease (mg/l)	16	11	11	5.80	8.4	11	8.9	4.67	6.3	12	6.9	0.67	12	8.8
Sulfide (mg/l)	0.08	0.08	0.49	0.28	0.061	< 0.01	0.045	< 0.01	0.04	< 0.08	0.02	0.03	< 0.01	0.01
Total Hardness (mg $CaCO_3$/l)	1,200	1,500	1,500	1,700	1,600	982	3,500	2,300	2,300	540	28	160	300	130
Total Dissolved Solids (mg/l)	--	--	8,300	8,800	9,800	10,000	21,000	13,000	16,000	--	840	500	3,500	320
Calcium (mg/l)	600	410	250	110	85	130	180	60	150	390	1	11	45	33
Chloride (mg/l)	4,200	5,600	4,000	4,400	5,100	5,000	12,000	7,400	8,200	400	210	120	47	22
COD (mg/l)(1)	130	42	220	540	270	315	870	450	455	43	110	170	136	52
pH	6.9	6.6	7.4	8.3	7.2	7.4	7.5	8.0	7.6	8.0	7.7	8.0	7.6	7.7
Iron (mg/l)	30	41	32	32	34	16	30	1.2	21	370	290	400	470	330
Magnesium (mg/l)	100	130	860	250	260	270	650	160	380	16	67	130	32	30
Nitrate Nitrogen (mg N/l)	0.42	0.42	0.40	1.4	0.50	1.4	0.40	1.1	1.6	0.20	6.4	1.2	28	21
Potassium (mg/l)	140	190	270	120	340	87	400	160	12	17	84	11	1.4	1.6
Sodium (mg/l)	1,300	1,000	3,800	1,000	3,700	2,800	7,000	1,300	4,400	240	84	55	65	50
Sulfate (mg/l)	78	10	24	64	2.8	< 10	32	5.6	< 10	50	0.05	34	26	98
Mercury (μg/l)	< 1.0	< 1.0	< 1	1.0	< 1.0	< 0.5	< 1.0	1.0	3.3	< 1.0	< 1.0	2.6	8.2	1
Lead (mg/l)	0.10	0.12	0.25	< 0.04	0.16	0.30	0.22	0.05	0.38	0.20	0.28	0.18	0.51	0.32
Total Phosphate (mg P/l)	0.26	0.40	0.43	0.44	0.51	1.0	1.3	0.40	0.7	0.40	0.10	9.7	2.9	1.9
Total Kjeldahl Nitrogen (mg N/l)	19	51	33	61	11	110	104	110	240	3.0	2.0	8.8	9.8	5.0
Total Chromium (mg/l)	0.12	< 0.01	0.04	0.03	< 0.01	0.11	0.02	0.02	0.12	0.90	0.66	1.5	1.56	0.90
Cadmium (mg/l)	0.14	0.32	0.015	< 0.01	0.019	0.08	0.018	< 0.01	0.08	0.73	0.028	0.02	0.34	< 0.005
Turbidity (JTU)(2)	10	50	74	100	77	21	55	86	7.2	35	1,650	3,800	1.2	1.8
Ca Hardness (mg $CaCO_3$/l)	--	--	250	270	210	320	450	150	370	--	2.5	27	110	82
Mg Hardness (mg $CaCO_3$/l)	--	--	860	1,000	1,100	1,100	2,700	660	1,600	--	280	540	130	120

(1) Chemical oxygen demand
(2) Jackson turbidity units

*Located east of landfill

Note: Those numbers underlined exceed the average of the Bay averages in Column 1.

SOURCE: HARDING-LAWSON, 1978

Table 4

Gas Chromatographic Analysis Results for Observation Wells 5 and 9

	Concentration by Volume							
	Oxygen (O_2) %	Nitrogen (N_2) %	Carbon Dioxide (CO_2) %	Methane (CH_4) %	Ethane (C_2H_6) ppm	Propane (C_3H_8) ppm	Butane (C_4H_{10}) ppm	Pentane (C_5H_{12}) ppm
Well 5	3.2	70.0	19.0	8.3	2.4	39	1	1
Well 9	15.0	67.0	8.2	8.3	2.0	40	1	1

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

Table 5

Reduced Gas Chromatographic Analysis Results

Location	Concentration (% by Volume)			
	Oxygen (O_2)	Nitrogen (N_2)	Carbon Dioxide (CO_2)	Methane (CH_4)
Well 1	20	75	3.2	0.54
Well 4	18	73	1.2	1.3
Well 6	21	76	0.07	1.6
Well 10	21	77	0.05	0.01
Well 11	8.4	80	12.5	0.5
Well 12	10	45	19.0	27.3
Well 17	15	77	6.0	0.10
Well 18	21	76	.21	.24
Magazine 57	20	74	.05	.01
Magazine 353	22	77	.05	.01

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

Table 6

Combustible Gas Meter Results

	Percentage of Methane By Volume
Well 1	>3.40
Well 2	negative*
Well 3	negative
Well 4	1.30
Well 5	1.10
Well 6	0.40
Well 7	negative
Well 8	negative
Well 9	>3.40
Well 10	negative
Well 11	0.70
Well 12	>3.40
Well 17	0.02
Well 18	0.20
Well 19	negative
Magazine 56	negative
Magazine 57	negative
Magazine 58	negative
Magazine 353	negative

3.4% is the maximum the meter can measure when converted to methane concentrations.

* Means no gas measured.

SOURCE: HARDING-LAWSON ASSOCIATES, 1978

ANALYTICAL SCIENCE ASSOCIATES, Inc.

4560 HORTON ST. • EMERYVILLE, CA 94608 • (415) 547-6390

HLA Project No. 2176,059.01
April 1, 1983

ABSTRACT

Samples were received from the Alameda Naval Air Station on March 16 and 17 for the screening of Priority Pollutants. No contaminants were detected in the volatile or Base-Neutral fraction. The acid and pesticide fractions contained traces of phenol and polychlorinated biphenyls. No metals were detected above 1 ppm.

METHODS

I Volatile Fraction

Samples were analyzed by gas-chromatography[1,2] for the volatile priority pollutants using GCFID and GCHSD under the following analytical conditions:

Instrument	:	Perkin Elmer 3B
Column	:	SP 1000/Carbopack B
Program	:	50°-200° @ 8°/minute

II Base Neutral/Acid Fraction

Samples were analyzed by GCFID under the following analytical conditions:

Instrument	:	Perkin Elmer 3920
Column	:	1% SP2150 DB; Tenax 60/80
Program	:	50°-270° @ 8°/minute; 180°-300°

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

III Pesticide Fraction

The 6, 15 and 50 percent Florisil fractions were analyzed[3] by GCHSD under the following conditions:

Instrument	:	Perkin Elmer 38
Column	:	3% OV1
Temperature	:	180°C

IV Metals

Samples were filtered (0.45 um) and analyzed by Atomic Absorption spectroscopy.

RESULTS

Data are presented in Table I. Only the actual organic components found have been reported.

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1. 40 CFR, part 141 app. C
2. Sampling and Analysis Procedures for the Screening of Industrial Effluents. EPA 1979
3. Methods for the Organic Analysis of Water and Wastes. EPA 1980.

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

TABLE I

LANDFILL WELL NO.	17	18	3	19	9	8	near 6	near 12
Sample ID	9001	9002	9003	9004	9005	9006	9007	9008
Cadmium	0.053	0.03	0.024	0.024	0.018	0.011	0.012	0.009
Copper	0.72	0.06	0.06	0.04	0.04	0.03	0.06	0.08
Lead	0.17	0.09	0.07	0.05	0.06	0.06	0.07	0.06
Selenium	0.08	0.04	0.03	0.04	0.04	0.04	0.03	0.04
Silver	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05
Zinc	0.48	0.13	0.038	0.032	0.16	0.013	0.044	0.076
Oil & Grease	30	20	15	50	80	40	20	15
Phenol (ppb)	26	11	k10	k10	11	10	11	10
TICH (ppb, as arochlor 1248)	0.52	0.08	0.05	0.60	0.40	k0.05	0.20	0.10
Arsenic	0.09	0.06	0.05	0.06	0.04	0.04	0.05	0.05
Beryllium	0.012	k0.01	k0.01	k0.01	k0.01	k0.01	k0.01	k0.01
pH	7.4	7.0	7.3	7.1	7.2	7.2	7.5	7.7
Conductivity	6400	19,000	13,000	16,000	2700	3500	1500	1300
Nickel	0.11	0.11	0.10	0.13	0.12	0.07	0.06	0.07

All values in ppm unless otherwise noted.

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

ADDENDUM

LANDFILL WELL NO.	17	18	3	19	9	8	near 6	near 12
Sample ID	9001	9002	9003	9004	9005	9006	9007	9008
Chromium	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05	k0.05
Mercury	0.0008	k0.0001	k0.0001	k0.0001	0.0002	k0.0001	k0.0001	k0.0001
Magnesium	120	420	420	420	57	68	33	35

All values in ppm unless otherwise noted.

k = less than value

SOURCE: HARDING-LAWSON ASSOCIATES, 1983

EAL Corporation

Thermo Electron CORPORATION

2030 Wright Avenue
Richmond, California 94804
(415) 235-2633
(TWX) 910-382-8132

ANALYSIS REPORT

HARDING LAWSON ASSOCIATES
P O BOX 578
NOVATO CA 94947
Attention: Lyle Lewis

DATE: 9-7-83
Samples Received: 8-8-83
EAL W.O. No. 45-5300
Harding Lawson Job #: 2176.059.01
Samples Collected: 8-2-83

Well No.		23	21
		ANLW-16	ANLW-31
Analysis	Units	255-84-7	255-84-8
Antimony	MG/L	0.70	<0.01
Arsenic	MG/L	0.044	0.006
Beryllium	MG/L	<0.01	<0.01
Cadmium	MG/L	0.057	0.005
Chromium	MG/L	0.057	<0.01
Copper	MG/L	0.09	0.020
Lead	MG/L	0.33	0.04
Mercury	MG/L	<0.0005	<0.0005
Nickel	MG/L	0.40	0.08
Selenium	MG/L	0.06	<0.006
Silver	MG/L	0.053	<0.01
Thallium	MG/L	0.2	<0.01
Zinc	MG/L	0.087	0.043

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Report to HARDING LAWSON ASSOCIATES

Well No.		22	23	21	22
Analysis	Units	ANLW-35 255-84-9	ANLW-16 255-84-10	ANLW-31 255-84-11	ANLW-35 255-84-12
Antimony	MG/L	0.62	---	---	---
Arsenic	MG/L	0.056	---	---	---
Beryllium	MG/L	<0.01	---	---	---
Cadmium	MG/L	0.055	---	---	---
Chromium	MG/L	0.057	---	---	---
Copper	MG/L	0.06	---	---	---
Lead	MG/L	0.28	---	---	---
Mercury	MG/L	<0.001	---	---	---
Nickel	MG/L	0.41	---	---	---
Selenium	MG/L	0.04	---	---	---
Silver	MG/L	0.052	---	---	---
Thallium	MG/L	0.2	---	---	---
Zinc	MG/L	0.036	---	---	---
Cyanide	MG/L	---	<0.02	<0.02	<0.02

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Report to HARDING LAWSON ASSOCIATES

Well No.		23	21	22
		ANLW-16	ANLW-31	ANLW-35
Analysis	Units	255-84-13	255-84-14	255-84-15
Phenol, Total	MG/L	<0.1	<0.1	<0.1

Results for pesticides, volatile organics, and acid & base/neutrals attached

Laurence E. Penfold
Program Manager
Environmental Science Dept.

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-2
Client I.D.: ANLW-30 8-2-83
Well No. 21

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)	BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10	4-bromophenyl phenyl ether	< 2
p-chloro-m-cresol	< 10	bis(2-chloroisopropyl) ether	< 2
2-chlorophenol	< 10	bis(2-chlorethoxy)methane	< 2
2,4-dichlorophenol	< 10	hexachlorobutadiene	< 2
2,4-dimethylphenol	< 10	hexachlorocyclopentadiene	< 2
2-nitrophenol	< 10	isophorone	< 2
4-nitrophenol	< 10	napthalene	104
2,4-dinitrophenol	< 10	nitrobenzene	< 2
4,6-dinitro-2-methylphenol	< 10	N-nitrosodimethylamine	< 2
pentachlorophenol	< 10	N-nitrosodiphenylamine	< 2
phenol	< 10	N-nitrosodi-n-propylamine	< 2
BASE/NEUTRAL COMPOUNDS	**ug/L(ppb)**	bis(2-ethylhexyl)phthalate	10
acenaphthene	< 2	butyl benzyl phthalate	< 2
benzidine	<10	di-n-butyl phthalate	< 2
1,2,4-trichlorobenzene	< 2	di-n-octyl phthalate	< 2
hexachlorobenzene	< 2	diethyl phthalate	< 2
hexachloroethane	< 2	dimethyl phthalate	< 2
bis(2-chloroethyl)ether	< 2	benzo(a)anthracene	< 2
2-chloronaphthalene	< 2	benzo(a)pyrene	< 2
1,2-dichlorobenzene	< 2	benzo(b)fluoranthene	< 2
1,3-dichlorobenzene	< 2	benzo(k)fluoranthene	< 2
1,4-dichlorobenzene	< 2	chrysene	< 2
3,3'-dichlorobenzidine	<10	acenaphthylene	< 2
2,4-dinitrotoluene	< 2	anthracene	< 2
2,6-dinitrotoluene	< 2	benzo(ghi)perylene	< 2
2,2-diphenylhydrazine	< 2	fluorene	< 2
(as azobenzene)	< 2	phenanthrene	< 2
fluoroanthene	< 2	dibenzo(a,h)anthracene	< 2
4-chlorophenyl phenyl ether	< 2	indeno(1,2,3-cd)pyrene	< 2
2-methylnaphthalene	16	pyrene	< 2

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-3

Client I.D.: ANLW-34 8-2-83
Well No. 22

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10
p-chloro-m-cresol	< 10
2-chlorophenol	< 10
2,4-dichlorophenol	< 10
2,4-dimethylphenol	< 10
2-nitrophenol	< 10
4-nitrophenol	< 10
2,4-dinitrophenol	< 10
4,6-dinitro-2-methylphenol	< 10
pentachlorophenol	< 10
phenol	< 10

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
acenaphthene	< 2
benzidine	< 10
1,2,4-trichlorobenzene	< 2
hexachlorobenzene	< 2
hexachloroethane	< 2
bis(2-chloroethyl)ether	< 2
2-chloronaphthalene	< 2
1,2-dichlorobenzene	< 2
1,3-dichlorobenzene	< 2
1,4-dichlorobenzene	< 2
3,3'-dichlorobenzidine	< 10
2,4-dinitrotoluene	< 2
2,6-dinitrotoluene	< 2
2,2-diphenylhydrazine	< 2
(as azobenzene)	< 2
fluoroanthene	< 2
4-chlorophenyl phenyl ether	< 2

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
4-bromophenyl phenyl ether	< 2
bis(2-chloroisopropyl) ether	< 2
bis(2-chlorethoxy)methane	< 2
hexachlorobutadiene	< 2
hexachlorocyclopentadiene	< 2
isophorone	< 2
napthalene	< 2
nitrobenzene	< 2
N-nitrosodimethylamine	< 2
N-nitrosodiphenylamine	< 2
N-nitrosodi-n-propylamine	< 2
bis(2-ethylhexyl)phthalate	< 2
butyl benzyl phthalate	< 2
di-n-butyl phthalate	< 2
di-n-octyl phthalate	< 2
diethyl phthalate	< 2
dimethyl phthalate	< 2
benzo(a)anthracene	< 2
benzo(a)pyrene	< 2
benzo(b)fluoranthene	< 2
benzo(k)fluoranthene	< 2
chrysene	< 2
acenaphthylene	< 2
anthracene	< 2
benzo(ghi)perylene	< 2
fluorene	< 2
phenanthrene	< 2
dibenzo(a,h)anthracene	< 2
indeno(1,2,3-cd)pyrene	< 2
pyrene	< 2

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-1
Client I.D.: ANLW-15 8-2-83
Well No. 23

PRIORITY POLLUTANT DATA SHEET

ACID COMPOUNDS	ug/L(ppb)
2,4,6-trichlorophenol	< 10
p-chloro-m-cresol	< 10
2-chlorophenol	< 10
2,4-dichlorophenol	< 10
2,4-dimethylphenol	38
2-nitrophenol	< 10
4-nitrophenol	< 10
2,4-dinitrophenol	< 10
4,6-dinitro-2-methylphenol	< 10
pentachlorophenol	< 10
phenol	< 10

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
acenaphthene	< 2
benzidine	<10
1,2,4-trichlorobenzene	< 2
hexachlorobenzene	< 2
hexachloroethane	< 2
bis(2-chloroethyl)ether	< 2
2-chloronaphthalene	< 2
1,2-dichlorobenzene	< 2
1,3-dichlorobenzene	< 2
1,4-dichlorobenzene	< 2
3,3'-dichlorobenzidine	<10
2,4-dinitrotoluene	< 2
2,6-dinitrotoluene	< 2
2,2-diphenylhydrazine	< 2
(as azobenzene)	< 2
fluoroanthene	< 2
4-chlorophenyl phenyl ether	< 2

BASE/NEUTRAL COMPOUNDS	ug/L(ppb)
4-bromophenyl phenyl ether	< 2
bis(2-chloroisopropyl) ether	< 2
bis(2-chlorethoxy)methane	< 2
hexachlorobutadiene	< 2
hexachlorocyclopentadiene	< 2
isophorone	< 2
napthalene	80
nitrobenzene	< 2
N-nitrosodimethylamine	< 2
N-nitrosodiphenylamine	< 2
N-nitrosodi-n-propylamine	< 2
bis(2-ethylhexyl)phthalate	6
butyl benzyl phthalate	< 2
di-n-butyl phthalate	< 2
di-n-octyl phthalate	< 2
diethyl phthalate	< 2
dimethyl phthalate	< 2
benzo(a)anthracene	< 2
benzo(a)pyrene	< 2
benzo(b)fluoranthene	< 2
benzo(k)fluoranthene	< 2
chrysene	< 2
acenaphthylene	< 2
anthracene	< 2
benzo(ghi)perylene	< 2
fluorene	< 2
phenanthrene	< 2
dibenzo(a,h)anthracene	< 2
indeno(1,2,3-cd)pyrene	< 2
pyrene	< 2

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-5

Client I.D.: ANLW 28 & 29
Well No. 21

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	< 5	trans-1,3-dichloropropene	< 1
acrylonitrile	< 5	cis-1,3-dichloropropene	< 1
benzene	6	ethylbenzene	5
carbon tetrachloride	< 1	methylene chloride	<10
chlorobenzene	31	chloromethane	< 1
1,2-dichloroethane	< 1	bromomethane	< 1
1,1,1-trichloroethane	< 1	bromoform	< 1
1,1-dichloroethane	< 1	bromodichloromethane	< 1
1,1,2-trichloroethane	< 1	fluorotrichloromethane	< 1
1,1,2,2-tetrachloroethane	< 1	dichlorodifluoromethane	< 1
chloroethane	< 1	chlorodibromomethane	< 1
2-chloroethylvinyl ether	< 1	tetrachloroethene	< 1
chloroform	< 1	toluene	7
1,1-dichloroethene	< 1	trichloroethene	< 1
trans-1,2-dichloroethene	< 1	vinyl chloride	< 1
1,2-dichloropropane	< 1	acetone	620
		o-xylene	11

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-6

Client I.D.: ANLW 32 & 33 8-2-83
Well No. 22

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	< 5	trans-1,3-dichloropropene	< 1
acrylonitrile	< 5	cis-1,3-dichloropropene	< 1
benzene	< 1	ethylbenzene	< 1
carbon tetrachloride	< 1	methylene chloride	<10
chlorobenzene	< 1	chloromethane	< 1
1,2-dichloroethane	< 1	bromomethane	< 1
1,1,1-trichloroethane	< 1	bromoform	< 1
1,1-dichloroethane	< 1	bromodichloromethane	< 1
1,1,2-trichloroethane	< 1	fluorotrichloromethane	< 1
1,1,2,2-tetrachloroethane	< 1	dichlorodifluoromethane	< 1
chloroethane	< 1	chlorodibromomethane	< 1
2-chloroethylvinyl ether	< 1	tetrachloroethene	< 1
chloroform	< 1	toluene	< 1
1,1-dichloroethene	< 1	trichloroethene	< 1
trans-1,2-dichloroethene	< 1	vinyl chloride	< 1
1,2-dichloropropane	< 1		

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-4
Client I.D.: ANLW 13 & 14 8-2-83
Well No. 23

PRIORITY POLLUTANT DATA SHEET

VOLATILES	ng/mL(ppb)	VOLATILES	ng/mL(ppb)
acrolein	<25	trans-1,3-dichloropropene	< 5
acrylonitrile	<25	cis-1,3-dichloropropene	< 5
benzene	< 5	ethylbenzene	< 5
carbon tetrachloride	< 5	methylene chloride	<50
chlorobenzene	< 5	chloromethane	< 5
1,2-dichloroethane	< 5	bromomethane	< 5
1,1,1-trichloroethane	< 5	bromoform	< 5
1,1-dichloroethane	< 5	bromodichloromethane	< 5
1,1,2-trichloroethane	< 5	fluorotrichloromethane	< 5
1,1,2,2-tetrachloroethane	< 5	dichlorodifluoromethane	< 5
chloroethane	< 5	chlorodibromomethane	< 5
2-chloroethylvinyl ether	< 5	tetrachloroethene	< 5
chloroform	< 5	toluene	235
1,1-dichloroethene	< 5	trichloroethene	< 5
trans-1,2-dichloroethene	< 5	vinyl chloride	< 5
1,2-dichloropropane	< 5		

NON-PRIORITY POLLUTANTS

tetrahydrofuran	25	diethylether	25
diethylacetate	25	1-ethyl-4-methylbenzene	22
ozulene	22		

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-2

Client I.D.: ANLW-31
Well No. 21

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	0.2	pp-DDT (4,4')	<0.1
g-BHC (lindane)	<0.1	Endrin Aldehyde	<0.1
B-BHC	<0.1	Endosulfan Sulfate	0.1
Heptachlor	0.4	Chlordane	<0.1
D-BHC	<0.1	Toxaphene	<3
Aldrin	<0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.2
a-Endosulfan	<0.1	PCB-1221	<0.2
p,p-DDE (4,4')	<0.1	PCB-1232	<0.2
Dieldrin	<0.1	PCB-1242	<0.2
Endrin	<0.1	PCB-1254	<0.2
p,p-DDD (4,4')	<0.1	PCB-1260	<0.2
B-Endosulfan	<0.1	PCB-1262	<0.2
1,2,3,4-TCDD	<0.1		

Harding Lawson

Date: September 7, 1983

EAL Lab No.: 255-84-3

Client I.D.: ANLW-34
Well No. 22

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	<0.1	pp-DDT (4,4')	<0.1
g-BHC (lindane)	0.3	Endrin Aldehyde	<0.1
B-BHC	<0.1	Endosulfan Sulfate	<0.1
Heptachlor	0.2	Chlordane	<0.1
D-BHC	<0.1	Toxaphene	<0.6
Aldrin	0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.1
a-Endosulfan	<0.1	PCB-1221	<0.1
p,p-DDE (4,4')	<0.1	PCB-1232	<0.1
Dieldrin	<0.1	PCB-1242	<0.1
Endrin	<0.1	PCB-1254	<0.1
p,p-DDD (4,4')	<0.1	PCB-1260	<0.1
B-Endosulfan	<0.1	PCB-1262	<0.1
1,2,3,4-TCDD	<0.1		

Harding Lawson

Date: September 7, 1983
EAL Lab No.: 255-84-1
Client I.D.: ANLW-15
Well No. 23

PRIORITY POLLUTANT DATA SHEET

PESTICIDES	ug/L (ppb)	PESTICIDES	ug/L (ppb)
a-BHC	<0.1	pp-DDT (4,4')	0.7
g-BHC (lindane)	<0.1	Endrin Aldehyde	0.1
B-BHC	<0.1	Endosulfan Sulfate	0.5
Heptachlor	<0.1	Chlordane	<0.1
D-BHC	0.2	Toxaphene	<3
Aldrin	<0.1	PCB's	
Heptachlor Epoxide	<0.1	PCB-1016	<0.2
a-Endosulfan	<0.1	PCB-1221	<0.2
p,p-DDE (4,4')	<0.1	PCB-1232	<0.2
Dieldrin	<0.1	PCB-1242	<0.2
Endrin	<0.1	PCB-1254	<0.2
p,p-DDD (4,4')	<0.1	PCB-1260	<0.2
B-Endosulfan	<0.1	PCB-1262	<0.2
1,2,3,4-TCDD	<0.1		

ANALYTICAL SCIENCE ASSOCIATES, Inc.

4560 HORTON ST. • EMERYVILLE, CA 94608 • (415) 547-6390

7 September 1983

Lyle Lewis
HARDING LAWSON ASSOCIATES
P. O. Box 578
Novato, CA 94948

Dear Lyle:

Enclosed is the Alameda Naval Air Station Analytical Report. If you have any questions please call.

Sincerely,

Bill

William Prater

WP:la

Enclosure

ABSTRACT

Samples from Alameda Naval Air Station were screened for Priority Pollutants and pesticides using EPA 608/624/625 GCFID/EC methodology. The only parameters found were low-level (<10 ppb) PCB ontamination in two wells.

METHODS

(A) Volatile Fraction

Samples were analyzed for volatile components by GCEC/FID[1] using the following analytical conditions:

Instrument	:	Perkin-Elmer Sigma 3
Detector	:	EC/FID
Column	:	SP1000/Graphitized Carbon Black
Temperature	:	50° - 210° C.

(B) Base-Neutral/Acid Fraction

Samples were analyzed[2] under the following analytical conditions:

Instrument	:	Perkin-Elmer Sigma 3B
Detector	:	FID
Column	:	SP2100 DB; SP1240 DA
Temperature	:	50° - 270°; 50° - 200°
Internal Standard	:	D_{10}Anthracene; 2 Nitrophenol

(C) Pesticides/PCB's

Samples were analyzed[2] under the following analytical conditions:

Instrument	:	Perkin-Elmer 3B
Detector	:	EC
Column	:	3% OV1
Temperature	:	180°C
Internal Standard	:	Aldrin

1. 40 CFR Part III, App. C.
2. 40 CFR Vol 44, #233.

TABLE I

All values in ppb

SAMPLE ID	Well No.	VOLATILE	ACID, B-N	PESTICIDES/PCB's(3)
W01	19	<1	<20	-
W04	3	<1	<20	-
W07	24	<1	<20	-
W10	Blank	<1	<20	-
W17	25	<1	<20	-
W20	9	<1	<20	-
W23	20	<1	<20	-
W36	8	<1	<20	-
W201	19	<1	<20	ND
W203	20	<1	<20	8
W205	9	<1	<20	ND
W207	Blank	<1	<20	ND
W209	3	<1	<20	ND
W211	24	<1	<20	ND
W213	23	<1	<20	ND
W215	8	<1	<20	ND
W217	18	<1	<20	ND
W219	25	<1	<20	ND
W221	21	<1	<20	4
W223	22	<1	<20	ND

(3) **Detection Limit 1 ppb.**

TABLE II

PERCENT RECOVERY
OF INTERNAL STANDARDS

SAMPLE ID.	VOLATILE(1)	ACID(2)	B-N(3)	PESTICIDES(4) & PCBs
W01	95	79	98	
W04	97	85	100	
W07	93	85	100	
W10	95	90	96	
W17	95	88	95	
W20	96	89	100	
W23	98	79	95	
W36	99	75	92	
W201	93	80	100	85
W203	95	82	100	85
W205	99	80	100	90
W207	95	85	95	100
W209	96	80	96	85
W211	94	90	97	88
W213	95	85	95	89
W215	95	85	100	90
W217	100	90	95	89
W219	100	88	95	90
W221	95	90	96	88
W223	96	85	99	90

1. Bromodichloromethane
2. 2 Nitrophenol
3. D_{10}Anthracene
4. Aldrin

APPENDIX B

BORING LOGS FROM PREVIOUS STUDIES

BORING LOCATION Opposite to Ground Electronics Maintenance Division			GROUND EL.
DEPTH/ELEV. WATER 4.5 ft	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 25 ft
DRILL RIG Mobile B-24	BORING DIA. 8" ϕ HA	DATE DRILLED 10/12/84	LOGGED BY JMc/CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR/RQD	REC.	MODE	REMARKS
GP	0.0'-3.0' Sandy GRAVEL, angular to rounded gravel to ~2" max. with some minor rubble within top 2", tan/light brown (0-2') to dark brown (2'-3'), moist	0				HA	
SP	3.0'-20.0' Fine to Medium SAND with gravel, brown changing to gray at 4 ft, moist to saturated at 5 ft, mild organic odor at 3 ft.		S-1A S-1B	2/4/6	18"	DR	▽ Minor gas odor at 4 ft
		5	S-2A S-2B	5/3/3	14"	DR	4% LEL at 5 ft Minor gas odor
						HA	
				2/6/16		DR	Auger at 10 ft, stem filled to ~7.5 ft with running sand. PR taken in the stem
		10				HA	Poor cuttings return throughout interval
				4/3/3		DR	Auger at 15 ft, stem filled to ~13 ft with running sand. PR taken in the stem.
		15				HA	
MH-ML	20.0'-25.0' Clayey SILT, some sand, gray, soft, saturated	20					Installed 2" ϕ sch. 40 PVC pipes, (0-5 ft: blank, 5-25 ft: slotted, 0.01")
	[illegible] = 25'	25					

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG	BORING NO.
		PROJECT NO. WA/112A / SHEET NO. 1 OF 1	WA-1

BORING LOCATION North End of Skeet Range			GROUND EL.
DEPTH/ELEV. WATER 3 ft ±	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 21.5 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/12/84	LOGGED BY JMc/CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP	0.0'-5.0' Sandy GRAVEL, gravel particles are 3/4" to 1½" in size, light brown, some concrete rubble up to 12"x 12"x3".	0				HA	DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES. THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION. THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS. THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL. SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM
SP-GP	5.0'-8.0' Gravelly fine to medium SAND, brown to gray, damp to wet	5	S-1A S-1B	2/4/4	12"	DR	
						HA	
SP	8.0'-19.0' Fine to Medium SAND, blue gray, saturated	10					Moderate petroleum fuel odor. Definite oily band on sampler @ 10', oil sheen on spilled water
	Gray-brown, appeared oxidized						Much milder odor at about 12 ft
	Numerous shell fragments to ¼" at about 15 ft	15		2/5/3		DR	Auger at 15 ft, stem filled to ~10 ft with running sand
						HA	
MH-CH	19.0-21.5' Clayey SILT, blue gray, saturated, soft, plastic, sometimes dilatant	20		1/1/0		DR	Trace gray clay on bit and plug. No fuel smell
	Hole terminated at 20.5' after drilling out the sampled interval						Installed 2" Φ sch. 40 PVC Threaded; (0-5.5': blank, 5.5'-19.5' slotted, 0.01")

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG — PROJECT NO. [illegible] — SHEET NO. [illegible] OF [illegible]	BORING NO. NA-2

BORING LOCATION By the Fence of Party Hut Picnic Ground			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 20.0 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/15/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
SM-SP	0.0'-5.0' Fine SAND with wood chips and rubble, Moist, dark gray and black	0				HA	
SP	5.0'-8.0' Fine to medium SAND with wood chips, rubble, wires, etc., black.	5	S-1	2/2/3	6"	DR	Strong diesel and oil odor
						HA	
SD	8.0'-16.5' Fine to medium SAND, gray, saturated, loose, saturated	10		1/14" and 1/6"		DR	Diesel odor (not as strong as S-1). 8% LEL at 10 ft
						HA	
		15		2/1/0		DR	400 ppm at 15 ft. At the last 6" drive, the sampler dropped to about 18 ft
CH-MH	16.5'-20.0' Silty CLAY, gray, very soft					HA	Sidewall pressure: drive rotation pressure (on 3rd gear) increased from 600 to 715 psi
	Hole terminated at 20 ft	20					Installed 2" Φ sch. 40 PVC pipes, (0-6' blank, 6'-16' slotted, 16'-20' blank)

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG — PROJECT NO. NAV1123 — SHEET NO. 1 OF 1	BORING NO. WA-3

BORING LOCATION West End of Runway 7, Northwestern Corner			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR		TOTAL DEPTH
DRILL RIG	BORING DIA.	DATE DRILLED	LOGGED BY

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / ROD	REC.	MODE	REMARKS
		25				DR	Same condition occurred at 25 ft. No sampling
						HA	
CH	22.0'-31.5' Silty CLAY, trace sand and shells, gray, soft.	30		1/1/1		DR	
	Terminated at 31.5 ft						Installed 2" ϕ sch. 40 PVC pipes (0-5': blank 5'-25' slotted, 25'-30': blank). Material kep: coming up in the stem. Hole was cleaned one more time before being able to set the tip of the pipe at 30 ft

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN OR LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG		BORING NO.
		PROJECT NO.	SHEET NO.	
		NAV 112A	2 OF 2	NA-C

BORING LOCATION West End of Runway 7, Northwestern Corner			GROUND EL.
DEPTH/ELEV. WATER 4 ft	DRILL CONTRACTOR EXCELTECH-RPM		TOTAL DEPTH 31.5 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/17/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH (ft)	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP-GC	0.0'-4.0' Gravelly fine SAND, some silt and clay, dark brown, moist, gravel to ~2" max., some rubble and roots	0				HA	
SP	4.0'-14.0' Fine to medium SAND, some gravel, brown, moist. Became saturated at ~5 feet.	5	S-1	7/2/10	18"	DR	No noticeable odor
						HA	
		10		3/5/6		DR	
						HA	
SM-SP	4.0'-28.0' Fine to medium SAND, some silt, trace gravel, dark gray, saturated. No noticeable odor. (Gas meter did not register any reading)	15				DR	Much water came out with cutting during drilling. Could not get sample at this depth. Drillers could not get the plug out because of running sand. Water was poured into the stem and driven through.
						HA	
		20				DR	Same condition occurred at 20'. No sampling
						HA	
	More silt and less gravel	25					

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG — PROJECT NO. NAV 113A — SHEET NO. 1 OF 2	BORING NO. WA-4

BORING LOCATION North End of Runway 13, West side			GROUND EL.
DEPTH/ELEV. WATER 5 ft	DRILL CONTRACTOR		TOTAL DEPTH 26.5 ft
DRILL RIG Mobile B-34	BORING DIA. 8" Φ HA	DATE DRILLED 10/19/84	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
GP-GM	0.0'-5.0' Silty GRAVEL and SAND, some cobble, rubble, groves, etc., damp, dark brown	0				HA	
GP-GM	5.0'-10.0' Silty GRAVEL and SAND, some cobble, moist to wet, dark brown	5	S-1A S-1B	12/14/5	18"	DR	Gas meter reading negligible
						HA	Radiation survey meter reading negligible
GP-GM	10.0'-24.0' Fine to medium SAND, some silt, trace shells and gravel, gray, saturated, loose	10		2/3/4		DR	Gas meter reading negligible
						HA	Radiation survey meter reading negligible
		15		1/2/4		DR	
						HA	
		20		3/3/5		DR	
						HA	
	(See next sheet)	25					

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG PROJECT NO. NAV 112 A SHEET NO. 1 OF 2	BORING NO. WA-5

BORING LOCATION North End of Runway 13, West side			GROUND EL.
DEPTH/ELEV. WATER	DRILL CONTRACTOR		TOTAL DEPTH
DRILL RIG	BORING DIA.	DATE DRILLED	LOGGED BY

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
CH-MH	24.0'-26.5' Silty CLAY, trace sand, gravel and shells, dark gray, soft	25		1/0/1		DR	
	Hole terminated at 26.5'	30					Installed 2"Φ Sch. 40 PVC pipes (0-4' blank 4'-24' slotted) The stem was filled with soft material. The hole was cleaned and the tip of the pipe was set at 24ft.

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

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SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG		BORING NO.
		PROJECT NO. NAV 112A	SHEET NO. 2 OF 2	NA-5

LOG OF BORING 1

Equipment 6" Flight Auger

Elevation 115.5* feet Date 10/29/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SILTY SAND (SM) loose to medium dense, moist, with debris
			5		
			10		water level 4/18/77
			15		BROWN SAND (SP) loose, saturated,
			20		
			25		
			30		
			35		
			40		

Refuse Fill

Hydraulic Fill

*Reference: Topo, NAS Alameda Sanitary Dump Facility, 1975, by M. B. Cristi

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Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 1

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 2

LOG OF BORING 2

Equipment 5" Rotary Wash

Elevation 113.4 feet Date 10/26/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN-BLACK CLAY (CH) very soft, moist
			5		LIGHT BROWN CLAYEY SAND (SC) loose, saturated
	22.9	94			
					water level 4/7/77
			10		GRAY SILTY SAND (SM) loose, saturated
			15		Hydraulic Fill
			20		
			25		GRAY SILTY CLAY (CH) very soft, saturated, (bay mud)
			30		
			45		LIGHT BROWN CLAYEY SAND (SC) medium dense, saturated
	17.6	113			
			50		

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LOG OF BORING 2

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 3

LOG OF BORING 3

Equipment 5" Rotary Wash

Elevation 111.4 feet Date 10/25/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
97% passing No. 200 sieve	64.7	59	0		BROWN-GRAY CLAY (CH) very soft, saturated
			5		LIGHT GRAY CLAYEY SAND (SC) medium dense, saturated water level 4/18/77
			10		LIGHT GRAY-BROWN CLAYEY SAND (SC) - very loose, saturated
			15		
			20		
			25		
	23.6	99			
			30		GRAY SILTY CLAY (CL) very soft, saturated, (bay mud)
			35		
			40		

Hydraulic Fill

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LOG OF BORING 3

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 4

LOG OF BORING 4

Equipment 5" Rotary Wash

Elevation 110.7 feet Date 10/21/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
13% passing No. 200 sieve	18.5	104	0		LIGHT BROWN CLAYEY SAND (SC) loose, dry, with debris
			5		DARK GRAY SILTY SAND (SM) medium dense, saturated, with concrete rubble — water level 4/18/77
			10		
			15		
			20		DARK GRAY CLAY (CH) soft, saturated, (bay mud)
			25		
			30		
			35		
			40		

Refuse Fill

Hydraulic & Sea Wall Fill

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LOG OF BORING 4

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 5

LOG OF BORING 5

Equipment 5" Rotary Wash

Elevation 110.1 Date 10/20/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
	5.0	122	0		BROWN SILTY SANDY GRAVEL (GM) medium dense, dry
					BLACK SILTY SAND (SM) loose, moist, with debris
					water level 4/18/77
			5		
			10		
					DARK GRAY SILTY SAND (SM) loose, saturated
			15		
	32.7	84	20		
			25		BLACK CLAY (CH) very soft, saturated, (bay mud)
			30		
			35		
			40		

Refuse Fill

Hydraulic Fill

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Job No. 2176,030.01 Appr: KD Date 5/20/77

LOG OF BORING 5

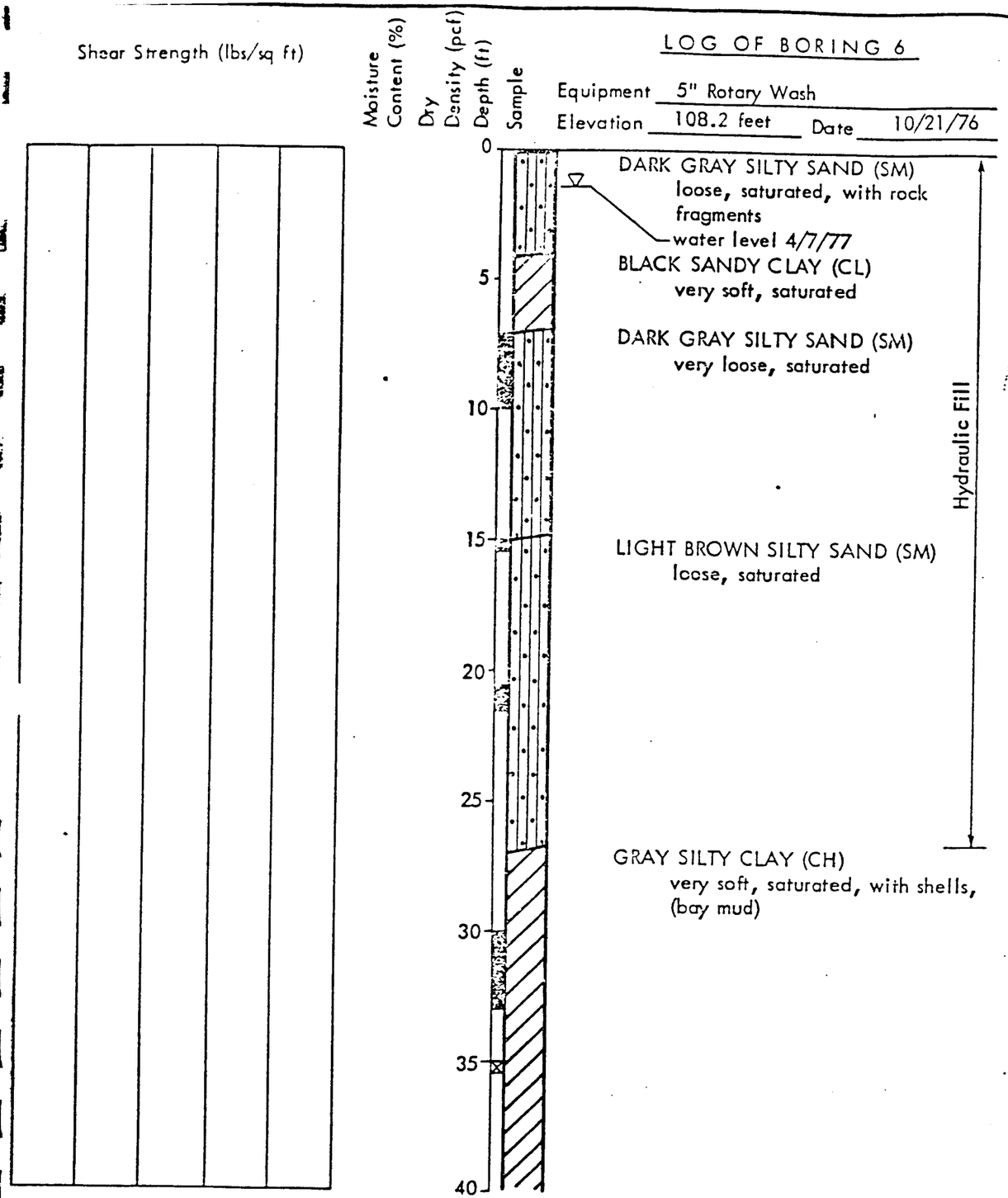
Sanitary Landfill Site
Alameda Naval Air Station

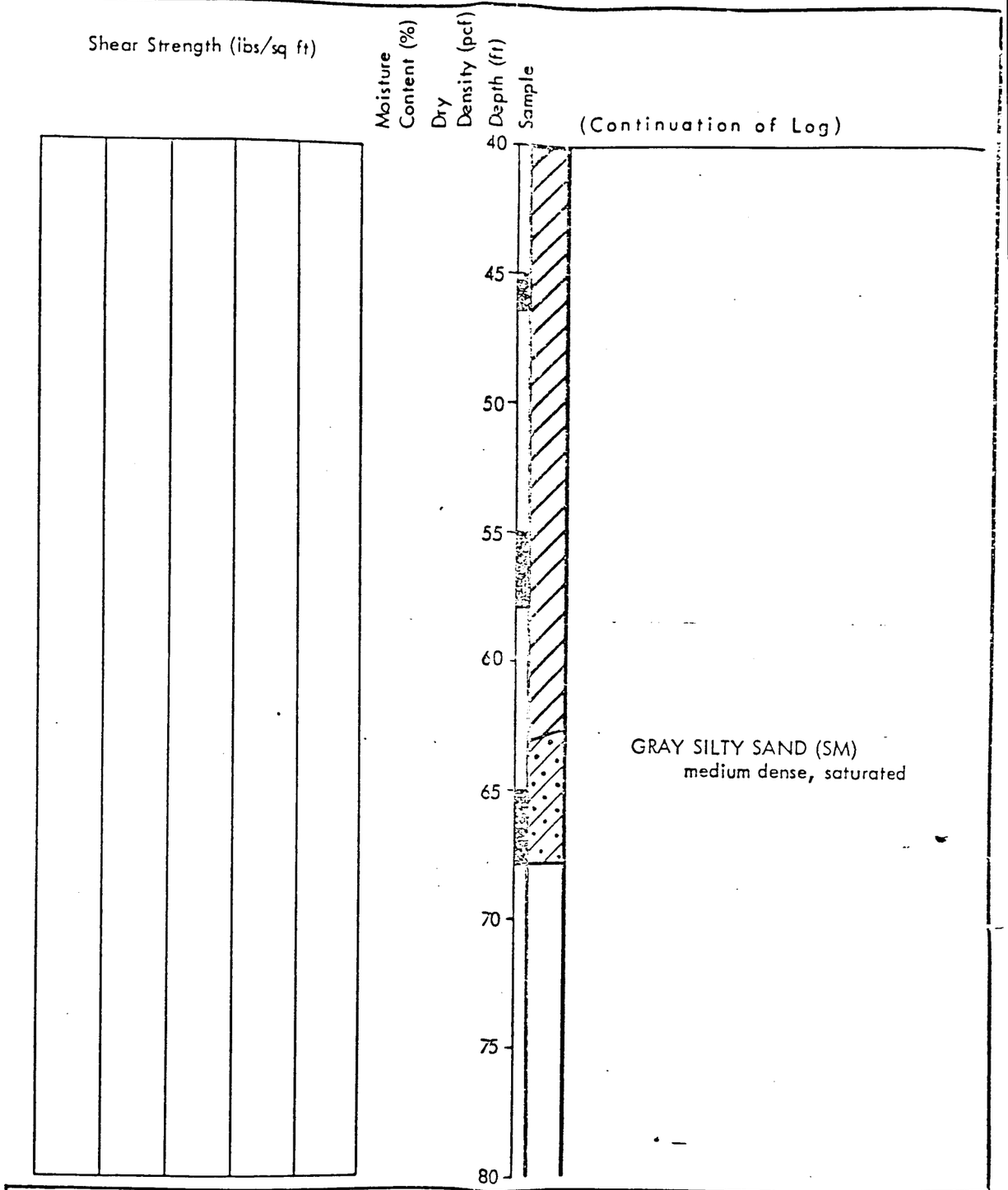
PLATE 6

LOG OF BORING 6

Equipment 5" Rotary Wash

Elevation 108.2 feet Date 10/21/76





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Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 6
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 7

LOG OF BORING 7

Equipment 5" Rotary Wash

Elevation 109.9 feet Date 10/25/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description	
			0		LIGHT BROWN SILTY SAND (SM) loose, with debris water level 4/7/77	Refuse Fill
			5		GRAY SILTY SAND (SM) loose, saturated	Hydraulic Fill
			10		LIGHT BROWN SILTY SAND (SM) loose, saturated	Hydraulic Fill
			15		LIGHT GRAY CLAY (CH) very soft, saturated, (bay mud)	
			20			
			25			
			30			
			35			
			40			

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Job No 2176,030.01 Appr: JCP Date 5/10/77

LOG OF BORING 7

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 8

LOG OF BORING 8

Equipment 8" Hollow Auger

Elevation 114.0 feet Date 10/29/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SAND (SP) medium dense, moist, with debris
			5		water level 4/7/77
			10		Refuse Fill
	19.2	104	15		DARK GRAY SILTY SAND (SM) loose, saturated
			20		Hydraulic Fill
			25		
			30		
			35		
			40		

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Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 8

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 9

RF11

LOG OF BORING 9

Equipment 6" Flight Auger

Elevation 113.8 feet Date 10/29/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	
			0		BROWN SILTY SAND (SM) loose to medium dense, moist, with debris
			5		water level 4/7/77
			10		Refuse Fill
			15		
			20		DARK GRAY CLAYEY SILT (MH) soft to medium stiff, saturated, (bay mud)
			25		
			30		
			35		
			40		

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LOG OF BORING 9

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 10

LOG OF BORING 10

Equipment 8" Hollow Auger

Elevation 112.0 feet Date 10/28/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		LIGHT BROWN SAND (SP) medium dense, moist, with silt lenses water level 4/7/77
	20.3	104	5		
			10		
5.7% passing No. 200 sieve	21.4	100	15		
			20		DARK GRAY SANDY SILT (ML) medium stiff, saturated
			25		
			30		
			35		
			40		

Hydraulic Fill

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Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 10

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 11

RF11

LOG OF BORING 11

Equipment 6" Flight Auger

Elevation 112.5 feet Date 10/29/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SILTY SAND (SM) loose to medium dense, with debris
			5		water level 4/7/77
			10		Refuse Fill
			15		
			20		DARK BLUE-GRAY SILTY SAND (SM) loose, saturated
			25		BLUE-GRAY CLAYEY SILT (MH) medium stiff, saturated, with lenses of silty sand
			30		Hydraulic Fill
			35		
			40		

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Job No. 2176,030.01 Appr. JCD Date 5/20/77

LOG OF BORING 11

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 12

LOG OF BORING 12

Equipment 6" Flight Auger

Elevation 113.0 feet Date 10/29/76

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	
			0		BROWN SILTY SAND (SM) loose, moist, with debris
			5		water level 4/7/77
			10		Refuse Fill
			15		
			20		DARK GRAY CLAYEY SILT (MH) medium stiff, saturated, (bay mud)
			25		DARK GRAY SILTY SAND (SM) loose, saturated
			30		
			35		
			40		

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Job No 2176,030.01 Appr JCD Date 5/20/77

LOG OF BORING 12

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 13

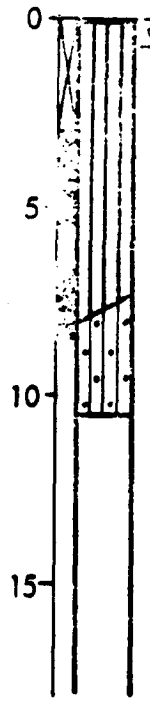
Shear Strength (lbs/sq ft) | Moisture Content (%) | Dry Density (pcf) | Depth (ft) | Sample

LOG OF BORING 13

Equipment: Hand Auger

Elevation: 109.5 feet Date: 11/9/76

82.3% passing No. 200 sieve



BROWN CLAYEY SILT (MH)
stiff, dry, (desiccated bay mud)
becoming soft, moist at 3'
water level 4/7/77

DARK GRAY SILTY SAND (SM)
loose, saturated, (fill)

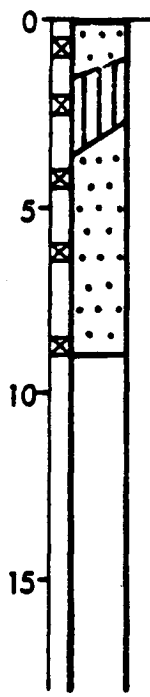
Hydraulic Fill

LOG OF BORING 14

Equipment: Hand Auger

Elevation: 113.3 feet Date: 11/9/76

15% passing No. 200 sieve



BROWN SAND (SP)
loose, moist, with organic matter

GRAY-BLACK SILT (MH)
soft, saturated

BROWN SAND (SP)
loose, moist
becoming wetter at 6'

Hydraulic Fill

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Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORINGS 13&14

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 14

N34547

Shear Strength (lbs/sq ft)

Moisture Content (%)

Dry Density (pcf)

Depth (ft)

Sample

LOG OF BORING 15

Equipment Hand Auger

Elevation 113.9 feet Date 11/16/76

0

5

10

15

LIGHT BROWN SILT (MH)
medium stiff, dry, (desiccated bay mud)

LIGHT BROWN SAND (SP)
medium dense, dry

wet at 8'

Hydraulic Fill

LOG OF BORING 16

Equipment Hand Auger

Elevation 109.3 feet Date 11/16/76

95.4% passing No. 200 sieve

0

5

10

15

BROWN SILT (MH)
soft to medium dense, moist, (desiccated bay mud)
becoming softer at 4'

Hydraulic Fill

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Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORINGS 15&16

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 15

N34547

LOG OF BORING 17

Equipment 9" Hollow Auger

Elevation 110.3 feet Date 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SANDY CLAY (CL) medium stiff, wet, with organic matter
			5		DEBRIS FILL loose water level 4/18/77
			10		
			15		BLACK SAND (SP) loose, saturated
	20.2	106			
			20		
			25		BLUE-GRAY CLAYEY SILT (MH) soft, saturated, (bay mud)
			30		BROWN SAND (SP) loose, saturated
			35		
			40		

Refuse Fill

Hydraulic Fill

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Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 17

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 16

LOG OF BORING 18

Equipment 9" Hollow Auger

Elevation 110 feet Date 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SANDY CLAY (CL) medium stiff, wet, with debris
					DEBRIS FILL loose water level 4/18/77
			5		
			10		
15.0% passing No. 200 sieve	20.9	107			BLACK SILTY SAND (SM) loose, saturated
			15		
			20		
			25		DARK GRAY CLAYEY SILT (MH) soft, saturated, (bay mud)
			30		
			35		
			40		

Refuse Fill

Hydraulic Fill

HARDING-LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 18

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 17

LOG OF BORING 19

Equipment 9" Hollow Auger

Elevation 109.8 feet Date 3/16/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SANDY CLAY (CL) medium stiff, wet
					DEBRIS FILL loose, saturated
			5		water level 4/18/77
			10		
					BLACK SILTY SAND (SM) loose, saturated, with layers of sandy silt
	44.6	75	15		
			20		
			25		
			30		
			35		
			40		

Refuse Fill

Hydraulic Fill

HARDING-LAWSON ASSOCIATES

Consulting Engineers and Geologists

Job No 2176,030.01 Appr: JCD Date 5/20/77

LOG OF BORING 19

Sanitary Landfill Site
Alameda Naval Air Station

PLATE 18

RF11

LOG OF BORING 20

Equipment: Hand Auger

Elevation: 114.5 feet Date: 10/6/77

Shear Strength (lbs/sq ft)	Moisture Content (%)	Dry Density (pcf)	Depth (ft)	Sample	Description
			0		BROWN SAND (SP) medium dense, dry
					becomes moist at 2'
					becomes wet at 4'
			5	▽	water level 10/6/77
			10		
			15		
			20		
			25		
			30		
			35		
			40		

Hydraulic Fill

HARDING-LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JS Date 11/21/77

LOG OF BORING 20
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 19

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS (MORE THAN HALF IS LARGER THAN #200 SIEVE)	GRAVELS (MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS (MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN HALF IS SMALLER THAN #200 SIEVE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

SAMPLE DESIGNATION

"Undisturbed" Sample — Bulk or Classification Sample

STRENGTH TESTS

VANE SHEAR TEST
F = Field
L = Laboratory

UNCONFINED COMPRESSION TEST

1000 (30.0) DIRECT SHEAR TEST
CD = Consolidated - Drained
Moisture Content after Test (%)
Stress Normal to Shear Plane (psf)

1000 (30.0) TRIAXIAL COMPRESSION TEST
UU = Unconsolidated - Undrained
CU = Consolidated - Undrained
CD = Consolidated - Drained
1/2 Deviator Stress (psf)
Moisture Content after Test (%)
Confining Stress - σ_3 (psf)

KEY TO TEST DATA

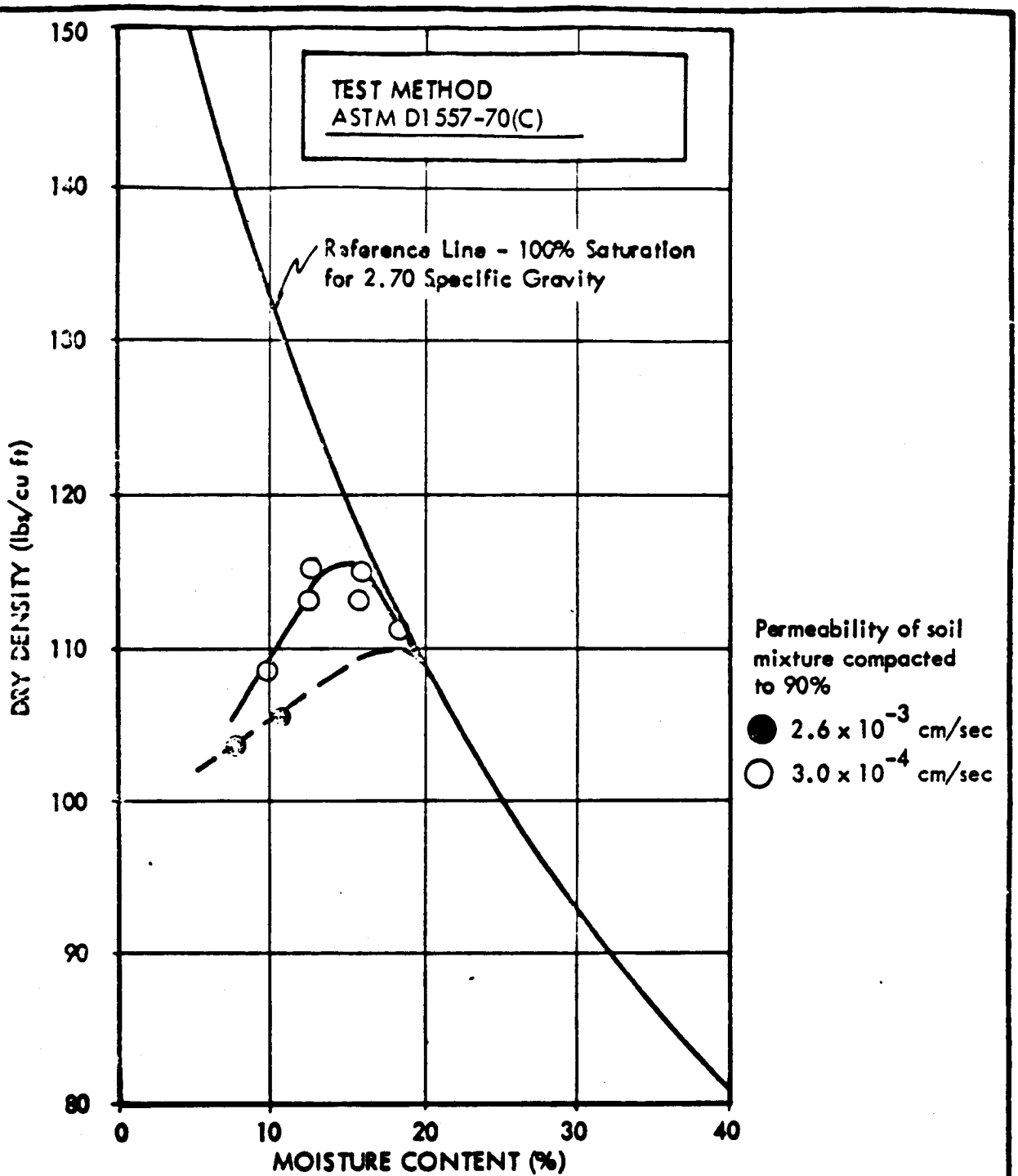
HARDING-LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCD Date 6/3/77

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA
Alameda Naval Air Station

PLATE 20

N02470



Symbol	Sample Source	Classification	Optimum Moisture (%)	Maximum Dry Density (pcf)
-●-	Dredged slurry pond	50% Sand, 50% Bay Mud (CH)	18.0	110
-○-	Dredged slurry pond	70% Sand, 30% Bay Mud (CH)	15.0	116

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

Job No. 2176,030.01 Appr: JCG Date 11/21/77

COMPACTION TEST DATA

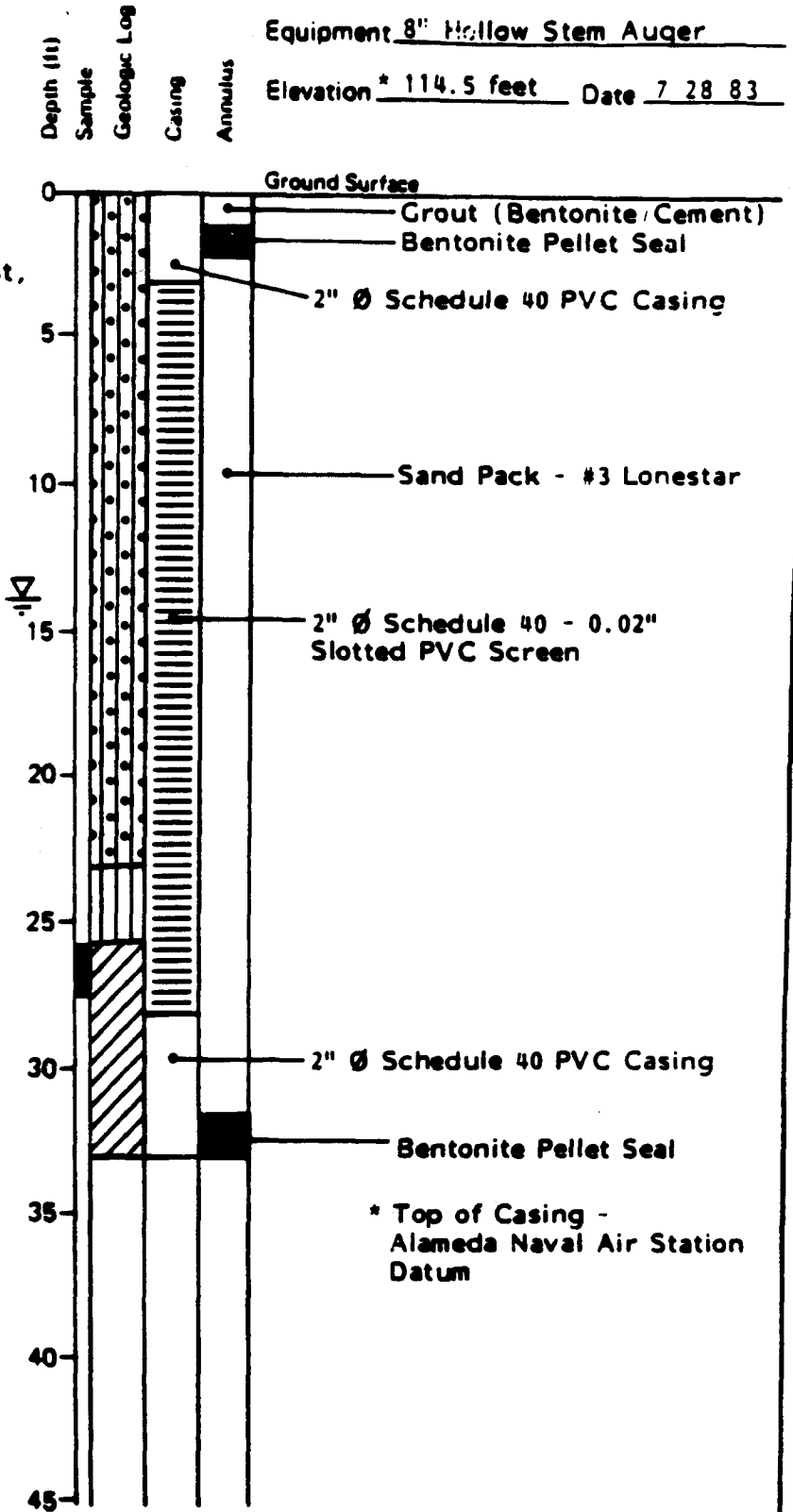
Sanitary Landfill Site
Alameda Naval Air Station

PLATE 21

N30336

Equipment 8" Hollow Stem Auger

Elevation * 114.5 feet Date 7 28 83



BROWN SILTY SAND (SM)
loose to medium dense, moist, with debris beginning at 1.5 feet

DARK BROWN SANDY SILT (ML) - medium stiff, saturated

GRAY CLAY (CH)
soft, saturated

Harding Lawson Associates
Engineers, Geologists & Geophysicists

Log of Boring 20
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

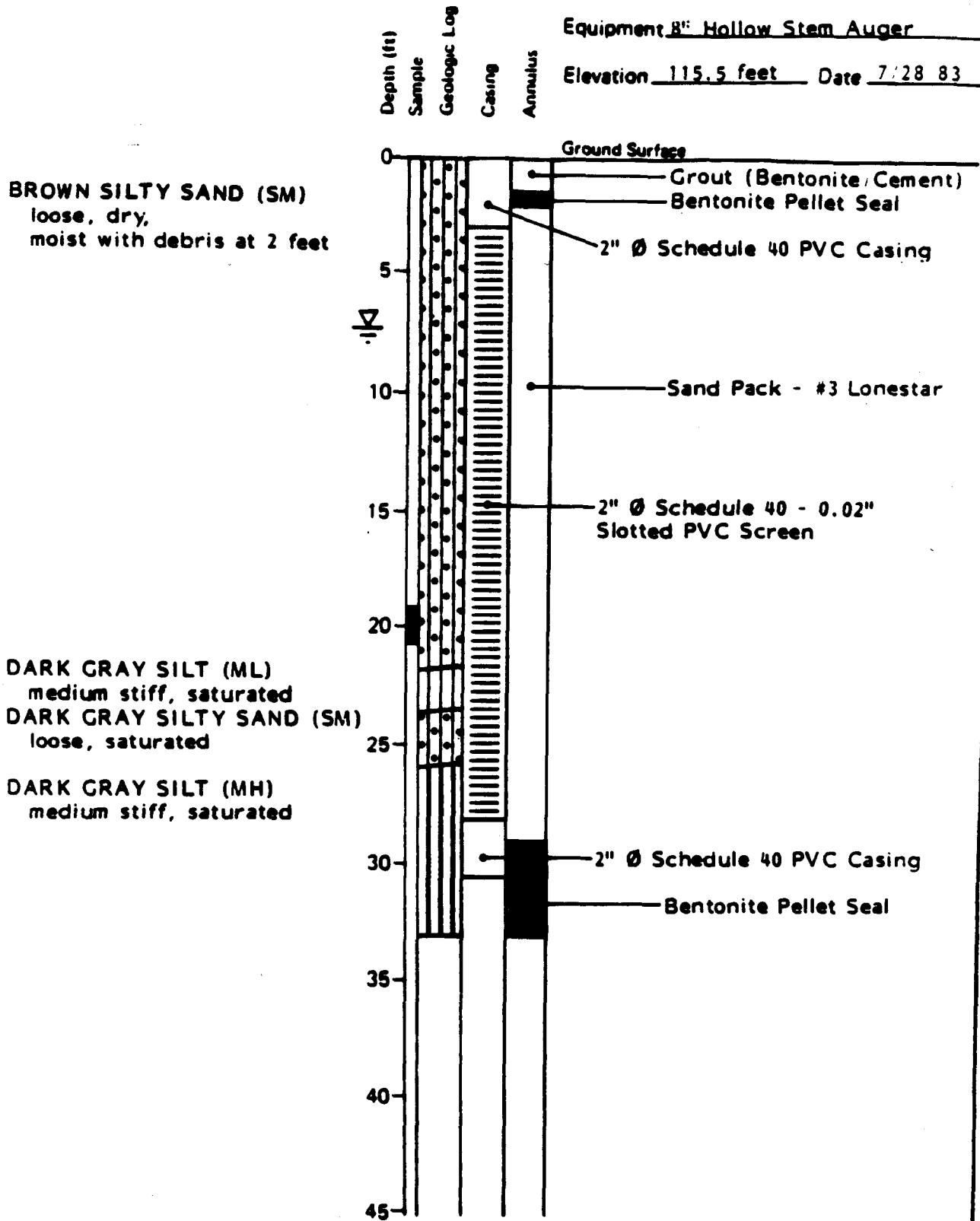
PLATE **2**

DRAWN	SCALE	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176.059 0002

Equipment 8" Hollow Stem Auger

Elevation 115.5 feet Date 7/28 83



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Log of Boring 21
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

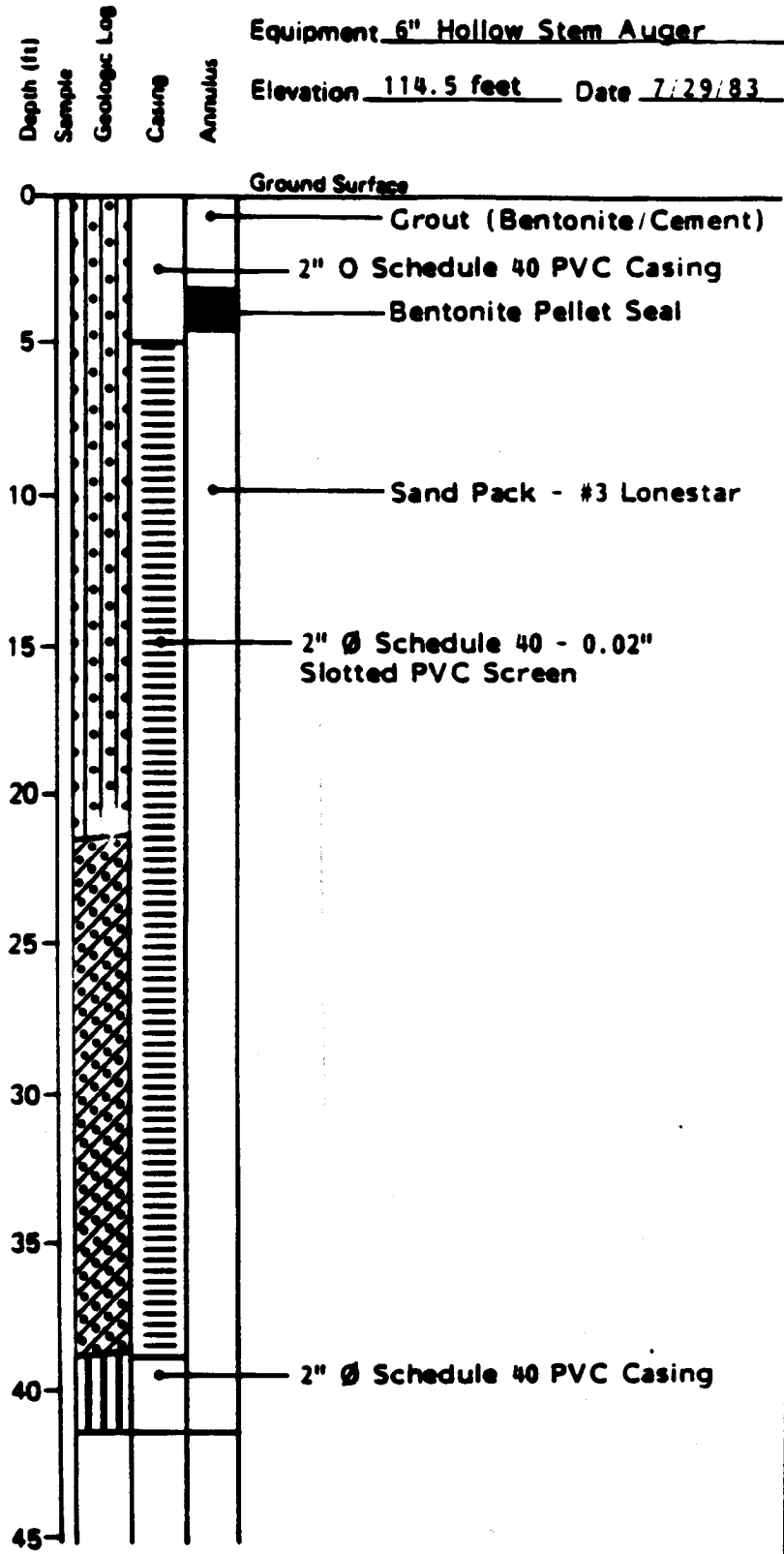
PLATE **3**

DRAWN	NUMBER	APPROVED	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176,059 0003

Equipment 6" Hollow Stem Auger

Elevation 114.5 feet Date 7/29/83



BROWN SILTY SAND (SM)
loose, dry, with debris
at 1.0 feet

change to gray in color
at 6 feet

DARK GRAY CLAYEY SAND
(SC) - loose, saturated

DARK GRAY SILT (MH)
medium stiff, saturated

Harding Lawson Associates
Engineers, Geologists
& Geotechnical Consultants

Log of Boring 22
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

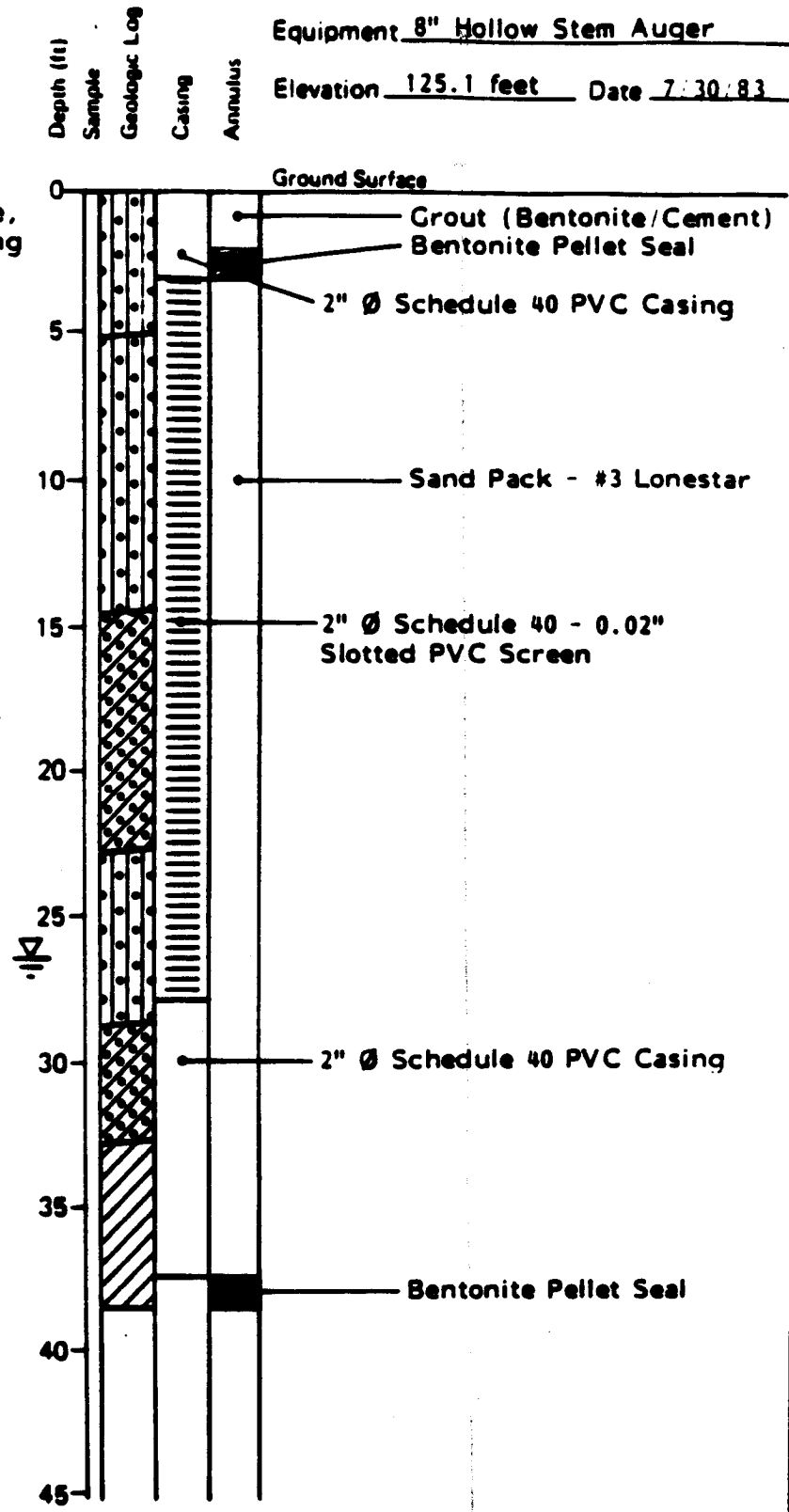
PLATE **4**

DRAWN	JOB NUMBER	APPROVED	DATE	REV. SEC	DATE
MLQ	2176,059.01		10/83		

2176.059 0004

Equipment 8" Hollow Stem Auger

Elevation 125.1 feet Date 7/30/83



BROWN GRAVELLY SILTY SAND (SM) - medium dense, moist, with debris beginning at 1.0 feet

BROWN SILTY SAND (SM) loose, saturated, with debris

BROWN CLAYEY SAND (SC) medium dense, saturated, with small amount of debris

GRAY SILTY SAND (SM) medium dense, saturated

DARK GRAY CLAYEY SAND (SC) - medium dense, saturated

DARK GRAY SANDY CLAY (CH) - medium stiff, saturated

HLA Harding Lawson Associates
Engineers, Geologists & Scientists

Log of Boring 23
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

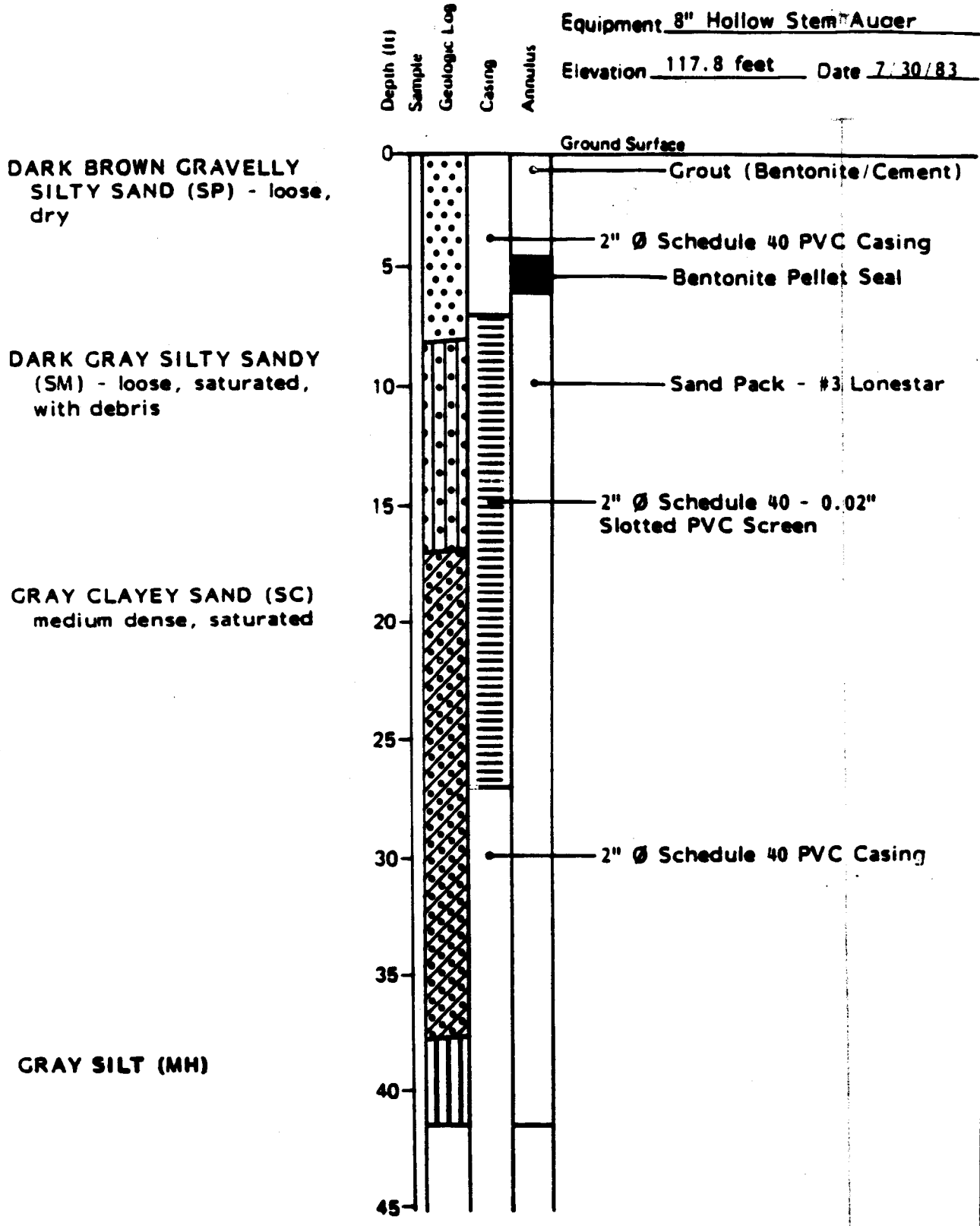
PLATE 5

DRAWN	JOB NO.	ASSOCIATE	DATE	REVISED	DATE
MLQ	2176,059.01		10/83		

2176.059.0005

Equipment 8" Hollow Stem Auger

Elevation 117.8 feet Date 7/30/83



HLA Harding Lawson Associates

Log of Boring 24
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

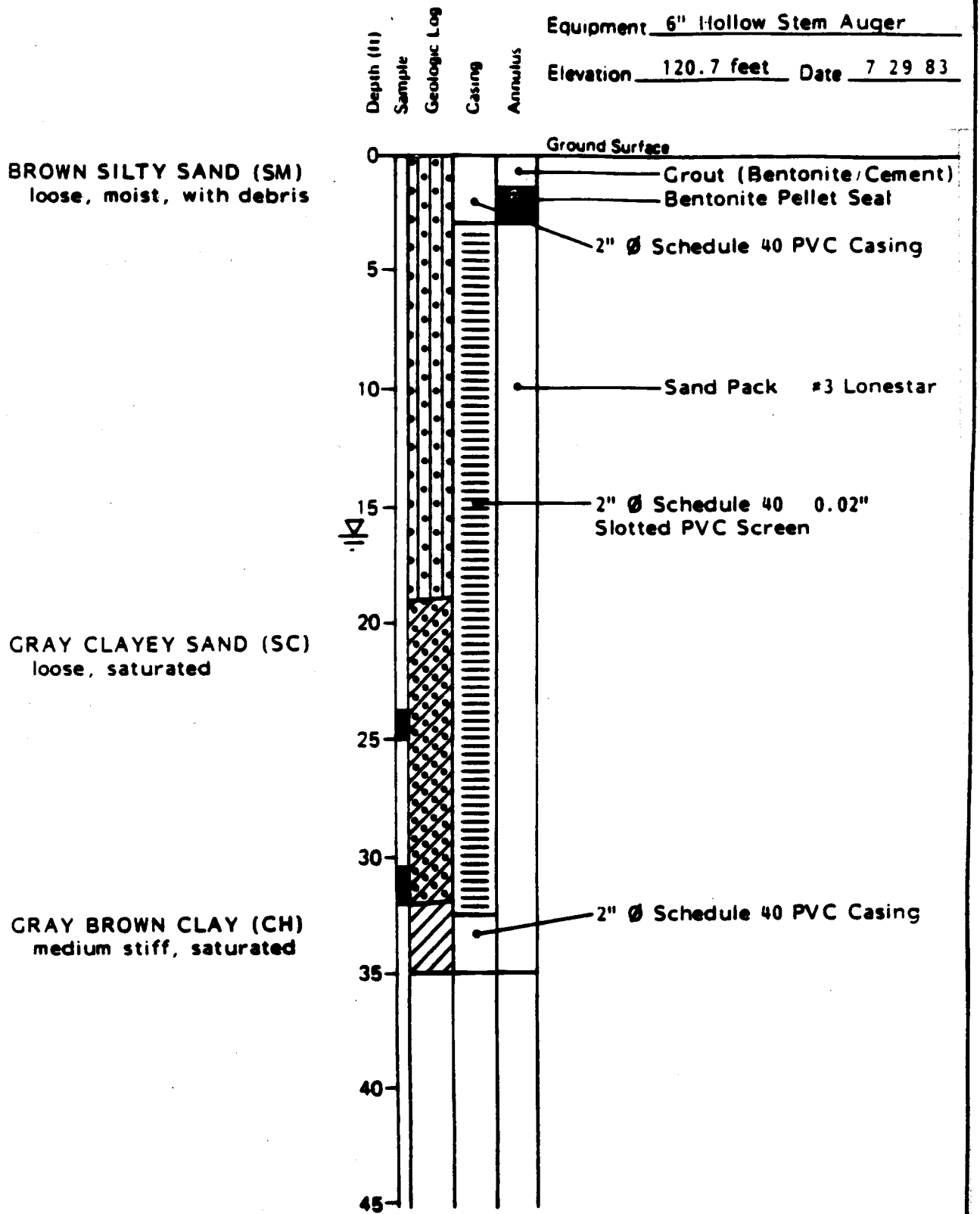
6

MLQ	2176,059.01		10/83

2176.059 0006

Equipment 6" Hollow Stem Auger

Elevation 120.7 feet Date 7 29 83



Harding Lawson Associates

Log of Boring 26
Sanitary Landfill Site
Alameda Naval Air Station
Alameda, California

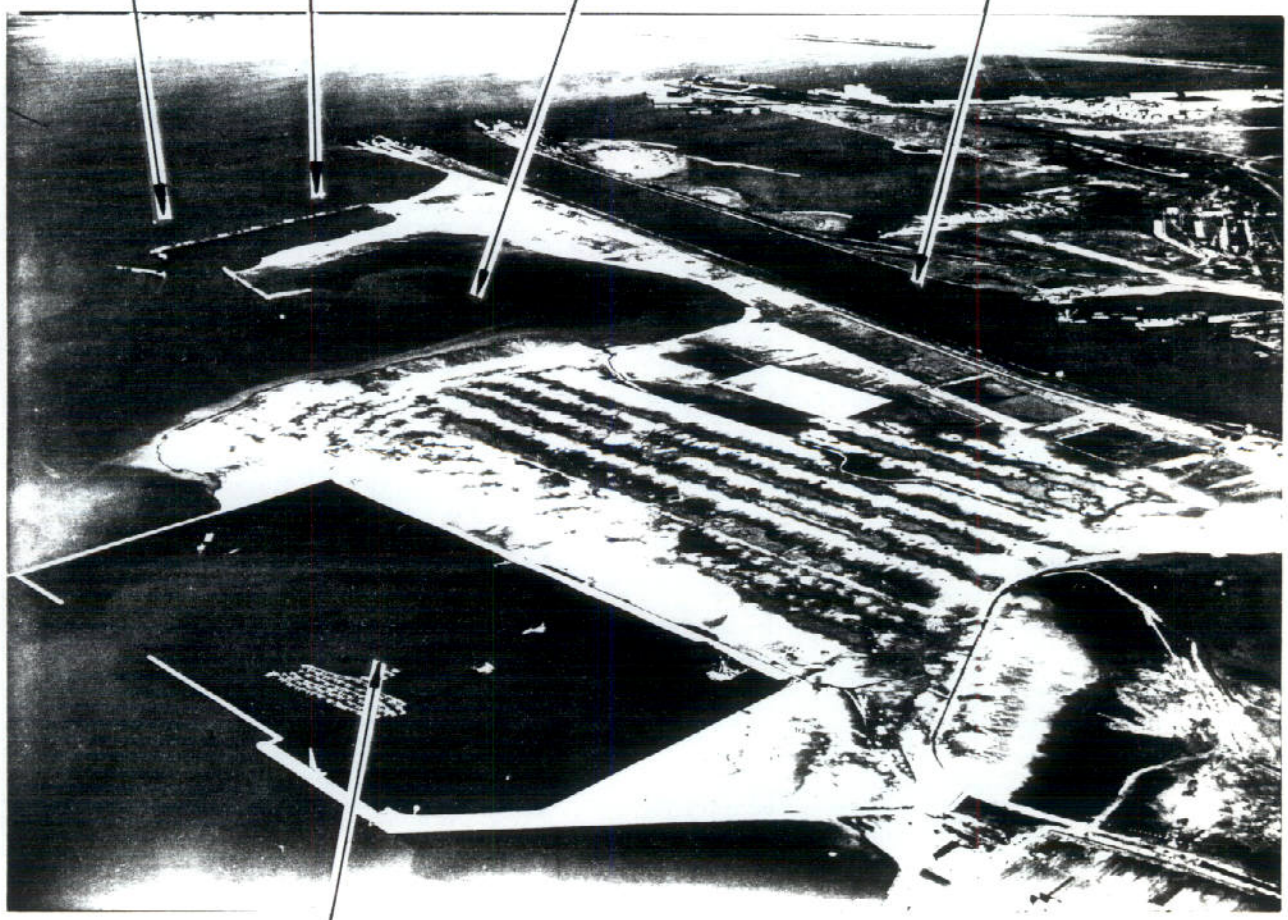
PLATE 7

MLQ	2176,059.01		10/83	

2176.059 0067

APPENDIX C

HISTORICAL AERIAL PHOTOGRAPHS



HISTORICAL AERIAL PHOTO
FEBRUARY 18, 1939
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

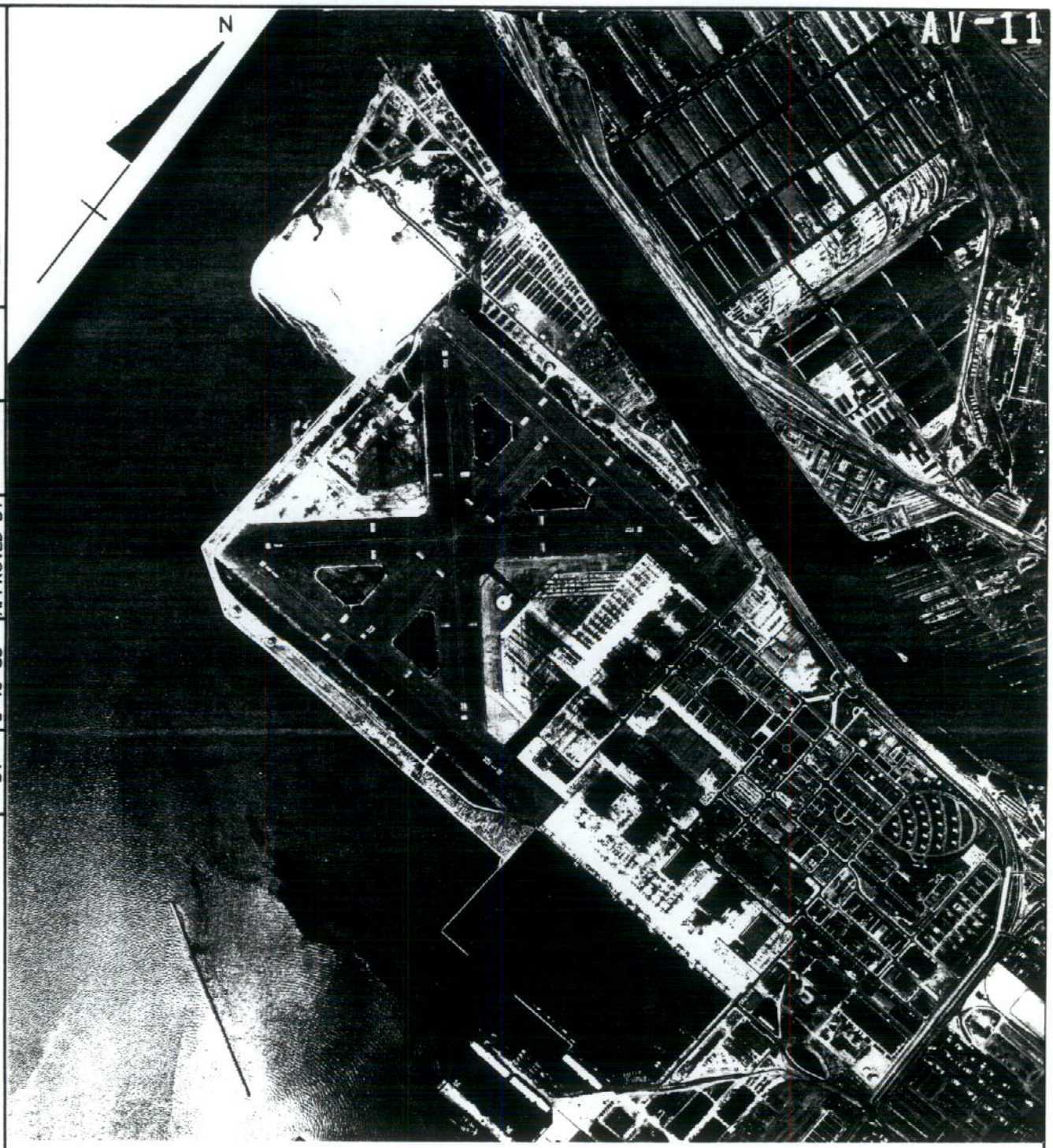
PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH FEBRUARY 18, 1939
PHOTO NO. AAP-2-14

DATE: 9-13-88	FIGURE C-1	DRAWING NUMBER 86-018-A10
SCALE: N.T.S.		

DRAWN BY	J. WADE 9-13-88
CHECKED BY	
APPROVED BY	
DRAWING NUMBER	86-018-A10

REVISIONS

NO.	DATE



HISTORICAL AERIAL PHOTO
MARCH 24, 1947
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

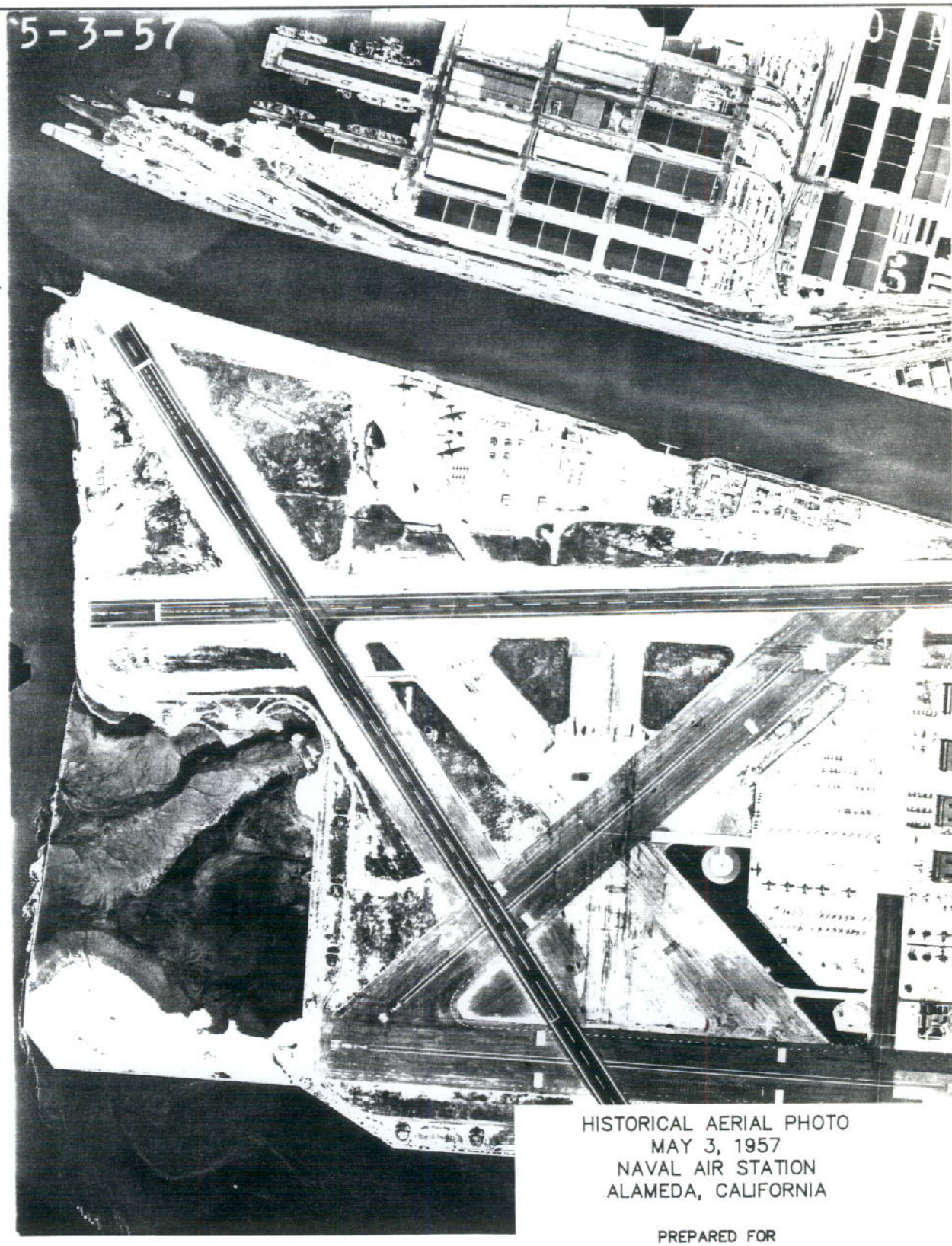
REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MARCH 24, 1947
PHOTO NO. AV-11-08-06

CanonieEnvironmental

DATE: 9-13-88	FIGURE C-2	DRAWING NUMBER 86-018-A11
SCALE: N.T.S.		

REVISIONS	NO.	DATE	DRAWN BY	J. WADE	9-13-88	CHECKED BY		APPROVED BY		DRAWING NUMBER	86-018-A11



HISTORICAL AERIAL PHOTO
MAY 3, 1957
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

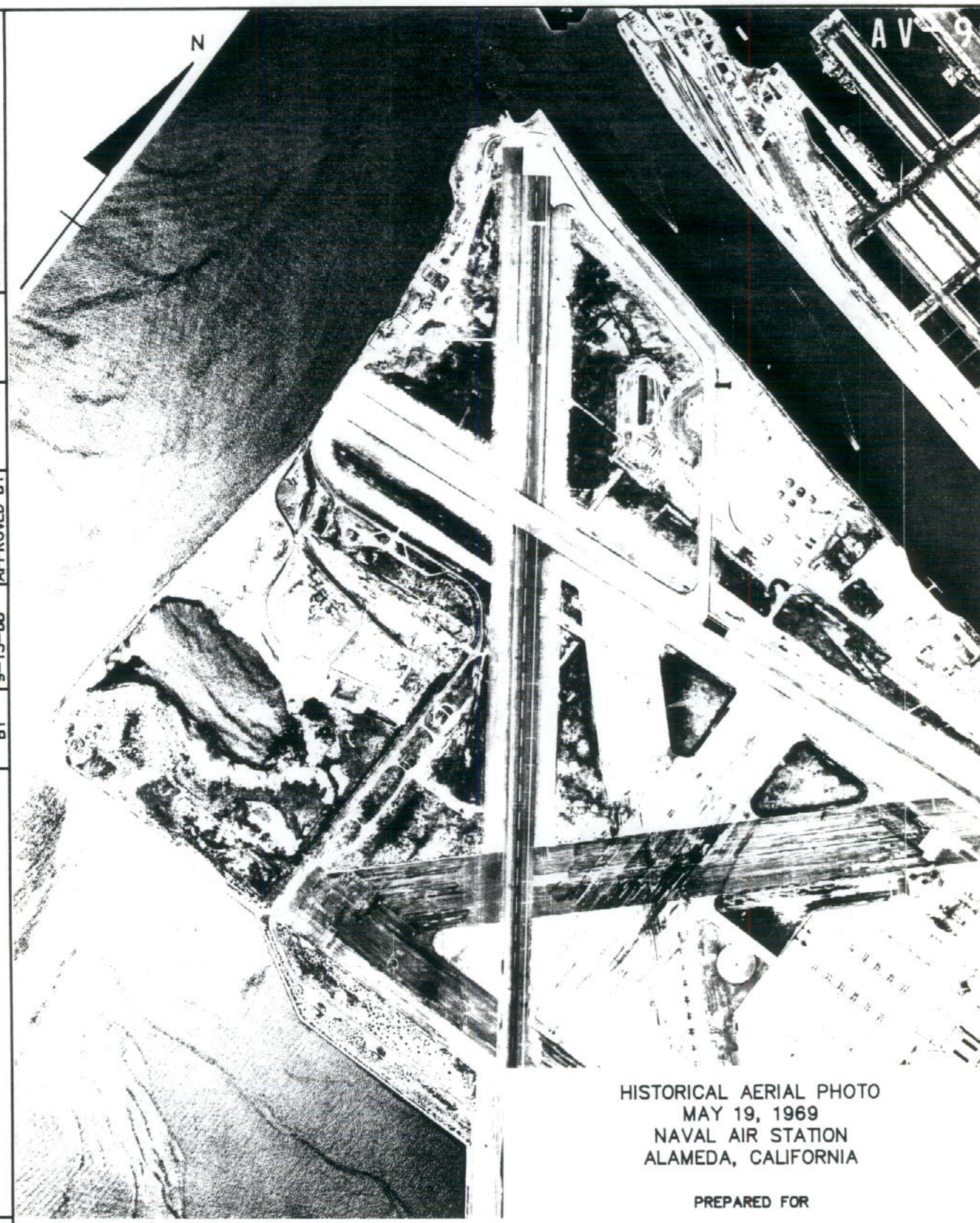
PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY 3, 1957
PHOTO NO. AV-253-06-23

DATE: 9-13-88	FIGURE C-3	DRAWING NUMBER 86-018-A12
SCALE: N.T.S.		

DRAWN BY	J. WADE 9-13-88	CHECKED BY	
		APPROVED BY	
DRAWING NUMBER	86-018-A12		

REVISIONS

NO.	DATE



HISTORICAL AERIAL PHOTO
MAY 19, 1969
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

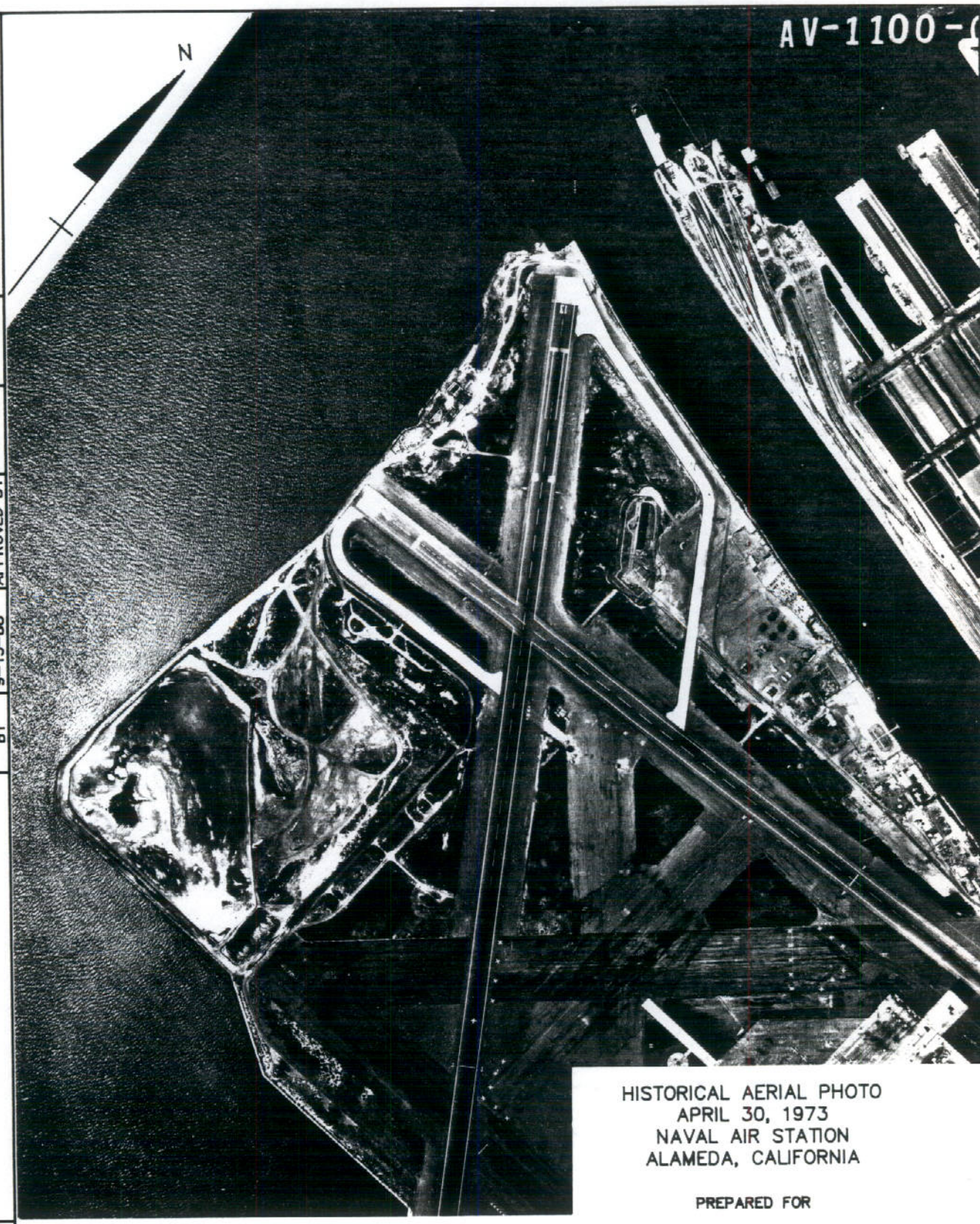
REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY 19, 1969
PHOTO NO. AV-902-03-07

DATE: 9-13-88	FIGURE C-4	DRAWING NUMBER 86-018-A13
SCALE: N.T.S.		

DRAWING NUMBER	86-018-A13
CHECKED BY	
APPROVED BY	
DRAWN BY	J. WADE
	9-13-88

NO.	DATE
REVISIONS	



HISTORICAL AERIAL PHOTO
APRIL 30, 1973
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

REFERENCE:

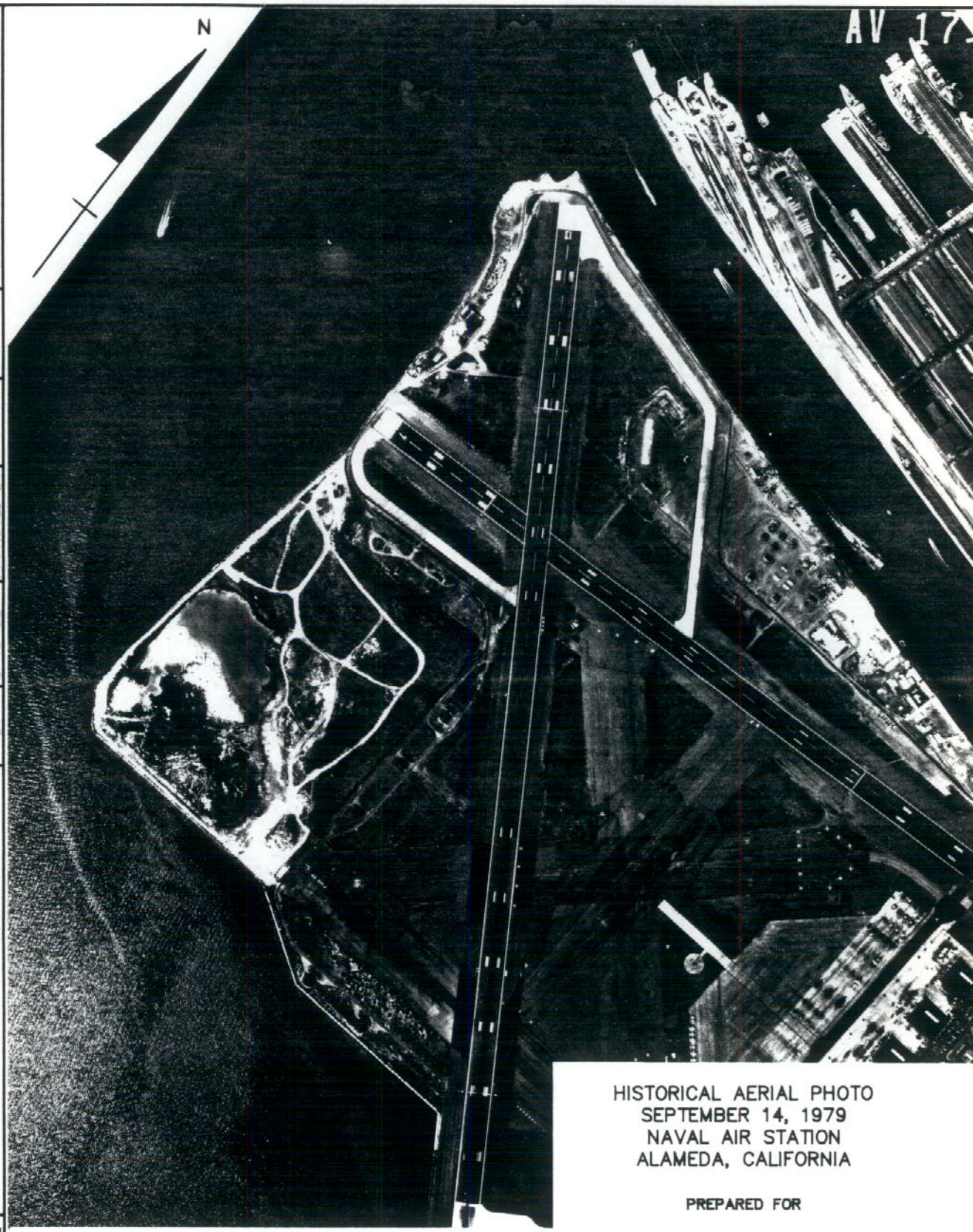
PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH APRIL 30, 1973
PHOTO NO. AV-1100-03-05

CanonieEnvironmental

DRAWN BY	J. WADE	CHECKED BY	
	9-13-88	APPROVED BY	
DRAWING NUMBER	86-018-A14		

REVISIONS	NO.	DATE

DATE: 9-13-88	FIGURE C-5	DRAWING NUMBER 86-018-A14
SCALE: N.T.S.		



HISTORICAL AERIAL PHOTO
SEPTEMBER 14, 1979
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

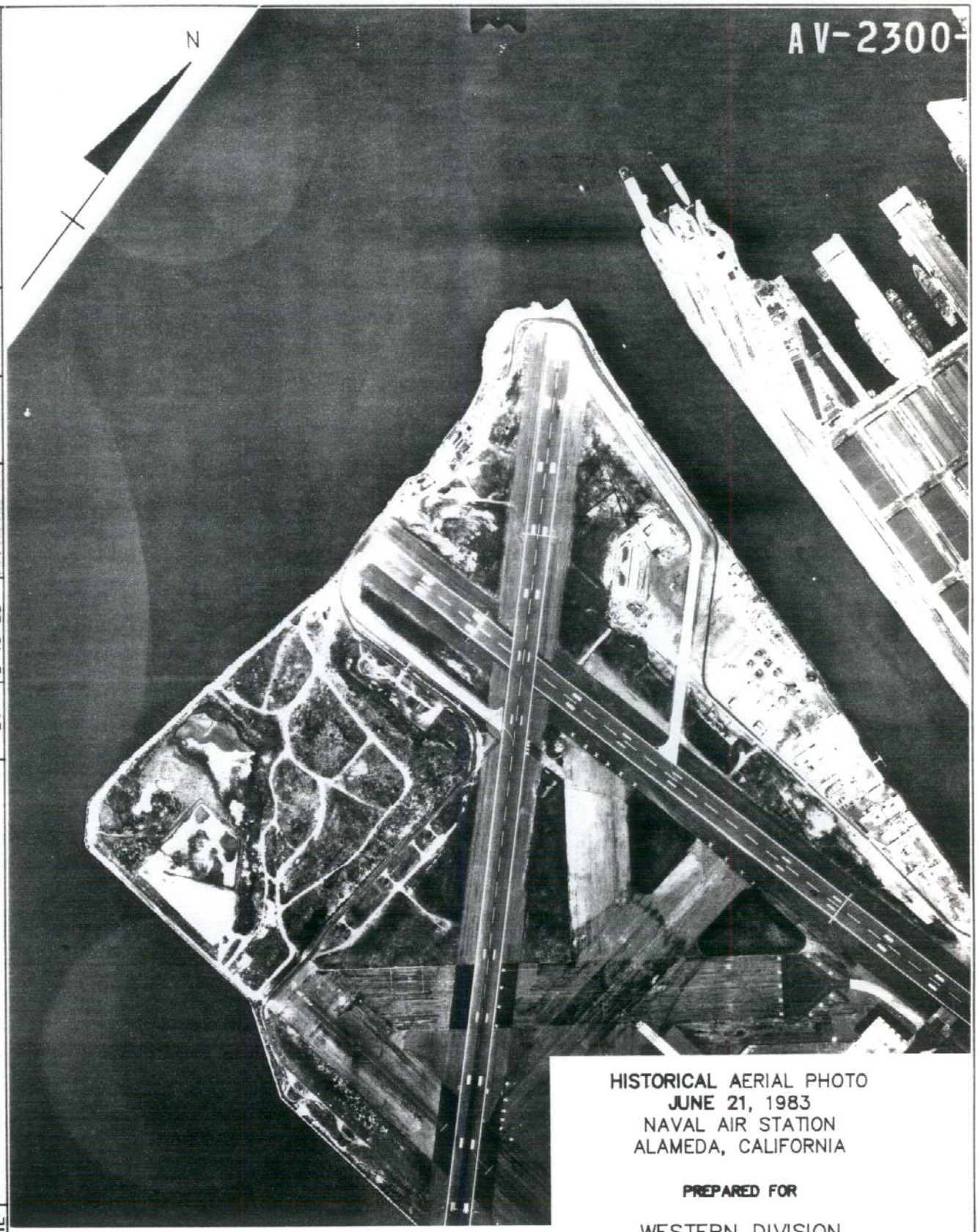
REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH SEPTEMBER 14, 1979
PHOTO NO. AV-1750-03-3

DATE: 9-13-88	FIGURE C-6	DRAWING NUMBER
SCALE: N.T.S.		86-018-A15

DRAWN BY	J. WADE 9-13-88	CHECKED BY	
		APPROVED BY	
DRAWING NUMBER	86-018-A15		

REVISIONS	NO.	DATE



HISTORICAL AERIAL PHOTO
JUNE 21, 1983
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH JUNE 21, 1983
PHOTO NO. AV-2300-03-03

CanonieEnvironmental

DATE: 9-13-88	FIGURE C-7	DRAWING NUMBER 86-018-A16
SCALE: N.T.S.		

DRAWING NUMBER	86-018-A16
CHECKED BY	
APPROVED BY	
DRAWN BY	J. WADE
	9-13-88

REVISIONS

NO.	DATE

HISTORICAL AERIAL PHOTO
MAY 15, 1985
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

CanonieEnvironmental

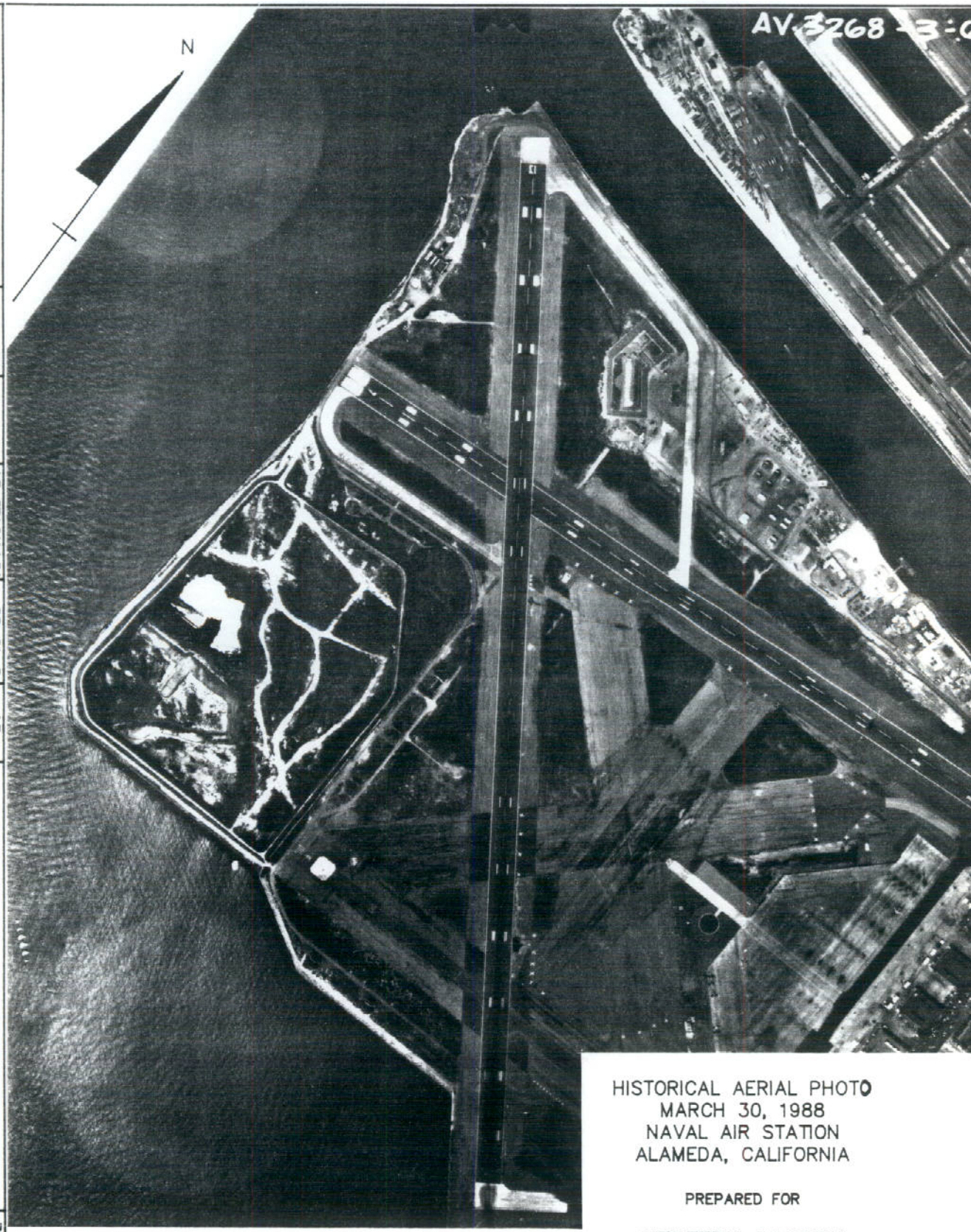
REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MAY 15, 1985
PHOTO NO. AV-2640-03-04

DATE: 9-13-88	FIGURE C-8	DRAWING NUMBER 86-018-A17
SCALE: N.T.S.		

DRAWN BY	J. WADE 9-13-88
CHECKED BY	
APPROVED BY	
DRAWING NUMBER	86-018-A17

REVISIONS	NO.	DATE



HISTORICAL AERIAL PHOTO
MARCH 30, 1988
NAVAL AIR STATION
ALAMEDA, CALIFORNIA

PREPARED FOR

WESTERN DIVISION
NAVAL FACILITIES ENGINEERING COM.
SAN BRUNO, CALIFORNIA

Canonie Environmental

REFERENCE:

PACIFIC AERIAL SURVEYS
AERIAL PHOTOGRAPH MARCH 30, 1988
PHOTO NO. AV-3268-03-06

DATE: 9-13-88	FIGURE C-9	DRAWING NUMBER 86-018-A18
SCALE: N.T.S.		

DRAWN BY	J. WADE 9-13-88	CHECKED BY		DRAWING NUMBER 86-018-A18
		APPROVED BY		

REVISIONS

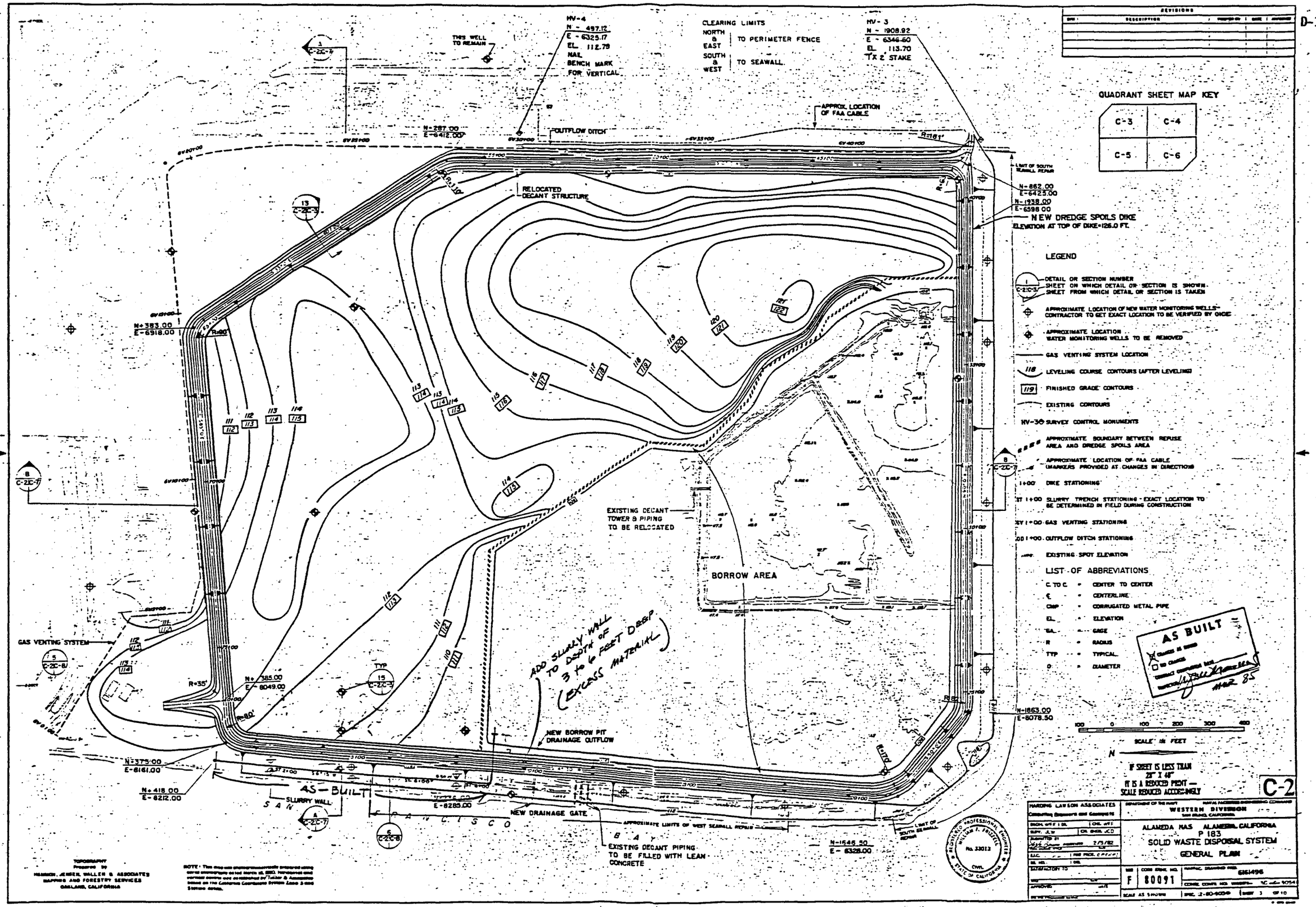
NO.	DATE

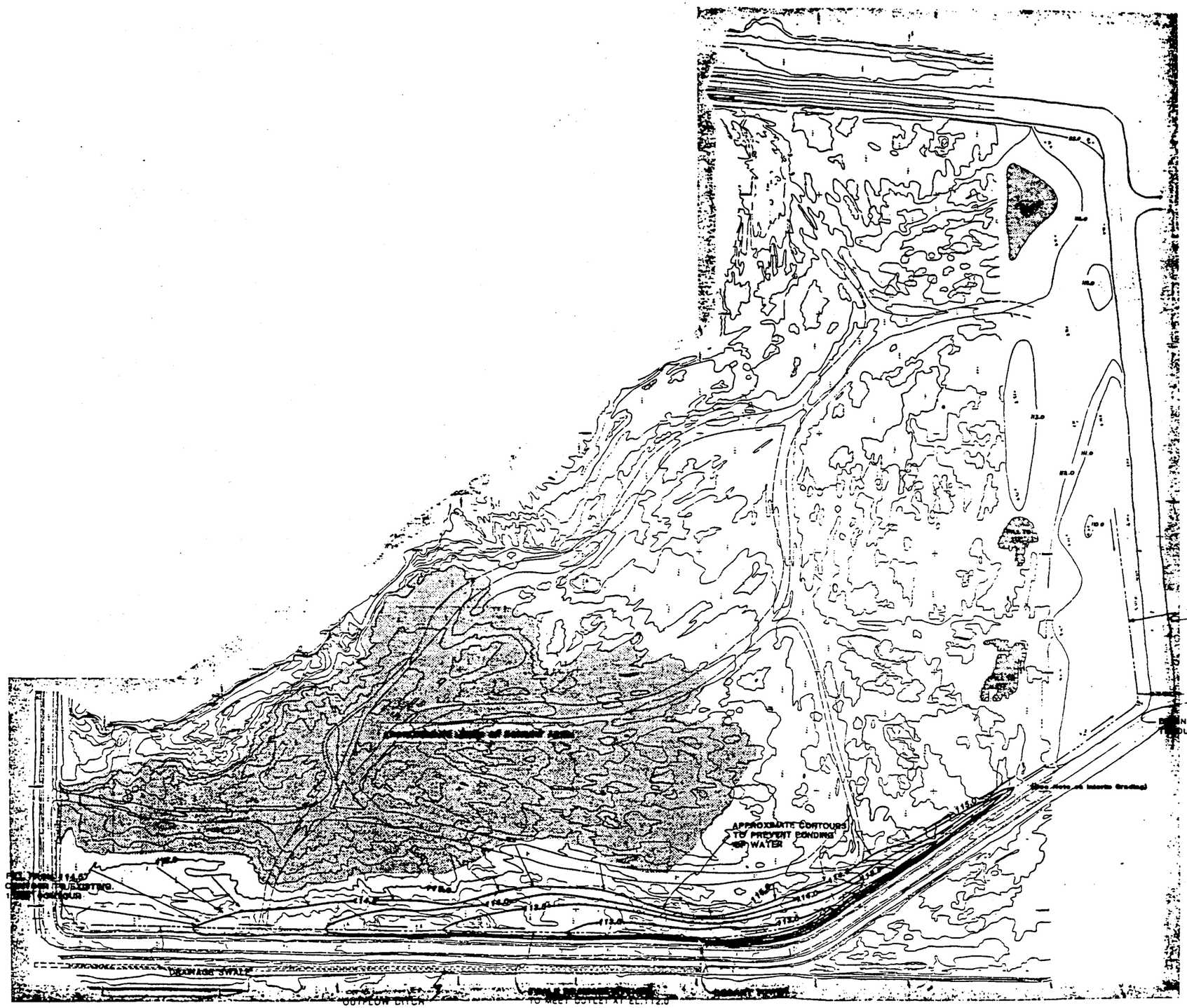
APPENDIX D

AS-BUILT DRAWINGS OF CLOSURE FEATURES

D-1

REVISIONS				
SYM	DESCRIPTION	DRAWN BY	DATE	APPROVED





N

0 100 200 300
SCALE IN FEET

NOTES

General

The purpose of the Interim Grading Plan is to prevent ponding in the area which occurred on the Alameda Naval Air Station Landfill during the winter of 1985-1986. The Plan includes cuts and fills in addition to a drainage swale and a pipe to promote drainage to the existing outlet (now located at the decant tower at approximately elevation 112.0 feet.*). Contours for the north end of the landfill were provided by the contractor in a revised As-Built Plan. The topography in this region has been added to the revised Interim Grading Plan.

Borrow Area

The approximate limits of an onsite borrow area are included on the Plan. About [illegible] to [illegible] foot of soil may be cut in this region and utilized for the fill. If there are areas in this region which are lower than the Plan indicates, these areas should be avoided. At least one foot of cover is to be maintained over debris. If debris is encountered during construction, it must be covered with a minimum of one foot of soil. If additional borrow is needed for fill, supplementary areas which have an excess of one foot of cover over debris will be located by the engineer and can be used.

Fill Area

Approximate contours for fill adjacent to the dikes in the east and northeast portions of the landfill are included on the Plan. Soil is to be transported from the borrow area and compacted over the existing cover in the areas shown on the Plan. The fill should be compacted sufficiently such that it can be sealed to minimize the infiltration of water. Sealing should be accomplished by rolling with rubber tired equipment. Additional low areas are to be filled as shown on the plan.

Drainage Swale

A swale is to be formed by cutting and filling at the locations shown on the Plan. The base of the swale is to be graded to promote drainage to the outlet pipe and the pipe in the north dike.

Interim Grading

Grading completed December 15, 1986 by Contri Construction Company consisted of the following items:

1. Cuts and fills to achieve the approximate contours shown. A slight adjustment was made to the contours in the northeast corner as they were shown on the original plan. Contri performed cuts and fills in this area as shown on the revised plan to promote drainage from the actual high point, 114.5, which was not shown on the original as built plan.
2. Drainage swale cut in the fill to promote drainage to the decant tower and the pipe in the north dike.
3. Installation of a drainage pipe in the north dike where a cut was originally proposed.

* All elevations are Naval Air Station Datum, MLLW+101.20 feet.

Harding Lawson Associates
Engineers, Geologists & Geophysicists

As-Built Interim Grading Plan
Alameda Naval Air Station
Landfill
Alameda, California ~~DRAFT~~

PLATE 2

JAS	2176.060.01		10/86
LM	12/86		

APPENDIX E

RESUME OF RESPONSIBLE PROFESSIONAL

RICHARD J. GREENWOOD

Project Manager

Education

M.S., Geotechnical Engineering, Utah State University, 1978
B.S., Civil Engineering, Utah State University, 1976

Registrations

Professional Engineer: California, Colorado

Affiliations

American Society of Civil Engineers
Society of Mining Engineers of AIME

Experience and Background

Mr. Greenwood has over 11 years of engineering experience with over six years of experience in investigation, engineering design and construction of ground water control and ground water remediation. He has been directly responsible for engineering, cost control and project management of both hazardous and non-hazardous sites. Non-hazardous projects have included: water resource planning and management for both confined and unconfined aquifer systems; seepaged modeling control and water supply management for large earth dam project and piezometric and pore pressure influence in both foundation and slope stability evaluations. Hazardous projects have included: feasibility studies, remedial investigation, design, construction, containment, and clean-up work sites contaminated with volatile organics, acids, pesticides, metals, aromatics and uranium.

Prior to joining Canonie Environmental Services Corp., Mr. Greenwood was involved in numerous field and analytical programs including:

- Design and construction supervision of small, medium, and large earth dams. Dam types included water resource, flood control, mining, and hazardous waste.

- Hydrologic analysis and hydraulic design of ditches and conveyance structures for control of surface water for large surface coal mines; flood plain prediction for large river courses; mine sequence planning for surface and underground coal mines; slope stability analysis on steep slope high-walls for large surface coal mines; research and development of methods for backfilling shafts and tunnels in conjunction diction, and design of remedial work for subsided areas; design of portal access openings for underground mines; and cause evaluation and design of stabilization measures for landslide areas in mined areas.

- Traffic surveys; traffic prediction and analysis; pavement design; design of timber roads; design of detention ponds and drainage and conveyance structures for shopping centers, residential subdivisions and multi-family developments; design of sewage treatment facilities in remote forest areas; preparing and filing legal descriptions of property boundaries and performing property surveys.

- Evaluation of retaining structures for highway embankments supported with rock anchor tiebacks and drilled caissons; liquefaction analysis for tailings embankments; cause evaluation of foundation and structural damage to school buildings; subsurface investigation and design of foundations for residential developments, commercial buildings, and electrical power plants.

- Experience with computer programming and design in Basic and Fortran. Design of CADD systems for civil and geotechnical engineering and geotechnical testing. Usage and evaluation of ground water flow using seepage and ground water flow models.

Publications

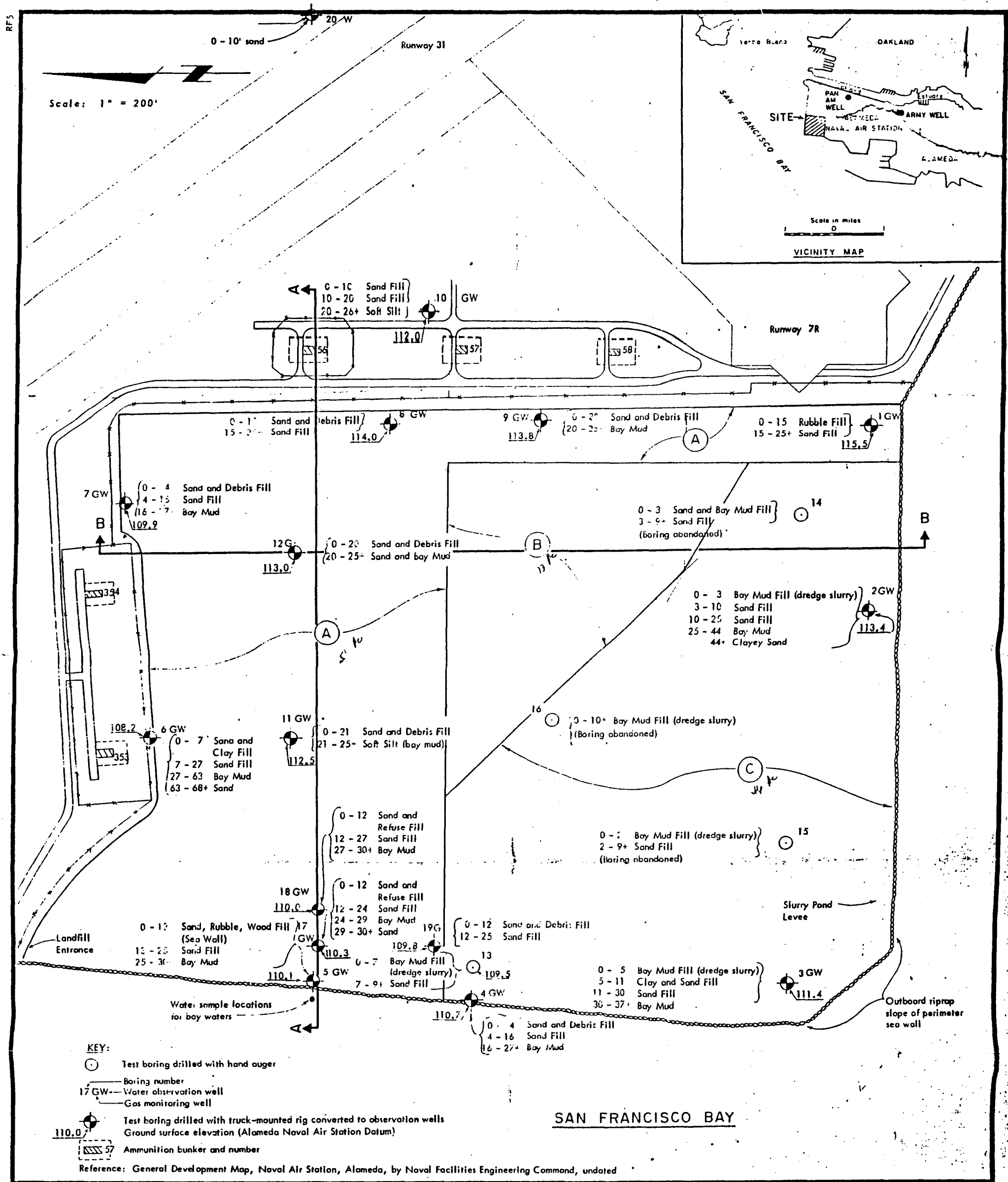
Greenwood, R. J., 1979, "Development of a Liquefaction opportunity Map for Cache Valley, Utah", Master's Thesis, Utah State University, Logan, Utah.

Taylor, M. J. and R. J. Greenwood, November 1981, "Classification and Surface Water Controls - Nonwater Impounding Mine Waste Structures", Proceedings of the Symposium on Design of Non-Impounding Mine Waste Dumps, Society of Mining Engineers of AIME, Denver, Colorado.

Greenwood, R. J., 1984, "Microcomputers in Civil Engineering - Small Business Applications", Proceedings - Second National Conference on Microcomputers in Civil Engineering, American Society of Civil Engineering.

APPENDIX F

WASTE DISPOSAL DATA



Job No. 2176,030.01 Designed ALB Drawn GER Checked LEL Approved Date 12/17/76 Scale 1" = 200'	HARDING - LAWSON ASSOCIATES *Consulting Engineers and Geologists*	PLOT PLAN SANITARY LANDFILL SITE ALAMEDA NAVAL AIR STATION Alameda California	PLATE 1

86-018-B44

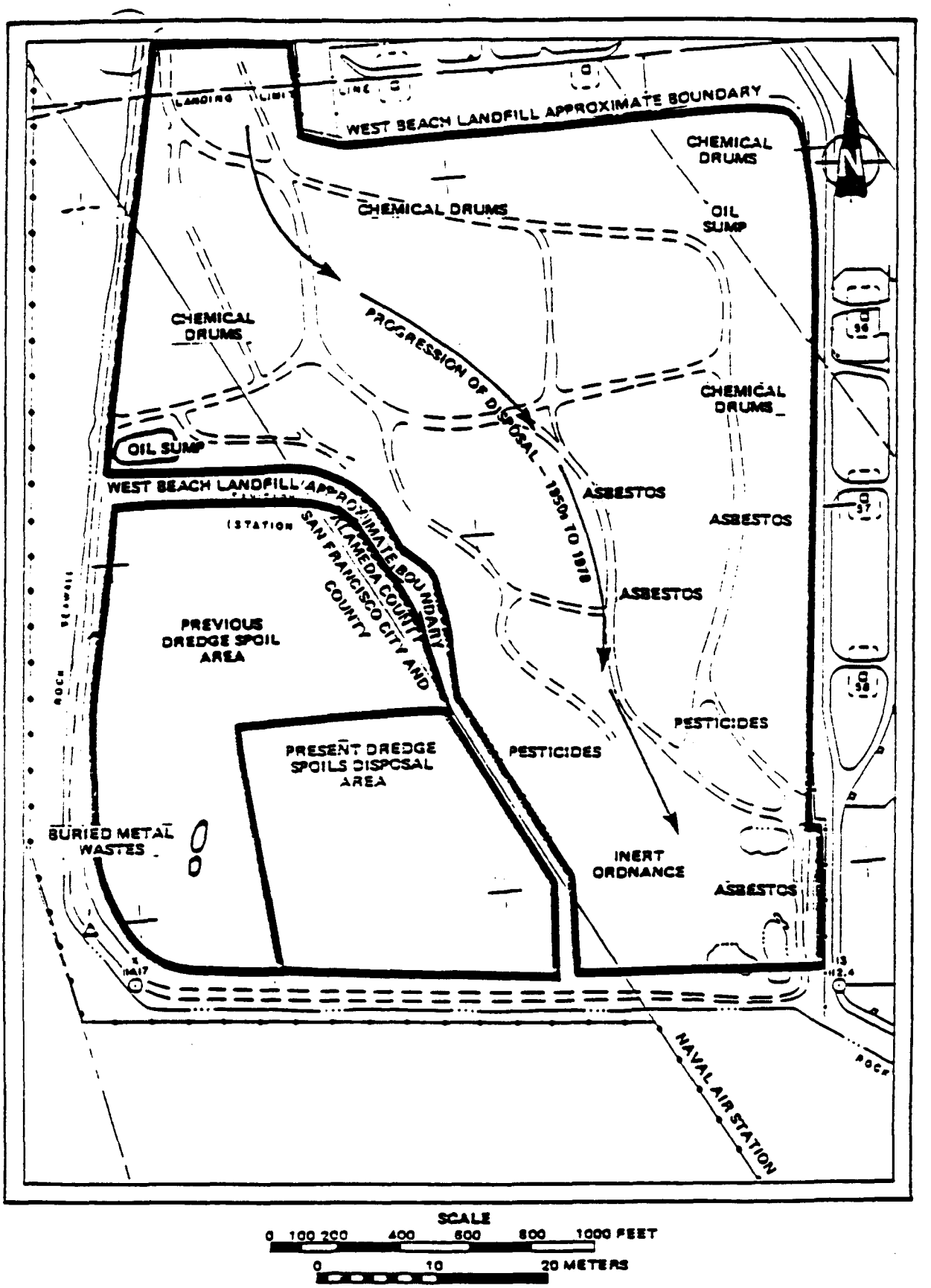


Figure 6–7 AREAS OF SUSPECTED HAZARDOUS WASTE DISPOSAL, WEST BEACH LANDFILL (SITE 1), NAS ALAMEDA

SOURCE: E & E (1983)

Table 6-15

WASTE PRODUCTS FROM AIRCRAFT OVERHAUL AND REPAIR

Nomenclature	Quantity/Year
Acid, Hydrochloric[1]	1,000 gallons
Acid, Nitric[1]	700 gallons
Acid, Sulfuric[1]	350 gallons
Methyl Ethyl Ketone[3]	18,000 gallons
Ethyl Acetate[3]	50,000 gallons
Sodium Hydroxide[1]	4,400 pounds
Stoddard Solvent[2]	160,000 gallons
Paint Remover[2]	105,000 gallons
Cleaner Brightener[1]	2,400 gallons
Ortho Dichlorobenzene[1]	1,000 gallons
Methylene Chloride[1]	11,000 gallons
Methyl Chloroform[3]	4,900 gallons
Trichlorethylene[2]	24,000 gallons
Toluene[1]	2,600 gallons
Xylene[1]	4,500 gallons
Oil, 1010[2]	16,000 gallons
Naphtha, Aliphatic[3]	4,000 gallons
Naphtha, Aromatic[3]	1,800 gallons
Emulsion Cleaner[1] (MIL-C-22543)	80,000 gallons
Carbon Remover[2] (MIL-C-19853)	12,000 gallons
Acetone	9,100 gallons
Cleaning Compound[2]	
Turco 4228	15,000 pounds
Chromic Acid[1]	19,700 pounds
Sodium Cyanide[1]	2,400 pounds
Potassium Cyanide[1]	2,400 pounds
Copper Cyanide[1]	500 pounds
#396 Perliton	
Heat Treating Cyanide	500 pounds
Paint Thinners[2] (various kinds)	35,000 gallons
Steam Cleaner	21,000 gallons

1. To drains by leakage, direct discharge, or drag-out; to seaplane lagoon or estuary.
2. Buried at the dump.
3. To drains or buried at dump.

Source: Navy, Department of, Naval Facilities Engineering Command, Western Division, 1966, Report on Study of Water Pollution Generated in Industrial Wastewater at Naval Air Station, Alameda, California.

Note: Quantities were rounded to two significant figures.

SOURCE: E & E (1983)

Table 6-16

ESTIMATED VOLUMES OF SLUDGE
DISPOSED OF AT THE
WEST BEACH LANDFILL - 1960s

Building	Volume
Plant Maintenance Disposals	
5	21,000 gallons per month
360	14,000 gallons per month
Public Works Disposals	
6	350 gallons per month
10	100 gallons per month
14	2,000 gallons per month
67	100 gallons per month
162	4,000 gallons per month
166	175 gallons per month
360	1,000 gallons per month
372	2,200 gallons per month
397	3,000 gallons per month
410	4,000 gallons per month
459	60 gallons per month
460	200 gallons per month
Total	53,000 gallons per month

Source: Navy, Department of, Naval Facilities Engineering Command, Western Division, 1966, Report on Study of Water Pollution Generated in Industrial Wastewater at Naval Air Station, Alameda, California.

Note: Quantities have been rounded to two significant figures.

SOURCE: E & E (1983)

APPENDIX G

TECHNICAL GUIDANCE MANUAL
SOLID WASTE WATER QUALITY ASSESSMENT TEST (SWAT)
PROPOSALS AND REPORTS

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TECHNICAL GUIDANCE MANUAL

SOLID WASTE WATER QUALITY ASSESSMENT TEST (SWAT)

PROPOSALS AND REPORTS

SOLID WASTE DISPOSAL PROGRAM
HYDROGEOLOGY SECTION
LAND DISPOSAL BRANCH
DIVISION OF WATER QUALITY
STATE WATER RESOURCES CONTROL BOARD

August 1988

TECHNICAL GUIDANCE MANUAL

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August 1988

SOLID WASTE ASSESSMENT TEST (SWAT) PROPOSALS AND REPORTS

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TECHNICAL GUIDANCE MANUAL
SOLID WASTE DISPOSAL PROGRAM

SOLID WASTE WATER QUALITY ASSESSMENT TESTS (SWATs) PROPOSALS AND REPORTS

I. PREFACE

It has long been known that solid waste disposal sites designed to receive only domestic or commercial waste also receive some hazardous waste. It is nearly impossible to prevent some hazardous wastes from entering these sites. For many years, most regulatory agency staff felt that only small quantities of hazardous wastes were received by ordinary solid waste disposal sites. Further, it was largely perceived that this hazardous waste would be diluted or adsorbed by the rubbish to the point where significant quantities, if any, would not reach ground water.

In recent years, however, we have seen scattered indications that hazardous wastes in ordinary disposal sites might be more of a problem than we had anticipated. Solvents and pesticides have been found in ground water under disposal sites and in landfill gases emanating from the soil.

Based on these findings, legislation has been passed which requires all solid waste operators to demonstrate whether these indications of hazardous waste leakage are representative of a serious, widespread problem or are rare exceptions.

II. INTRODUCTION

A. BACKGROUND

In 1984, Section 13273 was added to the Water Code.[1] This Section required the State Water Resources Control Board (State Board) to rank all solid waste disposal sites throughout the State on the basis of the potential threat they may pose to water quality. Further, this Section mandates that these sites be tested to determine whether there is hazardous waste leakage from the site.

The State Board approved a ranked list of approximately 2,100 active and inactive solid waste disposal sites in December, 1985. Revised rankings were adopted by the State Board in October and December, 1986 and December, 1987. The most recently approved list contains over 2,200 sites, consisting of 14 ranks of 150 sites each, and a 15th partially filled rank.

Water Code Section 13273 requires the operators (and/or owners) of solid waste disposal sites to submit a Solid Waste Water Quality Assessment Test (SWAT) report to the appropriate California Regional Water Quality Control Board (Regional Board).[2] The SWAT reports are due the first day of July each year, depending on their ranking, with Rank 1 sites due July 1, 1987 (see Section II.C.).

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[1]Chapter 1532, Statutes of 1984 (sometimes known as the Calderon Act after its author). This law added Sections 66795.53 and -.54 to the California Code of Regulations; Sections 40511, 41805.5, and 4231.5 to the Health and Safety Code; and Section 13273 to the Water Code. There were subsequent amendments to some of these Sections in 1986 and 1987. Copies of all relevant laws are contained in Appendix Number 1.

[2]Under Section 41805.5 of the Health and Safety Code, Air-SWAT reports are required to be submitted to the Air Resources Board. Only Water-SWATs are addressed in this document.

As per Subsection 13273(b), the SWAT report must contain:

1. An analysis of the surface and ground water on, under, and within one mile of a solid waste disposal site to provide a reliable indication of whether there is any leakage of hazardous waste; and

2. A chemical characterization of the soil-pore liquid in those areas which are likely to be affected if the solid waste disposal site is leaking, as compared to geologically similar areas near the solid waste disposal site which have not been affected by leakage of waste discharge.

Subsection 13273(b) states that a qualified professional must certify that the report contains all of the information required above as well as any additional information required by the Regional Board. This certification must be made by a professional meeting the following qualifications:

1. Must be registered or certified as:

   a. A Registered Geologist registered pursuant to Business and Professions (B&P) Code Section 7850, or

   b. A Certified Engineering Geologist certified pursuant to B&P Code Section 7842, or

   c. A Registered Civil Engineer registered pursuant to B&P Code Section 6762, and,

2. Must have at least five years experience in ground water hydrology.

Based on the Regional Board's prior experience with similar investigations and reports, it was recognized that the site operator's preparation of a SWAT investigation proposal was a necessary first step. Although Water Code Section 13273 makes no mention of a proposal, Section 13267 of the same code authorizes Regional Boards to require submittal of technical reports. Thus, a SWAT investigation proposal, containing detailed plans for the work required for this program, should be prepared at least a year before the SWAT report due date. Further, the Regional Boards are urged to require that the proposal be prepared by a person having the same qualifications as required for the certification of a SWAT report.

B. PURPOSE

This Technical Guidance Manual (Manual) addresses the contents of the SWAT proposals and reports. It draws upon two draft technical guidance documents, dated March and October, 1986, as well as various guidance memoranda, literature, and other relevant sources.

The Manual provides guidance for:

1. The preparation of adequate SWAT proposals and SWAT reports to meet the requirements set forth in Water Code Section 13273, and

2. The review of SWAT proposals and reports by Regional Board staff.

The Manual's contents are <u>not</u> regulations; thus site specific considerations should dictate how closely the Manual's procedures are followed. However, the Regional Boards may wish to ask the site owner/operator to justify any omissions on the basis that local circumstances make them unnecessary and that the final results will not be compromised. (For example, a site having average ground water levels above most of the refuse will not need unsaturated zone monitoring since there is no unsaturated zone.)

Use of procedures different than those suggested in this Manual should also be justified on the basis that the proposed substitute procedure will provide data that is equally or more reliable than that discussed in the Manual. For example, a newly developed lysimeter design might be substituted for the current procedures if it is more suitable for the soils underlying the site.

It is intended that this Manual be a dynamic document. As significant advances in the fields of ground, vadose zone, and surface water sampling and other germane subjects are developed, addenda or corrections to this Manual will be prepared and distributed.

C. WAIVERS

The SWAT law contains one clause for which waivers for the SWAT work may be granted. Water Code Subsection 13273(c) states, "If the regional board determines that the information specified in paragraph (1) [surface and ground

water sampling] or (2) [soil-pore liquid sampling] is not needed because other information demonstrates that hazardous wastes are migrating into the water, the regional board may waive the requirement to submit this information specified in paragraphs (1) and (2) of subdivision (b)." Thus, for those sites where existing monitoring systems or other available data indicate that there is hazardous waste leakage, the Regional Board may grant a waiver.

In those cases where hazardous waste is leaking from the site, ongoing investigations should be capable of determining the extent of the leakage and whether there are any additional leakage areas. These investigations are covered under Subchapter 15 and Water Code Sections 13301 and 13304.

If a waiver is granted, the Regional Board must notify the California Department of Health Services (DHS) and must take remedial action pursuant to Chapter 5 (Section 13300 et. seq.).

D. INCORPORATION OF SUBCHAPTER 15 REQUIREMENTS

The technical requirements of the SWAT program and Subchapter 15[3] have a substantial overlap. Owners of active solid waste disposal sites were required to submit to the Regional Board by mid-1985 a proposed monitoring program that would meet the requirements of Articles 5 and 9 of Subchapter 15. Wherever such a program was implemented, it should have met all or most of the SWAT requirements. There are, however, some important differences between the two programs:

1. Water Code Section 13273 is written in language that can be interpreted as requiring only a single sample per sampling point. Since almost all of California has distinctly wet and dry seasons, water quality may likewise have a seasonal variation. During and immediately following the wet season, infiltrating rainfall may dilute and reduce the mineral concentrations of existing vadose zone and ground water. On the other hand, following the infiltration of precipitation from a major storm through waste, a distinct "slug" of degraded water may be found moving toward or within the zone of

[3]California Code of Regulations, Title 23, Chapter 3, Subchapter 15, "Disposal of Waste to Land".

saturation. A further complication is that a "slug" of leachate may take many months to move from the site to a particular monitoring well. Therefore, the general rule should be that a reliable indication of ground water quality can only be obtained from a suite of at least four quarterly samples. Any site operator submitting sample data that does not meet the above criteria must demonstrate that his site is different from the general rule stated above.

2. Subchapter 15 only mandates water quality monitoring of active sites. The SWAT law makes no distinction between active and inactive sites.

3. Subchapter 15's requirements for unsaturated (vadose) zone sampling apply only "if feasible". The SWAT law contains no such exception.

Disposal site operators with active sites on the State Board's ranked SWAT list should comply with the monitoring requirements in Subchapter 15 at the same time they complete the SWAT report. Disposal site operators should contact their Regional Boards for site specific information on Subchapter 15 compliance. Disposal site operators in the process of implementing Subchapter 15 requirements may find that many of their SWAT Program requirements will have been satisfied with their Subchapter 15 efforts. In these cases, the required SWAT will summarize the ongoing Subchapter 15 efforts and report on the specific hazardous waste test results required by the Regional Board. Hence, for all references contained in this guidance, unless otherwise noted, refer to code sections found in Title 23, Chapter 3, Subchapter 15 of the California Code of Regulations.

III. SWAT PROPOSALS

The purpose of a SWAT proposal is threefold:

- Provide to the Regional Board all relevant background information and supporting data for the proposed SWAT investigation.
- Provide to the Regional Board an outline of the investigation plan, including the location, design, and rationale for all monitoring and sampling stations.
- Provide the site operator an early opportunity to adjust the SWAT investigation plans in order to meet the mandates of the law and the requirements of the Regional Board.

In most cases, a preliminary (pre-proposal) hydrogeologic assessment of the site will be necessary. This should include a thorough inventory of all available site and regional data, such as existing maps and literature, well data, water quality analyses, etc. If additional background information is needed, the operator may wish to install piezometers or exploratory boreholes, do site specific geologic mapping, or take other measures to establish hydraulic gradients, aquifer characteristics, etc. The Regional Board staff may wish to confer with the site operator at this stage to ensure that the necessary preliminary assessment work is being done.

The following sections (III.A through III.F) provide an outline of the items which should be addressed in the SWAT proposal. It is expected that much of the requested data will not be available for older and/or smaller sites. In such cases, the Regional Boards should determine whether any of the omitted data are critical for successful completion of the SWAT report. In such cases, they should require that these data or equivalent alternative data be obtained by the site operator.

Site data previously submitted to the Regional Board under another program need not be resubmitted; however, it must be clearly and accurately referenced.

A. GENERAL SITE INFORMATION

This section is designed to give all relevant background data concerning the disposal site.

1. SITE NAME: Include the preferred name and all previous names used for the facility.

2. SITE LOCATION: Data submitted should include both general information necessary for determining where the site is located and, also, data showing where on the site property waste has been placed. All of the following should be submitted:

   a. A scaled map showing the relationship of the site to highways, communities and other cultural features.

   b. A street address, if available, or general location.

   c. Township, range, section, and fractional section, if available.

   d. County Assessor's parcel map showing site boundaries.

   e. Other types of maps or descriptive matter that provide equivalent information useful for specifying the site and waste location.

3. OWNERS/OPERATORS: Include current property owner(s) and site operator(s) of the facility. Include names, current mailing addresses and telephone numbers.

4. CURRENT PERMITS AND/OR REGULATORY ORDERS: Reference all relevant permits and orders (copies need not be submitted unless specifically requested by the Regional Board).

5. SITE HISTORY:

   a. Identify names and current addresses, and duration of involvement for all past site owners and operators.

   b. Describe past and present modes of operation used at the site.

6. WASTE DISPOSAL HISTORY:

   a. Include a description of the types, quantities, physical states, concentrations, and disposal locations of wastes contained in the site. This should include information for all previous operations. Wastes and waste constituents should be specifically identified according to the most descriptive nomenclature. This should include, if possible, reference numbers for listings established by DHS in Section 66680, Title 22, California Code of Regulations.

   b. Include a description of waste disposal methods specifying waste mixing and management practices.

7. SITE CONSTRUCTION DETAILS (Section 2596(a)(1)):

   a. Include detailed information on liners including:

      (1) Liner material specifications and testing.

      (2) Method of placement and other construction details.

      (3) Quality assurance/quality control procedures.

      (4) Subsequent inspections, repairs, etc.

   b. If a leachate collection and removal system pursuant to Section 2557 is present, include construction details and specifications along with a representative analysis of leachate. Include a summary of all previous analyses.

8. SITE CLOSURE DETAILS:

   a. Date operations ceased.

   b. Date closure plan was approved. (If site closure was phased, provide map showing closure dates for each portion of the site.)

   c. Details on final treatment processes (mixing, chemical treatment, burial, removal, etc.).

   d. Quantity and quality of all waste left in place.

e. Cover specifications (same details as for liners, 7a. above). Specify if cover is final cover.

f. Description of landfill gas collection system and gas condensate disposal method.

g. Description of occurrences of settlement or cracking.

9. CURRENT AND PROPOSED LAND USE:

Describe the present and proposed (if known) land use of the disposal site property and the present and proposed land use patterns existing within 0.5 mile of the disposal site.

B. SITE ASSESSMENT

This section is designed to describe the geology and hydrogeology of the site as necessary to justify all monitoring station locations and designs (Section 2596(a)).

1. GEOLOGIC OVERVIEW

a. REGIONAL DATA:

(1) Excerpts of all relevant published geologic information that is referenced in the SWAT proposal.

(2) Topographic maps, geologic maps, and air photos (if available) of the disposal site area. Include locations of all springs, seeps, and surface flows within one mile of the facility boundaries.

(3) Regional geologic cross sections.

(4) Regional soil surveys (available through the U.S. Soil Conservation Service) within one mile of the facility boundaries.

(5) All available well logs within one mile of the facility boundaries, along with a map showing locations and functions of all wells (i.e., monitoring, production, etc.).

b. SITE-SPECIFIC DATA:

(1) Surface and subsurface geologic maps, and a description of the geologic structure of the waste site, including the lithology, thickness, strike, and dip of bedding; the location, attitude, and condition (tight, open, clay- or gypsum-filled, etc.) of any fractures or faults; the nature, type (anticlinal, synclinal, etc.), and orientation of any folds; and all other structural data relevant to ground water and pollutant movement.

(2) Logs and a location map of all monitoring and other wells drilled for this facility (see Appendix 3: Geologic Well Log Description).

(3) Trench logs (if available).

(4) Geologic cross-sections: These sections should be both perpendicular to, and along the regional structure.

2. HYDROGEOLOGIC OVERVIEW

a. REGIONAL DATA: Include a summary of all relevant published regional hydrologic and hydrogeologic information. If referenced reports are not readily available, copies of the appropriate data should be submitted (Section 2595(c)).

b. SITE-SPECIFIC DATA: Include the following:

(1) Well logs and completion reports from pilot holes, wells, or any prior piezometer construction (see Appendix 3: Geologic Well Log Description).

(2) All prior water level measurement data (see Appendix 5: Piezometer Design and Placement).

(3) All prior analytical data from surface waters, ground waters or vadose zone soil pore liquids under or adjacent to the landfill (see Appendix 5: Physical Analysis of Soil Samples).

C. PROPOSED MONITORING/SAMPLING STATIONS

1. SURFACE WATER SAMPLING: Proposed locations and sampling methodology together with supporting rationale for each.

2. VADOSE ZONE SAMPLING: Proposed locations and vadose zone sampling methodology together with supporting rationale for each (see Appendix 6: Vadose Zone Monitoring) (Section 2559).

3. GROUND WATER SAMPLING: Proposed locations and ground water monitoring well design, along with supporting rationale for each (see Appendix 7: Monitoring Well Design and Placement) [Section 2555(c),(d),(e),(f),(g) & Section 2596(a)].

D. PROPOSED SAMPLING PROCEDURES

Full details should be provided on all proposed surface, vadose, and ground water sampling methods (see Appendix 2: Sampling Procedures) (Section 2855).

E. PROPOSED CHEMICAL ANALYTICAL METHODS

An important consideration in implementing the SWAT program is the assumption that solid waste disposal sites will contain some wastes that were not expected to be present. It is easy to picture circumstances where site users have brought in hazardous wastes, knowingly or unknowingly, for disposal at a site intended for common domestic waste only. Therefore, the chemical analytical methods used must be aimed not at the determination of what is known to be present, but rather, what might be present (see Appendix 2, Section G: Methods of Analyses).

F. PROPOSED QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

One of the responsibilities of the operator is to ensure the reliability and validity of field and analytical laboratory data gathered as part of the overall ground water monitoring program.

The operator's sampling and analysis plan must explicitly describe the QA/QC program that will be used in the field and laboratory. (see Appendix 2, Section H: Quality Assurance/Quality Control).

IV. SWAT REPORTS

All SWAT reports will be thoroughly reviewed to determine whether they fully comply with the law and provide adequate data to support the required findings. Matters of special importance include:

A. **DOES THE REPORT CONTAIN AN EXECUTIVE SUMMARY OF THE KEY FINDINGS AND CONCLUSIONS?** The SWAT report's executive summary should contain the following:

1. For each type of sampling (monitoring) method (surface, vadose zone, and ground water):

   - Number of monitoring points.
   - Number of sampling events per monitoring point.
   - Evidence of waste leakage (hazardous, non-hazardous, or none).

2. Is there evidence of hazardous waste in the waste disposal site?

B. **IS THE PERSON CERTIFYING THE REPORT QUALIFIED?** Water Code Subsection 13273(b) states:

> "(b)...a registered geologist, ...a certified engineering geologist, ...or a civil engineer, ...who has at least five years' experience in groundwater hydrology, shall certify that the report contains all of the following information ...."

The report must contain clear evidence that the person certifying the report fully meets the above requirements. The person's license number and expiration date should be given together with a thorough description of their qualifying experience.

C. **IS ALL THE REQUIRED INFORMATION PROVIDED?** Water Code Subsection 13273(b) continues with a description of required data:

> "(1) An analysis of the surface and groundwater on, under, and within one mile of the solid waste disposal

site to provide a reliable indication whether there is any leakage of hazardous waste."

"(2) A chemical characterization of the soil-pore liquid in those areas which are likely to be affected if the solid waste disposal site is leaking, as compared to geologically similar areas near the solid waste disposal site which have not been affected by leakage or waste discharge."

Emphasis should be placed on the following considerations:

1. **ARE YOU CONVINCED THAT THE MONITORING STATIONS PROVIDE RELIABLE DATA ON THE CHEMICAL CHARACTER OF THE WATER?**

   Do all monitoring stations comply with Subchapter 15, Articles 5 and 9? Does the sampling program provide representative samples of ground water, surface water (if appropriate), and unsaturated zone water from all significant potential pollutant escape routes? Are the sampling points capable of intercepting pollutant movement that occurs for only a short period each year (i.e., after a heavy rainfall or as a result of nearby seasonal heavy pumping)?

2. **DOES THE REPORT PROVIDE ADEQUATE DATA FROM THE FOLLOWING LIST TO VALIDATE THE FINAL LOCATION AND AS-BUILT DESIGN FOR EACH MONITORING POINT?**

   - Site improvements and locations of waste.
   - Site geology.
   - Site hydrogeology.
   - Site soils data.
   - Other relevant information.

   Enough data should be provided so that the reviewer, given the same information, would select the same monitoring network locations and designs as those constructed. The report should include geologic cross-sections, ground water gradient data, and other supporting rationale for the location, depth, and

methods for each sampling point. This discussion also should support the numbers of monitoring points relative to the size, shape, and location of each significant potential escape route.

Much of this information may have been included in the proposal; however, initial assessment of site conditions may prove to be significantly different than actual subsurface conditions discovered during drilling and exploration. If actual conditions are similar to those initially described, a brief discussion here with reference to the proposal would be appropriate.

3. **DOES THE REPORT DESCRIBE ADEQUATE INSTALLATION QUALITY CONTROL AND QUALITY ASSURANCE MEASURES TO ENSURE THAT ALL MONITORING STATIONS WILL WORK PROPERLY?**

   Improperly installed stations can be a vehicle for movement of pollutants into heretofore clean aquifers. In addition, if they produce non-representative samples (i.e., diluted or de-gassed) they can lead to erroneous data and a false sense of security. An incorrectly installed lysimeter that cannot obtain a water sample gives false data on the presence of water in the formation and prevents one from obtaining data on its quality. The SWAT report should contain as-built details and rationale for locations and construction designs for all sampling (monitoring) stations.

4. **WERE THE SAMPLING METHODS APPROPRIATE TO OBTAIN RELIABLE AND REPRESENTATIVE DATA?**

   The sampling procedures should have been capable of obtaining fresh, representative samples of the water with no significant loss of volatile organic chemicals or undue dilution of the samples.

5. **WERE APPROPRIATE CHEMICAL ANALYTICAL AND QUALITY CONTROL METHODS USED?**

   The analytical methods used should have been capable of providing data on any significant quantities of hazardous substances that could be leaking from the disposal site. Have standard quality control procedures (blanks, spikes, etc.) been employed?

Did the analytical laboratory have the appropriate certifications?

6. HAVE ENOUGH SAMPLES BEEN TAKEN TO PROVIDE INDICATION OF ANY SEASONAL VARIATIONS OF WATER QUALITY?

This is especially important where pollutant movement is related to periods of heavy rainfall. Unless exceptional circumstances are demonstrated, quarterly samples should be required.

D. DOES THE REPORT CONTAIN A REASONABLE INTERPRETATION OF THE BASIC DATA INDICATING WHETHER HAZARDOUS WASTE IS LEAKING FROM THE SOLID WASTE DISPOSAL SITE?

- There should be a full description of the chemical quality of surface, vadose zone, and ground water under and adjacent to the waste disposal site.
- The report must contain all relevant analytical data, not just a summary of results.
- Chemical data should be accompanied by a description of the analytical methods used and a discussion of all quality control measures, including chain-of-custody documents, spikes, blanks, etc.
- Are the SWAT report conclusions consistent with the findings and conclusions of the Air-SWAT report?

1. DETERMINATION OF LEAKAGE

As discussed above, chemical analytical work must be aimed at a determination of what constituents might be present. If a chemical constituent is found that is not naturally occurring in water (e.g., vinyl chloride) and is absent from upgradient waters, these facts alone indicate the heavy probability of site leakage. In some cases, a positive determination of whether leakage has occurred may require a statistical analysis of data from upgradient and downgradient wells.

2. FINDING OF HAZARDOUS WASTE LEAKAGE

Water Code Subsection 13273(e) requires the Regional Board to make a finding whether any hazardous waste has migrated into the water. The question of whether a water sample from one of the site's monitoring (sampling) points is hazardous can be answered by referring to the California Code of Regulations, Title 22, Article 11, Sections 66693 et seq.

More frequently, however, sample analyses will indicate the presence of hazardous constituents listed in Title 22, Article 9, Section 66680 rather than hazardous waste, per se. Most of the constituents will be at concentrations below the Soluble Threshold Limit Concentration (STLC) or equivalent levels. When this occurs, all the circumstances of the determination must be examined. Certainly, any finding of a hazardous waste constituent at levels above background concentrations is a cause of concern.

In some cases, hazardous waste will be the source of the pollutants found at the monitoring point. Preferring to err on the safe side, assume that significant dilution and/or attenuation of the hazardous waste constituent has occurred.

In those cases where it is questionable that the pollutant source <u>is</u> hazardous waste in the disposal site, continued monitoring is critical. It must be determined whether the given chemical concentrations are indicative of a hazardous waste source which will continue to degrade the water, or are temporal or naturally occurring constituents which do not indicate a problem.

E. REJECTION OF INADEQUATE REPORTS

Water Code Section 13273 states:

"(d) The regional board shall examine the report submitted pursuant to subdivision (b) and determine whether the number, location, and design of the wells and the soiling (sic) testing could detect any leachate buildup, leachate migration, or hazardous waste migration. If the regional board determines that the monitoring program could detect the leachate

and hazardous waste, the regional board shall take the action specified in subdivision (e). If the regional board determines that the monitoring program was inadequate, the regional board shall require the solid waste disposal site to correct the monitoring program and resubmit the solid waste assessment test based on the results from the corrected program."

The SWAT report must meet all the criteria set forth in Section 13273. A SWAT report should be returned for modifications if:

- The report fails to fulfill any of the law's requirements.
- It lacks the required professional certification, as per Subsection 13273(b).
- It is not complete in its sampling of ground water, surface water (if applicable), and unsaturated zone water, as required by Subsections 13273(b)(1) and (2); both with regard to space (consider three-dimensions!) and time.
- It does not provide adequate rationale for the location and design of each monitoring station to allow the Regional Board to make the determination specified in Subsection 13273(d).
- It does not provide convincing evidence that supports its conclusions regarding hazardous waste leakage and does not allow the Regional Board to make the determination specified in Subsection 13273(e).

APPENDIX 1: APPLICABLE LAWS
A. GOVERNMENT CODE

TITLE 7.3. Solid Waste Management, Resource Recovery, and Recycling
CHAPTER 3. Enforcement Program
ARTICLE 1. Administrative Enforcement and Remedies Available to an Enforcement Agency

Section
66796.53. **Enforcement order or action; explanatory and justifying statement to other agencies; time; inspection of site; receipt of complaint by wrong agency; action by agency or written explanation required**

(a) At least 10 days before issuing an enforcement order which is not for an emergency, within 5 days after issuing an enforcement order for an emergency, and within 15 days after discovering a violation of a state law, regulation, or permit, or a local ordinance, rule, regulation, license, or permit, for a solid waste disposal site which is likely to result in an enforcement action, the following agencies shall provide a written statement providing an explanation of, and justification for, the enforcement order or a description of the violation in the following manner:

(1) The enforcement agency shall provide the statement to the local California regional water quality control board, the local air pollution control district or air quality management district, and the State Department of Health Services.

(2) A California regional water quality control board shall provide the statement to the enforcement agency, the local air pollution control district or air quality management district, and the State Department of Health Services.

(3) An air pollution control district or an air quality management district shall provide the statement to the enforcement agency, the California regional water quality control board, and the State Department of Health Services.

(4) The State Department of Health Services shall provide the statement to the enforcement agency, the local California regional water quality control board, and the local air pollution control district or air quality management district.

(b) Within 10 days after receiving a notice of the issuance of, or the proposal to issue, an enforcement order, pursuant to subdivision (a), the local California regional water quality control board, the enforcement agency, the local air pollution control district or the air quality management district, and the State Department of Health Services shall inspect the solid waste disposal site to determine whether any state law, regulation, or permit, which that board or agency is authorized to enforce, is being violated.

(c) If any board or agency specified in subdivision (a) receives a complaint concerning a solid waste disposal site and the board or agency determines that it is not authorized to take action concerning the complaint, the board or agency shall refer the complaint within 10 days of receipt to another state agency which it determines is authorized to take action.

(d) If any agency or board specified in subdivision (a) receives a complaint concerning a solid waste disposal site which the agency or board does not refer to another state agency pursuant to subdivision (c), or if such an agency or board receives a complaint referred to it by another agency or board pursuant to subdivision (c), the agency or board shall either take enforcement action concerning that facility or provide the person who filed the complaint with a written statement within 10 days explaining why an enforcement action would not be appropriate.

HISTORY:

+Added Stats. 1984, ch. 1532, Section 1.

GOVERNMENT CODE

Section
66796.54. Report to the legislature; extent of hazardous wastes; potential effects on water quality; accuracy of tests

(a) On or before January 1, 1989, January 1, 1990, and January 1, 1991, the State Water Resources Control Board shall submit a report to the Legislature summarizing the extent of hazardous waste in solid waste disposal sites and the potential effects these hazardous wastes may have upon the quality of waters of the state, and recommending actions needed to protect the quality of water. Each report shall summarize the data from those solid waste water quality assessment test reports which have been submitted during the preceding year to California regional water quality control boards pursuant to Section 13273 of the Water Code, and shall evaluate the accuracy of the solid waste water quality assessment tests conducted.

(b) On or before July 1, 1988, and July 1, 1989, the State Air Resources Board shall submit a report to the Legislature summarizing the extent of hazardous waste in solid waste disposal sites and the potential effects these hazardous wastes may have upon the ambient air quality of the state, and recommending actions needed to protect the quality of air. The reports submitted on July 1, 1988, and July 1, 1989, shall summarize the data from the solid waste air quality assessment test reports submitted to air quality maintenance districts and air pollution control districts on or before July 1, 1987, and January 1, 1988, respectively, pursuant to Section 41805.5 of the Health and Safety Code, and shall evaluate the accuracy of the solid waste assessment tests conducted.

HISTORY:

+Added Stats. 1986, ch. 1055, Section 3, effective September 24, 1986, operative January 1, 1987.

+Former Section: Former Section 66796.54, similar to the present section was added by Stats. 1984, ch. 1532, Section 2, amended by Stats. 1986, ch. 971, Section 1, and repealed by Stats. 1986, ch. 1055, Section 1, effective September 24, 1986.

B. WATER CODE

DIVISION 7. Water Quality
CHAPTER 4. Regional Water Quality Control
ARTICLE 4. Waste Discharge Requirements

Section
13273. **Solid waste disposal sites; ranking based on threat to water quality; submission of water quality assessment test reports by rank; waiver; evaluation; procedure upon discovery of inadequate monitoring or contamination of the water; revision of discharge requirements**

(a) The state board shall, on or before January 1, 1986, rank all solid waste disposal sites, as defined in Section 66714.1 of the Government Code, based upon the threat which they may pose to water quality. On or before July 1, 1987, the operators of the first 150 solid waste disposal sites ranked on the list shall submit a solid waste water quality assessment test to the appropriate Regional Board for its examination pursuant to subdivision (d). On or before July 1 of each succeeding year, the operators of the next 150 solid waste disposal sites ranked on the list shall submit a solid waste water quality assessment test to the appropriate regional board for its examination pursuant to subdivision (d).

(b) Before a solid waste water quality assessmenttest report may be submitted to the regional board, a registered geologist, registered pursuant to Section 7850 of the Business and Professions Code, a certified engineering geologist, certified pursuant to Section 7842 of the Business and Professions Code, or a civil engineer registered pursuant to Section 6762 of the Business and Professions Code, who has at least five years' experience in groundwater hydrology, shall certify that the report contains all of the following information and any other information which the state board may, by regulation, require:

(1) An analysis of the surface and groundwater on, under, and within one mile of the solid waste disposal site to provide a reliable indication whether there is any leakage of hazardous waste.

(2) A chemical characterization of the soil-pore liquid in those areas which are likely to be affected if the solid waste

disposal site is leaking, as compared to geologically similar areas near the solid waste disposal site which have not been affected by leakage or waste discharge.

(c) If the regional board determines that the information specified in paragraph (1) or (2) is not needed because other information demonstrates that hazardous wastes are migrating into the water, the regional board may waive the requirement to submit this information specified in paragraphs (1) and (2) of subdivision (b). The regional board shall also notify the State Department of Health Services, and shall take appropriate remedial action pursuant to Chapter 5 (commencing with Section 13300).

(d) The regional board shall examine the report submitted pursuant to subdivision (b) and determine whether the number, location, and design of the wells and the soiling testing could detect any leachate buildup, leachate migration, or hazardous waste migration. If the regional board determines that the monitoring program could detect the leachate and hazardous waste, the regional board shall take the action specified in subdivision (e). If the regional board determines that the monitoring program was inadequate, the regional board shall require the solid waste disposal site to correct the monitoring program and resubmit the solid waste assessment test based upon the results from the corrected monitoring program.

(e) The regional board shall examine the approved solid waste assessment test report and determine whether any hazardous waste migrated into the water. If the regional board determines that hazardous waste has migrated into the water, it shall notify the State Department of Health Services and the California Waste Management Board and shall take appropriate remedial action pursuant to Chapter 5 (commencing with Section 13300).

(f) When a regional board revises the waste discharge requirements for a solid waste disposal site, the regional board shall consider the information provided in the solid waste assessment test report and any other relevant site-specific engineering data provided by the site operator for that solid waste disposal site as part of a report of waste discharge.

HISTORY:

+Added Stats. 1984, ch. 1532, Section 6; Amended Stats. 1986, ch. 971, Section 3.

WATER CODE

Section
13273.1. Solid waste assessment questionnaires

(a) Except as provided in subdivision (b), an operator of a solid waste disposal site may submit a solid waste assessment questionnaire to the appropriate regional board at least 24 months prior to the site's solid waste water quality assessment test due date as established pursuant to Section 13273. The regional board shall require the operator to submit any additional information, as needed, or require onsite verification of the solid waste assessment questionnaire data in order to render a decision pursuant to subdivision (c).

(b) Any solid waste disposal site which is larger than 50,000 cubic yards or is known or suspected to contain hazardous substances, other than household hazardous wastes, shall be prohibited from submitting a solid waste assessment questionnaire under this section.

(c) The regional board shall complete a thorough analysis of each solid waste assessment questionnaire submitted pursuant to this section by a date 18 months prior to the solid waste assessment test due date. Based upon this analysis, the regional board shall determine whether or not the site has discharged hazardous substances which will impact the beneficial uses of water. If the regional board determines that the site has not so discharged hazardous substances, the regional board shall notify the operator that the operator is not required to prepare a solid waste water quality assessment test pursuant to Section 13273.

(d) If the regional board does not make the determination specified in subdivision (c), the operator shall submit all, or a portion of, a solid waste water quality assessment test. The regional board shall notify the operator of this determination and indicate if all, or what portion of, a solid waste water quality assessment test shall be required. The operator shall submit the solid waste water quality assessment test, or a portion thereof, by the date established pursuant to Section 13273.

(e) The state board shall develop a solid waste assessment questionnaire and guidelines for submittal no later than three months after the effective date of this statute adding this section. The questionnaire shall contain, but not be limited to, a characterization of the wastes, size of the site, age of the site, and other appropriate factors.

(f) Those operators of solid waste disposal sites listed by the state board pursuant to Section 13273 in Rank 3 and seeking an exemption under this section shall submit their solid waste assessment questionnaire no later than July 1, 1988. If the regional board does not make the determination specified in subdivision (c), the regional board shall require the operator to submit all, or a portion of, a solid waste water quality assessment test by July 1, 1990.

HISTORY:

+Added Stats. 1987, ch. 932, Section 2, effective September 22, 1987.

Section 13273.2. Reevaluation of solid waste disposal site status; requirement to submit or revise solid waste water quality assessment test

Notwithstanding subdivision (b) of Section 13273.1, a regional board may reevaluate the status of any solid waste disposal site ranked pursuant to Section 13273, including those sites exempted pursuant to Section 13273.1, and may require the operator to submit or revise a solid waste water quality assessment test after July 1, 1989. The regional board shall give written notification to the operator that a solid waste assessment test is required and the due date. This section shall not require submittal of a solid waste water quality assessment test by a date earlier than established in accordance with Section 13273.

HISTORY:

+Added Stats. 1987, ch. 932, Section 3, effective September 22, 1987.

Section
13273.3. Operator defined

As used in Sections 13273, 13273.1, and 13273.2, "operator" means a person who operates or manages, or who has operated or managed, the solid waste disposal site. If the operator of the solid waste disposal site no longer exists, or is unable, as determined by the regional board, to comply with the requirements of Section 13273, 13273.1, or 13273.2, "operator" means any person who owns or who has owned the solid waste disposal site.

HISTORY:

+Added Stats. 1987, ch. 932, Section 4, effective September 22, 1987.

C. HEALTH AND SAFETY CODE

DIVISION 26. Air Resources
PART 4. Nonvehicular Air Pollution Control
CHAPTER 3. Emission Limitations
ARTICLE 2. Nonagricultural Burning

Section
41805.5. **Solid waste air quality assessment test report; contents; questionnaires; exemptions**

(a) Except as provided in subdivisions (b) and (c), the operator of a solid waste disposal site shall submit to the district on or before July 1, 1987, a solid waste air quality assessment test report that contains all of the following:

(1) Test results to determine if there is any underground landfill gas migration beyond the solid waste disposal site's perimeter.

(2) Analyses for specified air contaminants in the ambient air adjacent to the solid waste disposal site to determine the effect of the site on air quality.

(3) Chemical characterization test results to determine the composition of gas streams immediately above the solid waste disposal site, or immediately above the solid waste disposal site and within the solid waste disposal site, as appropriate, as determined by the district.

(4) Any other information which the district board may require, by emergency regulation.

The solid waste air quality assessment test report shall be prepared in accordance with the guidelines developed by the state board pursuant to subdivision (d).

(b) The operator of an inactive solid waste disposal site shall complete and submit the screening questionnaire, developed pursuant to subdivision (e), to the district on or before November 1, 1986, unless the operator is required to submit a report containing the same information specified in subdivision (a) pursuant to a federal, state, or district order, or unless exempted pursuant to subdivision (c). The district shall evaluate the submitted screening questionnaires in accordance with the guidelines developed pursuant to

subdivision (e) and shall determine whether the operator of the site be required to submit all, or a portion of, the information required to be reported in a solid waste air quality assessment test report. The district shall notify the operator in writing on or before January 1, 1987, of the information identified in subdivision (a) to be submitted for the site. After receiving this notification, the operator of the inactive solid waste disposal site shall submit a solid waste air quality assessment test report containing the required information on or before January 1, 1988, to the district.

(c) A district may exempt from subdivisions (a) and (b) a solid waste disposal site or inactive solid waste disposal site which has accepted or now contains only inert and nondecomposable solids. To receive an exemption, the operator of the site shall submit, on or before November 1, 1986, a copy of all permits, all waste discharge requirements pertinent to the site, and any other data necessary for the district to determine whether an exemption should be granted to the site.

(d) On or before February 1, 1987, the state board, in coordination with the districts, shall develop and publish test guidelines for the solid waste air quality assessment report specifying the air contaminants to be tested for and identifying acceptable testing, analytical, and reporting methods to be employed in completing the report.

(e) On or before October 1, 1986, the state board, in coordination with the districts, shall develop and publish a screening questionnaire for inactive solid waste disposal sites and guidelines for evaluating the questionnaire by the districts pursuant to subdivision (b). The screening questionnaire and guidelines shall require an inactive solid waste disposal site to be evaluated based on the nature and age of materials in the site, the quantity of materials in the site, the size of the site, and other appropriate factors. The guidelines for evaluating the screening questionnaire shall require a district to weigh heavily the proximity of the site to residences, schools, and other sensitive areas, and to pay particular attention to potential adverse impacts on facilities such as hospitals and schools, and on residential areas, within one mile of the site's perimeter.

(f) A district may reevaluate the status of a solid waste disposal site, including sites exempted pursuant to subdivision (c), and require the operator to submit or revise a solid waste air quality assessment test report after January 1, 1987. The district shall give written notification to the operator of the solid waste disposal site that a solid waste air quality assessment test report is to be submitted, or that the existing report is to be revised, and the date by which the report is to be submitted.

(g) A district shall evaluate any solid waste air quality assessment test reports submitted pursuant to subdivisions (a), (b), and (f), and determine if the report's testing, analytical and reporting methods comply with the guidelines developed pursuant to subdivision (d). If the district determines that the solid waste air quality assessment test report complies with the guidelines, it shall evaluate the data. If the district determines, after evaluation of the report and consultation with the state department and the California Waste Management Board, that levels of one or more specified air contaminants pose a health risk to human beings or a threat to the environment, the district shall take appropriate remedial action.

(h) If a district determines that a solid waste air quality assessment test report does not comply with the guidelines developed pursuant to subdivision (d), the district shall provide the operator of the site with a written notice specifying the inadequacies of the report and shall require the operator to correct the deficiencies and resubmit the report by a date determined by the district.

(i) For the purpose of this section, the following definitions apply:

(1) "Inactive solid waste disposal site" means a solid waste disposal site which has not received any solid waste for disposal after January 1, 1984.

(2) "Landfill gas" means any untreated, raw gas derived through a natural process from the decomposition of organic waste deposited in a solid waste disposal site or from the evolution of volatile species in the waste.

(3) "Operator" means the person who operates or manages, or who has operated or managed, the solid waste disposal site. If the operator of the solid waste disposal site no longer exists, or is unable, as determined by the district, to comply with the requirements of this section, "operator" means any person who owns or who has owned the solid waste disposal site.

(4) "Perimeter" means the outer boundary of the entire solid waste disposal site property.

(5) "Solid waste disposal site" means a place, location, tract of land, area, or premises in use, or which has been used, for the landfill disposal of solid waste, as defined in Section 66719 of the Government Code, or hazardous waste, as defined in Section 66714.8 of the Government Code, or both.

(6) "Specified air contaminants" means substances determined to be air contaminants by the state board in coordination with the districts. The state board and the districts shall consider determining the following compounds to be air contaminants for purposes of this paragraph: benzene, chloroethene, 1,2-dibromoethane, 1,2-dichloroethane benzyl chloride, chlorobenzene, dichlorobenzene, 1,1-dichloroethene, dichloromethane, formaldehyde, hydrogen sulfide, tetrachloroethylene, tetrachloromethane, toluene, 1,1,1-trichloroethane, trichloroethylene, trichloromethane, xylene, and any other substance deemed appropriate by the state board or a district.

HISTORY:

+Added Stats. 1984, ch. 1532, Section 4. Added Stats. 1986, ch. 1055, Section 5, effective September 24, 1986; Amended Stats. 1987, ch. 932, Section 1, effective September 22, 1987.

+Former Section: Former Section 41808.5, similar to the present section, was repealed by Stats. 1986, ch. 1055, Section 4, effective September 24, 1986.

APPENDIX 2: SAMPLING AND ANALYSIS PROCEDURES

The operator should specify the indicator parameters and waste constituents to be monitored after considering the following factors:

- The possible types, quantities, and concentrations of constituents in wastes at the waste site.
- The mobility, stability, and persistence of possible waste constituents or their reaction products.

A. FREQUENCY OF SAMPLING

Water quality sampling should consist of measuring indicator parameters (temperature, electrical conductivity, pH) and testing for various waste constituents quarterly for one year. The sampling for an entire year should account for errors in sampling and analyses as well as seasonal fluctuations. The site operator should take a minimum of one sample from each sampling point for each sampling event.

B. SAMPLING PLAN

The site operator should prepare a formal sampling plan addressing all elements contained in this section. Water levels should be noted before each sampling event. The plan should include appropriate quality control/quality assurance practices including standards, laboratory blanks, duplicates, and spiked samples.

C. GROUND WATER SAMPLE COLLECTION

1. **WELL PURGING:** The chemical properties of water that has been sitting inside the well bore for an expended period of time may differ substantially from that of the formation water. Therefore, it is a common practice to pump from three to five well volumes of water from the well prior to sampling.

   The purging rate should never be fast enough to cause water to vigorously cascade down the sides of the screen.

Low yield aquifers may require substantial time to obtain several well volumes. This could lead to degassing of the formation water. These aquifers may need to be sampled with varying purged volumes over time to determine adequate purging values. A low yield aquifer which has only one casing volume of fluid removed should have the sample tested for pH, temperature, and specific conductance. After recovery, the well should be retested for these parameters. If full recovery of the well exceeds two hours, the sample for retesting should be collected as soon as a sufficient sample is available, but within two hours of the original sampling.

2. SAMPLING DEVICES: The sole task of a sampling device is to obtain a thoroughly representative, reliable sample of the formation water. It is recommended that an individual sampling device be dedicated to each well to save the time, cost, and difficulty of decontaminating the equipment between well sampling. It is critical that there be no significant gain or loss of chemical constituents. It is especially critical to prevent the loss (degassing) of volatile organic constituents such as vinyl chloride and other related chemicals. Extreme care should be taken when transferring the sample from the sampling device to the sample container. Loss of volatiles can be minimized by using a "bottom-emptying device", which eliminates the need to turn the sampling device upside down.

   Acceptable sampling devices for these parameters include fluorocarbon resin or stainless steel bailers, syringe bailers, or bladder pumps.

   a. BAILERS: A bailer consists of a tube with a check ball valve at the bottom or bottom and top. The single check ball valve model is not capable of sampling discrete intervals. It is difficult to transfer the sample from the bailer to the sample container without contaminating the sample, especially in tubes that are not designed for using a bottom-emptying device.

   b. SYRINGE BAILERS: A syringe bailer pulls the sample into the bailer tube either by direct movement of a plunger in the tube or a pump on the

surface moving the plunger. This delivers a highly representative sample.

c. BLADDER PUMPS: Bladder pumps have a flexible bladder inside a rigid body. Rhythmical inflation and deflation of the bladder causes the fluid to rise to the surface. A sampling tube attached to the intake of the pump retains the sample, which may then be withdrawn from the well and transferred to an appropriate sample vial.

D. SURFACE WATER SAMPLE COLLECTION

Surface water sampling methods also vary according to the circumstances. Deeper water bodies are normally sampled with a bailer or "thief" type sampler. Shallow water bodies or seeps must be sampled by construction of a small "pond". After it has filled, the sample bottle can be immersed in the water and filled.

All surface waters and springs within a mile both upgradient and downgradient from the disposal site should be sampled. Perennial streams should be sampled quarterly. Intermittent streams should also be sampled when water is present, but not during storm events or other periods of high flow. A map showing all sampling points must be included in the report.

Under circumstances where the water body originates on the site, consider your upgradient sample as the springs or seeps (rising water) at the headwaters of the stream. If there is no evidence of rising water, presume that the upgradient water quality is that of the precipitation in the area.

E. SAMPLE STORAGE

Different methods of sample storage are used depending on whether the sample is being tested for metals or organic chemicals.

1. METAL ANALYSES: For metal analyses, the containers should be washed in non-phosphate detergent and tap water, and rinsed with a 1:1 mixture of nitric acid and tap water, a 1:1 mixture of hydrochloric acid and tap water, and Type II reagent water. Only fluoro-

carbon resin or polyethylene containers with polypropylene caps should be used.

Metal analysis samples should be split into two portions. The first portion should be filtered through a 0.45 micron membrane filter, then transferred to a container, and preserved with nitric acid with pH less than 2. The remaining sample should be treated the same way; however, without filtration. (Cr(VI) should not be acidified.)

2. ORGANIC CHEMICALS: For organic chemicals, glass bottles with fluorocarbon resin-lined caps should be used. The containers should be washed first with a non-phosphate detergent in hot water, then rinsed with tap water, distilled water, acetone, and pesticide-quality hexane.

3. OTHERS: Storage of other constituents such as pesticides, extractable organic chemicals, etc., require specific methods of treatment beyond the scope of this document.

In some cases heating and/or treatment of storage containers with chromic acid may have occurred and the presence of chromic acid may result in a sampling error. Residue analysis from clean containers should be available before sampling, if necessary, to document the presence of chromic acid.

F. SAMPLE PRESERVATION

- After transferring the sample from the sampling device to a container, it should not be retransferred from one container to another as loss of organic material and aeration may occur.
- No headspace should exist in samples for total organic halogens, total organic carbon, and volatile organic chemicals.
- Organic samples should not be filtered.
- An estimate of the turbidity (NTU's) should be made for turbid samples.

G. METHODS OF ANALYSES

The testing program should include a pollutant scan including U.S. Environmental Protection Agency (EPA) methods 601/602. Laboratory orders should request that all peaks be reported. The Regional Board has the option of requiring EPA methods 624/625 (instead of 601/602) or to identify peaks found in initial testing. The Regional Board may also wish to require additional analyses when circumstances indicate that constituents not detected by these tests may be present (see 40 CFR, Part 136 for information on the various analysis methods).

An Inductively Coupled Plasma-Emission Spectroscopy (ICP) scan (EPA Method 6010) or Atomic Absorption Spectroscopy (AA), covered under EPA's 7000 series, should be run for metals and salts. As a minimum, the following substances should be reported from ICP metals procedure: Ag, As, Ba, Be, Ca, Cd, Cr, Cr(VI), Co, Cu, Fe, Hg, K, Mn, Mo, Na, Ni, Pb, Se, Sb, Tl, V, and Zn. Due to the limited detection limits of the ICP metals method for As, Cr(VI), Hg, Mg, and Se, the AA method may be used to analyze for these five elements, if conditions warrant.

For initial screening, performing an electrolyte scan or testing conductivity upgradient and downgradient could indicate whether leaching has occurred.

The analytical laboratory performing the chemical analysis must be a hazardous waste testing laboratory certified by the Hazardous Materials Laboratory of DHS.

H. QUALITY ASSURANCE/QUALITY CONTROL

The following QA/QC procedures are excerpted in part from "Department of Health Services Procedures for Conducting a Comprehensive Ground Water Monitoring Evaluation of Hazardous Waste Disposal Facilities" (July, 1986) and EPA's RCRA publication, "Ground-Water Monitoring Technical Enforcement Guidance Document" (September, 1986).

1. Field QA/QC Program

Various types of field blanks should be used to verify that the sample collection and handling process has not affected the quality of the samples. The operator's sampling plan should provide for the routine collection and analysis of two types of Quality Control blanks: trip blanks and equipment blanks. These should be:

Trip Blank: Each time a group of bottles is prepared for use in the field, one bottle of each type (e.g., glass, fluorocarbon resin, polyethylene) should be selected from the batch and filled with deionized water. The bottles filled with the blank should be transported to the sampling location and returned to the laboratory in a manner identical to the handling procedure used for the samples. One trip blank per sampling event is recommended.

Any contaminants found in the trip blanks could be attributed to (1) interaction between the sample and the container, (2) contaminated rinse water, or (3) a handling procedure that alters the sample analysis results.

Equipment Blank: To ensure that the nondedicated sampling device has been effectively cleaned (in the laboratory or field), the device should be filled with deionized water (or pump deionized water through the device). The water should then be transferred to the sample bottle(s), and returned to the laboratory for analysis. Handling procedures should be identical to those used for ground water samples. A minimum of one equipment blank for each day that ground water monitoring wells are sampled is recommended.

The results of the analyses of the blanks should not be used to correct the ground water data. If contaminants are found in the blanks, the concentration levels of any contaminant should be noted and the source of the contamination should be identified. Corrective action, including resampling, should be initiated.

All field equipment that will be used should be calibrated prior to field use and recalibrated in the field before measuring each sample. The SWAT proposal should describe a

program for ensuring proper calibration of field equipment. Other QA/QC practices such as sampling equipment decontamination procedures and chain-of-custody procedures should also be described in the proposal.

2. Laboratory QA/QC Program

Any sample analyses performed for the SWAT should be done only at a certified laboratory. When a commercial laboratory is used to conduct analyses of ground water samples, the operator must ensure that the laboratory of choice is exercising a proper QA/QC program. The QA/QC program used by the laboratory analyzing samples must conform to that described in the SWAT proposal.

The sampling and analysis plan should provide for the use of standards, laboratory blanks, duplicates, and spiked samples for calibration and identification of potential matrix interferences. The quality control program for the laboratory must ensure that the following actions are completed:

Calibration of laboratory instruments to within acceptable limits according to EPA or manufacturer's specifications before, after, and during use. Reference standards must be used when necessary.

Periodic inspection, maintenance, and servicing (as necessary) of all laboratory instruments and equipment.

The use of reference standards and quality control samples (e.g., checks, spikes, laboratory blanks, duplicates, splits), as necessary, to determine the accuracy and precision of procedures, instruments, and operators.

The use of adequate statistical procedures (e.g., quality control charts) to monitor precision and accuracy of the data and to establish acceptable limits.

A continuous review of results to identify and correct problems within the measurement system (e.g., instrumentation problems, inadequate

operator training, inaccurate measurement methodologies).

Documentation of the performance of systems and operations.

Regular participation in external laboratory evaluations to determine the accuracy and overall performance of the laboratory. This should include performance evaluation and interlaboratory comparison studies and formal field unit/laboratory evaluations and inspections.

3. Chain-of-Custody

An owner must include plans for "chain-of-custody" in the sampling and analysis plan to assure the integrity of the sample from the time of collection until it has been analyzed. Adequate chain-of-custody can be described as the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition.

A chain-of-custody program must include:

Sample labels which prevent misidentification of samples;

Sample seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory;

Field log book to record information about each sample collected during the ground water monitoring program;

Chain-of-custody-record to establish the documentation necessary to trace sample possession from the time of collection to ultimate disposition;

Sample analysis request sheets which serve as official communication to the laboratory of the particular analysis(es) required for each sample and provide further evidence that the chain-of-custody is complete; and

Laboratory log book which is maintained at the laboratory and records all pertinent information about the sample.

APPENDIX 3: GEOLOGIC WELL LOG DESCRIPTION[4]

The geologic well log gives meaning to analytical results and is the cornerstone of site characterization. A geologic well log should be a complete description of the materials penetrated and a history of activities associated with the drilling. The geologic log should be constructed as drilling advances.

If the observations or data recorded on the geologic log need to be changed or modified, the changes should be made by drawing a single line through the words or phrase which is to be changed and the new notation made. Erasures should not be made on a geological well log. Erasing notations can result in the loss of valuable information and the change may prove to be less accurate than the initial observation. A geologic log of a boring should, at a minimum, contain the following elements:

1) Key Names:

   Name of drilling contractor.

   Name of driller.

   Name and employer of person logging the boring, and

   Name of service companies called onto site, (e.g., electric logging, cementing, etc.).

2) Make and model of drilling equipment.

3) Drilling method.

4) Method of sample collection and preparation.

5) Sampling interval(s).

6) Complete and detailed lithologic description of materials penetrated.

7) Depth interval and estimated rate of discharge for all encountered ground water.

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[4]Modified from The California Site Mitigation Decision Tree Manual, DHS, May, 1986, pages 3-23 and 3-24.

8) Transient data such as penetration rate (ASTM D1586), bit pressure, drilling fluid weight and viscosity, drill chatter, adjustments made to the drilling machine or drilling procedure, problems or successes and other incidental information that may provide an indication of subsurface conditions.

9) Dates of starting and completion for all phases of the well drilling and construction (e.g., sampling, cementing, etc.).

10) As-built drawings of wells, piezometer, or other devices constructed or installed in the borehole.

APPENDIX 4: PHYSICAL ANALYSIS OF SOIL SAMPLES

Several tests should be performed to determine possible transport pathways and relative rates of leakage. This information, along with the other requested data, should help to determine where leak migration is most likely to occur. Thus, the correct monitoring layout and design can be achieved for both vadose and ground water monitoring.

The first analyses should be for grain size distribution (sieve analysis: ASTM D 422-630). The report should contain the following information:

1) Maximum size of particles.

2) Percentage retained on each sieve.

3) Description of sand and gravel particles (shape and hardness).

4) Specific gravity (ASTM D 854-83).

The pH (ASTM G51-77) of the discrete soil intervals should be submitted. This should be performed by a pH meter.

Soil moisture content (ASTM D 2216-80) should be submitted for discrete soil intervals.

Cation exchange capacity (EPA Method 9080) should be determined to aid in design of vadose zone monitoring. This test consists of replacing the original adsorbed nutrients by barium, potassium, or ammonium ions and determination of the amount of ions adsorbed.

Permeability of on-site soils should be determined by testing nearby soils that have characteristics similar to soils underlying the disposal area. Permeability should be determined by laboratory and field methods.

The laboratory permeability test method (ASTM D 2434) is designed for granular soils and is not as reliable for fine-grained soils. Granular soils should also have their permeability determined by field methods.

An infiltrometer is recommended for permeability determination of fine-grained soils. A double-ring infiltrometer (ASTM D 3385-75) is the preferred method. The report should contain a description of the soils underlying the infiltration test site down to the water table, temperature and pH of fluid used, and difference in rates of flow for inner ring and annular space between rings. Although this test is usually used only on man-made clay liners, it may have some applicability for fine grained solid waste disposal site soils.

APPENDIX 5: PIEZOMETER DESIGN AND PLACEMENT

The purpose of piezometers is to measure ground water gradients (pressure). They may also be used as sampling wells (monitoring wells) in some cases. If so, this should be stated as such in the SWAT proposal. However, this section will focus solely on ground water gradient measurement.

Piezometers should be capable of determining horizontal and vertical components of flow for the uppermost saturated zone. Seasonal and temporal variations should be accounted for. The well screen should be not more than ten feet in length and often may be as short as one foot. Piezometers screened through the water table may have a screen length of up to 20 feet; however, it should be documented by water level data that a significant variation in water table elevations over time necessitates this modification. The filter pack should not extend more than two feet above the screen.

The location and elevation of the top of the well casing should be surveyed to an accuracy of 0.01 feet and permanently marked. The water level measurements should have the same accuracy. The survey mark should be placed on the casing and may need to be resurveyed periodically.

Piezometer water level measurements of all points in the piezometer network should be taken as close together timewise as possible, preferably within a few hours,[5] and definitely within a 24 hour time span. This is necessary to minimize temporal variations in the water level.

The inside diameter of the piezometer casing may be as small as one inch. However, if this well also serves as a monitoring well, a larger size casing is necessary (see Appendix 7: Monitoring Well Design And Placement). Also, most pressure transducers require a one and one-quarter inch or larger inside diameter casing.

A minimum of three piezometers screened at the same depth is needed to determine horizontal gradients. Clustered single completion piezometers are recommended for determination of

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[5]Where piezometers are located near surface waters having significant water level changes (such as tides or flood flows), tide tables or stream gage data should be provided over the sampling period.

vertical gradients. Each cluster should be installed at one location according to the following guidelines:

- aquifers 50 feet or less in thickness: two depth-staggered piezometers.
- aquifers 50 to 100 feet in thickness: three depth-staggered piezometers.

Piezometer construction should follow the same guidelines as monitoring well construction except for screen length. These guidelines are outlined in Appendix 7: Monitoring Well Design And Placement.

A map showing all piezometer locations and ground water flow directions and equipotential lines (flow net) should be included in the SWAT report along with a full description of piezometer placement and design.

APPENDIX 6: VADOSE ZONE MONITORING

A. INTRODUCTION

Water Code Subsection 13273(b),(2) requires a chemical characterization of the soil-pore liquid in those areas which are likely to be affected if the solid waste disposal site is leaking, as compared to geologically similar areas near the solid waste disposal site which have not been affected by leakage or waste discharge.

Vadose zone (unsaturated zone) monitoring is especially useful where thick unsaturated zones underlie disposal facilities. The contaminant plume may be identified and leakage stopped long before a ground water monitoring well would show any evidence of a problem.

B. PRESSURE/VACUUM LYSIMETERS

1. DESCRIPTION:

The best device for obtaining water samples from the vadose zone is the pressure/vacuum lysimeter. This device consists of a closed cylindrical chamber made of inert material. The soil water intake portion (cup) is made of a porous material of low permeability. Soil moisture is drawn by vacuum into the chamber and collected by access tubes.

Lysimeters may be placed in either shallow trenches or in borings (either vertical or drilled at an angle below the landfill). The lysimeters should be put in place with a silica flour filter pack to provide continuity with the surrounding formation.

The placement of lysimeters is critical. These devices should be installed at locations which will optimize their efficiency in relation to fluid movement in the vadose zone. The lysimeter should be placed in fine-grained soils (silt or clay) as these materials tend to absorb fluid. Moisture in the vadose zone tends to move rapidly through porous soils thus requiring an excessive vacuum to obtain useful quantities of soil-pore fluid.

Although fluid transport tends to be vertical in the vadose zone, migration will also occur laterally along geologic contacts. Fluid movement also often occurs along small cracks and irregularities.

2. PRELIMINARY WORK:

Continuous soil coring should be performed prior to designing a vadose zone monitoring system. Soils data must be obtained to identify the best depths for placement of the lysimeter. The structure, lithology and soil characteristics of the vadose zone must be determined for correct lysimeter placement. This information can be derived from continuous soil cores. A complete lithologic and soil analysis of the cores should be performed (see Appendix 4: Physical Analysis Of Soil Samples, and ASTM D 422-63 and D 854-83).

3. QUALITY CONTROL PROCEDURES:

Lysimeters have earned an unwarranted reputation among many as being undependable. Much of the problem can be laid to an absence of good quality control work. There is a need for the lysimeter and all tubing to be pressure tested prior to placement in the ground. Further, the whole installation must be field tested after it has been placed at the target location. The system should be placed under vacuum to determine whether there are any significant leaks in the system. Next, the continuity of the lysimeter and its silica flour jacket with the formation should be tested. Distilled water is poured down the tubing and allowed to stand for several days. The lysimeter is then placed under vacuum. If the device fails to produce a relatively steady flow of water, the installation is faulty and should be replaced.

C. ALTERNATIVE DEVICES

Some field conditions create difficulties in using pressure/vacuum lysimeters. These include fractured rock areas or dry gravels. Many have proposed to conduct chemical analyses of soils obtained from drilling. This method fails to obtain representative soil pore fluid samples in that the volatile organic chemicals will be mostly lost.

The following alternative devices do not provide the information required in Subsection 13273(b)(1) (i.e., chemical characterization) but only provide an indication of moisture content. Consultation with the Regional Board is recommended prior to installing an alternative device.

In very dry soils or in granular soils, vacuum/pressure lysimeters may not be able to overcome the soil tension. In this case, tensiometers may be required. A tensiometer consists of an inert cup attached to the bottom of a rigid tube. A smaller tube leads below the sealed top to a recording device. The tensiometer is filled with de-aired water, a solution of ethylene or polyethylene glycol, or a solution of methanol. These devices measure the vacuum that is caused by the fluid leaving the vessel and going into the soil.

Any change in pressure indicates fluid movement through the vadose zone, assuming all components are operating correctly. The same considerations for placement of lysimeters apply to tensiometers.

Soil moisture blocks may be used under some circumstances. These consist of two electrodes embedded in a porous material that is in equilibrium with the soil in the vadose zone. Gypsum, ceramic, capstone, fiberglass, and nylon can be used as the porous material. These devices measure only the presence of moisture and do not yield qualitative results. Calibration curves should be run for each block used. The blocks are tested by being placed in distilled water and the resistance is measured. If it varies more than 50 ohms, the block is defective. The results should be submitted to the Regional Board.

A combination of soil moisture blocks and vacuum/pressure lysimeters may be used. First, soil moisture blocks are installed in a borehole to determine the location of fluid if present. Then a vacuum/pressure lysimeter may be installed in this location to sample the fluid.

Electrical resistivity net methods are not recommended. The results are not reliable except in ideal situations where leachate and soil conductivity are vastly different.

Borehole neutron logs may be used to estimate moisture content. They are the same devices used in downhole geophysical measurements. The device senses the presence

of hydrogen atoms surrounding the cased hole. A hole can be slant drilled under the landfill, cased, and covered. At various testing intervals, this device can be lowered down the hole, the presence of water response noted, and determination of fluid migration (and possible leak) made.

D. REFERENCES

For additional information on vadose zone monitoring techniques, the following publications are recommended:

- Morrison, Robert D., Ground Water Monitoring Technology, published by Timco Manufacturing, Inc., Wisconsin, 1983.

- Everett, L.G., L. G. Wilson, and E. W. Hoylman, Vadose Zone Monitoring For Hazardous Waste Sites, published by Kaman Tempo, Santa Barbara, California, 1983.

There are numerous other articles on the various techniques for vadose zone monitoring. As the field of vadose zone sampling is rapidly changing, it is important to review the latest literature.

APPENDIX 7: MONITORING WELL DESIGN AND PLACEMENT

A. INTRODUCTION

The primary purpose of a monitoring well is to obtain representative water quality samples. In most cases, it is also critical that good soil and ground water samples can be obtained during the drilling of the well. In this way, the hydrogeologic database for the site can be augmented.

In some cases, these wells may be utilized for piezometric measurements as well as for aquifer testing.

For most solid waste disposal sites, a minimum of four monitoring wells should be required including at least one upgradient and three downgradient wells. The monitoring wells shall be in full compliance with Section 2555(c), (d).

B. DRILLING METHODS

1. HOLLOW STEM AUGER:

A hollow stem auger is the method of choice whenever conditions permit (unconsolidated material and shallow depth). The auger leaves the borehole relatively undisturbed. There is no mud cake formed, therefore, no adverse change in the permeability and chemical characteristics of the formations immediately surrounding the borehole. In addition, continuous coring is more easily accomplished with this method.

2. CABLE TOOL:

This drilling technique has been used by well drillers for many decades. It is particularly effective for penetrating cobbles. Its main drawback, however, is the inability to obtain good soil samples.

3. ROTARY DRILL:

This drilling technique is widely used in both drilling of oil wells, water wells, and foundation borings. Drilling fluids or compressed air are required to bring the cuttings up to the top of the hole.

This method is particularly useful where resistant geologic formations are present and greater completion depths are required.

Most commonly, drilling mud is circulated as the drilling fluid, forming a mudcake which supports the borehole and reduces caving. Because the mud (or other drilling fluid) may affect formation permeability as well as the chemical characteristics of the aquifer, considerable effort must be employed to clean mud from the borehole and the formation. In many cases, the mud or other fluid cannot be entirely removed; thus, the chemistry of any drilling fluids used should be analyzed in order to determine their effects on ground water samples. Further, it is almost impossible to identify small inflows of ground water.

Less commonly, compressed air is used. The disadvantages of this method are lack of support for the borehole during drilling and substantial air pressure needed to remove the cuttings from the hole. The high-velocity air flow may dry out a seep to the point where it is not recognized.

4. CASING HAMMER:

This tool is operated by driving the casing into the ground at or a short distance behind the drill bit. In this way, caving of the hole is prevented without any degradation of the formation with drilling mud. It is particularly useful for drilling in unconsolidated materials such as gravels and cobbles. Depth limitations are inherent with driving casing due to the friction between the casing and the surrounding formation.

C. WELL DESIGN

Drawings and data should show construction details of monitoring facilities. These data should include:

- map of well locations
- borehole depth
- casing diameter and length
- casing materials (PVC, stainless steel, etc.)

- type, size and position of perforations (provide justification)
- method of joining sections of casing
- description of filter material (provide justification)
- depth and composition of seals
- method of cementing
- method and length of time of development (provide justification)

D. MATERIAL SELECTION

Casing and screen material selection is important for representative sampling results. The material should be chemically inert and should have high tensile and compressive strength. The selection of materials should be based on downhole conditions.

1. POLYVINYL CHLORIDE (PVC):

Drinking water quality PVC casing and screen are often used in shallow, corrosive environments. However, ketones, esters, and aromatic hydrocarbons tend to adsorb and desorb from this material. Thus, determination of absolute concentration is not possible and very low concentrations may not be detected. The relatively weak tensile strength of PVC will usually not allow placement much past 300 feet. The annular space should be larger than the three inches needed to accommodate centralizers (see section on Well Integrity) without placing undue stress on the PVC. No glued joints should be used in the casings; only threaded joints should go into the hole.

2. FLUOROCARBON RESINS (FR):

The FR have the same structural limitations as PVC. However, it is a more inert material and is more resistant to corrosives. Some adsorption and desorption occur here, also, although at a far lesser degree than PVC. Scratching of the FR will cause accelerated adsorption and desorption.

3. STAINLESS STEEL (SS):

Use of SS 316 is often a good choice. It is more chemically resistant overall then PVC and has a high

tensile strength. However, it may corrode and leach some trace metals over time. Stainless steel may act as a catalyst in some organic reactions. It may also act as a bacterial substrate and is susceptible to corrosion from chloride. SS 304 is not as resistant to corrosion as SS 316.

The above materials can be combined to create hybrid wells. These consist of more than one material being used in the casing and screen. However, two different metals cannot be installed next to each other due to cathodic corrosion.

The cost of installation is usually given too much priority. Considering the costs for chemical analyses on a 20-year well, the initial construction costs are less than one percent of the total cost.

E. WELL FILTER PACK DESIGN

Proper filter pack[6] design ensures correct screen entrance velocity so volatile organic chemicals will not be stripped out of the water sample. The filter pack also prevents clogging of the perforations. The filter pack design is governed by the aquifer material. A sieve analysis (described in Appendix 4: Physical Analyses of Soil Samples) should be performed on the portion of the aquifer open to the filter pack. If this is not possible, representative samples (at least three) should be taken at similar portions of the aquifer.

The sieve data is plotted on semi-log paper and a curve constructed. The uniformity coefficient (UC) is then calculated.[7] The D70 size is then multiplied by a number between 4 and 9, depending on the UC:

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[6]See The California Site Mitigation Decision Tree Manual, DHS, May, 1986, pages 3-64 through 3-68.

[7]This coefficient is determined by dividing the dimension of the mesh opening of the sieve which retains 40 percent of the sample (D40) by mesh opening which retains 90 percent, (D90).

- If the UC is less than or equal to 2.5, use a multiple of 4 or 5. If 10 percent or more of the formation passes through the 200 sieve, use 4 as the multiplier; otherwise, use 5.

- If the UC is between 2.5 and 5, use a number between 5 and 7. If 10 percent or more of the formation passes through, use 6; otherwise, use 7.

This value is plotted on the graph and a curve parallel to the original curve is constructed.

If the UC is greater than or equal to 5.0, a different method is used. The D70 is multiplied by 6 and 9, and the result plotted. Parallel lines with a UC of less than or equal to 2.5 are constructed. These are the boundaries of the filter pack. If 10 percent or more of the formation passes through the 200 sieve, the filter pack curve is to be near the lower boundary line. If less than 10 percent passes through, the filter pack curve is near the upper boundary line.

The filter pack should be no less than three inches wide and no larger than five inches.

F. SCREEN DESIGN

The screen is designed after the filter pack design is determined. For a filter pack having a UC less than or equal to 2.5, a slot size small enough to keep out 90 percent of the filter pack should be used. If the UC is larger than 2.5, use a slot size small enough to keep out 80 percent of the filter pack.

The entrance velocity through the well screen is a function of the open area of the screen and the pumping rate.[8] The optimal water entrance velocity is 0.1 feet per second or less. If it is any faster, volatile organic chemicals may be stripped away.

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[8]The pumping rate is determined by the transmitting capacity of the screen. Multiply the number of square inches of open area per foot of casing by the conversion factor of .31. This is the capacity of that screen in gallons per minute per foot. Multiply this by the total feet of screen to determine the pumping rate.

G. WELL DEVELOPMENT

For optimum well performance, all fine-grained soil that may have been introduced into the formation during the drilling process should be removed. (Turbid samples indicate that the well was not correctly designed or developed.) The recommended method for well development is the use of vented surge blocks.

H. WELL INTEGRITY

Centralizers are commonly used for centering the well screen and blank casing in the borehole. Without the centralizers in place, it is likely that the casing will be lying against the borehole at many points. These areas thus would not receive a cement grout mixture in sufficient quantity to assure a seal on the well. A poor seal can occur anywhere along the casing and cause surface infiltration and cross-contamination.

The annular space of the well should be at least three inches wide. This allows centralizer placement (as well as filter pack placement). A smaller annular space will put too much stress on the casing and not allow adequate development. In the case of PVC casing, an even larger annular space is required due to PVC's relatively slight tensile strengths. Hollow stem augers do not require the use of centralizers.

Centralizers in all types of wells should be placed every 20 feet on well screens longer than 20 feet in length. The beginning one is set at the bottom. If the screen is less than 20 feet in length, a centralizer should be set at the bottom and the top. The blank casing should have centralizers placed every 40 feet. The centralizers should be lined up to avoid interference with the tremie pipe during cementing. They should be set equidistant around the casing (120°).

I. CEMENTING

A seal should be placed above the filter pack to seal it from the grout[9]. The seal should consist of three to five feet of sodium bentonite placed directly on the filter pack. The bentonite is usually emplaced by a conductor (tremie) pipe or, if only a few feet below the ground surface, poured into the annulus. The bentonite mixture must be allowed sufficient time to hydrate before emplacement of the grout.

Two types of cement are acceptable for grouting of the wells. One is a cement-sand grout, and the other (for situations requiring lower density materials) is a cement-bentonite grout. The cement mixture should be jet mixed, and injected through a tremie pipe into the annular space. All ingredients should be dry, uniform, uncontaminated, and lump free.

The cement-sand grout formulation should consist of API Class A Portland cement, 20-40 grade sand, and potable water. The proportions should be 5.2 gallons of water per 85 pounds of cement (added last) to yield 1.70 cubic feet of grout.

The cement bentonite grout mix may be prepared by either prehydrating the bentonite or dry batching the cement and bentonite.

- The prehydration formulation consists of a 94 pound sack of API Class A Portland cement being added to a smooth jet mixed mixture of API cement-grade bentonite and water (proportions of 10 gallons water/2.0 pounds of bentonite). This yields 1.85 cubic feet of grout.

- Dry batching consists of mixing the cement and bentonite as dry ingredients in a special portable mixing plant. The formulation is 9.1 gallons of water (added at job site), 5.6 pounds of bentonite, and a 94 pound sack of cement, yielding 1.73 cubic feet of grout. If bentonite that is not API cement-

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[9] If grout has been placed below the filter pack, a bentonite seal should likewise be placed on top of the grout below the filter pack.

grade is used, the mixture may be unpumpable. If the driller has had experience with proprietary grouts (i.e., Volclay), use of these grouts may be considered.

The end of the tremie pipe should be submerged in the grout at all times during cementing. The pipe should be maintained full.

Many "E-Loggers" are prepared to conduct a cement bond log to determine the quality of the cementing job. This valuable tool works well with steel casing; however, it gives highly suspect data in PVC-cased wells.

J. WELL CONSTRUCTION

Multiple-screened wells are not recommended for the reasons outlined in Appendix 5: Piezometer Design and Placement.

The diameter of the wells should be related to the drilling conditions, transmissivity of the aquifer and size of the equipment to be lowered down the well. Larger diameter wells generally allow faster purging and have a larger area of influence. Small diameter wells, on the other hand, require far smaller purging quantities.

K. WELL PLACEMENT

At a minimum, four monitoring wells are usually required, one upgradient, and three downgradient from the solid waste disposal site.

The number, location, and depths of background (upgradient) monitoring wells must be capable of yielding ground water samples that are representative of background ground water quality in the uppermost aquifer beneath the landfill. The wells must be in the area of the aquifer not affected by the facility. Depending on the hydrogeologic characteristics of the site, more than one background well may be needed. In instances where it is impractical to get an upgradient well to serve as a background well (such as in steeply dipping aquifers), it may be possible to monitor a downgradient well. However, it must not be in a portion of the aquifer affected by the facility.

Downgradient wells should be located so as to detect any waste constituents migrating from the landfill as well as seasonal or temporal and naturally or artificially induced variations in ground water flow. The wells should be installed as close as physically possible to the edge of the landfill, ideally at the point where a plume will first enter the ground water. In most cases, this will be the uppermost aquifer; however, conduits (solution channels, open fractures, etc.) may actually provide a faster migration path to a deeper aquifer. These deeper aquifers may require monitoring also.

APPENDIX 8: DETERMINATION OF SUBSURFACE HYDRAULIC CONDUCTIVITY

Subsurface hydraulic conductivities should be determined for the uppermost aquifer and any boundary conditions (confining zones, flow restrictions, etc.) underlying the site. Without this information, proper monitoring well placement is uncertain. Monitoring wells should be screened in areas of greatest flow within the uppermost aquifer.

Field methods provide the most accurate hydraulic conductivity data but should be augmented by laboratory testing. Field hydraulic conductivity and transmissivity testing consists of either single well tests or multiple well tests.

Single well tests involve the addition or removal of a known volume of fluid (or air pressure increase and decrease). Rates of recovery are determined from this well. Multiple well tests consist of the pumping of one well while recording the levels of ground water in adjacent observation wells. The latter method gives more accurate results as it takes into account inhomogeneities in the aquifer. This latter method should always be used, with the single well tests used as supplementary testing.

Packer tests, consisting of packing off a section of borehole and injecting fluid, may also be used to measure hydraulic conductivity. However, these tests only provide semi-quantitative results. It may be difficult in some cases to differentiate confining beds from low yield aquifers. A full description of ground water flow rates should be presented.

The reader is referred to Groundwater And Wells by Fletcher G. Driscoll, 1986, Johnson Division, St. Paul, Minnesota, for a more thorough description of hydraulic conductivity testing.

APPENDIX H

NAVY RESPONSES TO THE COMMENTS
FROM THE DEPARTMENT OF HEALTH SERVICES

APPENDIX H

NAVY RESPONSES TO THE COMMENTS FROM THE DEPARTMENT OF HEALTH SERVICES

This appendix provides the Navy's responses to the comments made by the California Department of Health Services (DHS) concerning the SWAT Proposal Addendum Sampling Plan, Volume 1A of the Remedial Investigation/Feasibility Study Work Plan at Naval Air Station Alameda in Alameda, California.

DHS Comments

Comment 1 (Page 7, Paragraph 8):

Section 1.4.2 Is there a list of the pesticides which were disposed of at the landfill? Were just pesticides dumped or were herbicides and rodenticides also disposed of at the landfill? Is there any information regarding the quantities of pesticides/herbicides/rodenticides which were disposed of at the landfills?

Response 1:

There are no available official records of the various types and quantities of pesticides that were disposed of at the West Beach landfill. However, based on a review of the previous ground water analytical data, it appears that some organochlorine pesticides were detected at low concentrations in Monitoring Wells 21, 22, and 23, located along the eastern half of the landfill. These pesticides include alpha-BHC, gamma-BHC (lindane), delta-BHC, aldrin, endosulfan sulfate, endrin aldehyde, heptachlor, and pp-DDT (4, 4'). Organochlorine pesticides are generally considered insecticides. However, a review of some technical literature also indicates that DDT is also used as a rodenticide (Ware, 1983). The results of these analyses are presented in Appendix A on the EAL Corporation Priority Pollutant Data Sheets for pesticides, covering Harding Lawson Wells No. 21, 22, and 23, dated September 7, 1983.

Comment 2 (Page 12, Paragraph 2, Line 6):

Section 1.6.2 The reader is left with the impression that the slurry wall extends the length of the landfill along the shoreline. According to the as-built plans, the slurry wall is approximately 850 feet long and only along the north-west shoreline of the West Beach landfill. The location, length, width and vertical extent of the slurry wall should be described. The supporting figure (Appendix D, C-2) should also be modified so the slurry wall is more visible.

Response 2:

The as-built site plan prepared by Harding Lawson Associates, shown in Appendix D of the SWAT Proposed Addendum, indicates that the slurry wall extends along an 820-foot section of the northwest shoreline of the West Beach landfill. Based on the recollection of Navy personnel and further review of the construction specifications, the slurry wall is approximately 820 feet in length, 2 feet in width, with the depth varying between 20 and 30 feet. The slurry wall was keyed 2 feet into the underlying bay mud. Additional as-built records are not available for review. Because of the lack of additional information, Figure C-2 in Appendix D in the SWAT proposal will not be modified to show a more precise location of the slurry wall.

Comment 3 (Page 18, Paragraph 4, Line 3):

Section 2.2.1 Table 1 of Appendix A indicates that benzene was found at 9 ppb in monitor well WA-5. The Maximum Contaminant Level for benzene is 1 ppb which is significantly below the amount detected.

Response 3:

It is agreed that benzene was detected at a concentration of 9 ppb in monitoring well WA-5 at the 1943-1956 Disposal Area, as shown on Table 1 in Appendix A. Section 2.2.1 has been modified to reflect this information.

Comment 4 (Page 20, Line 3):

Section 2.2.2 Phenol concentrations in monitor wells at the West Beach landfill range from 10 to 26 ppb. The California Applied Action Level is 1 ppb for phenol in water.

Response 4:

Phenol concentrations were detected at these levels in the monitoring wells at the West Beach landfill in 1983, and Section 2.2.2 has been modified to reflect these results. However, a review of the List for Maximum Contaminant Levels for Primary Drinking Water Constituents, updated July 1, 1989, indicates that there are no action levels for phenol.

Comment 5 (Page 27, Paragraph 1, Line 8):

Section 3.2.1 Where will background radiation readings be taken? Will the Geiger-Muller detector be taking continuous readings?

Response 5:

Background radiation readings will be recorded at each nodal point in the survey grid, as discussed in Section 3.2.1. However, during the survey, the Geiger-Muller detector will obtain continuous readings along each grid line between each nodal point for the purpose of detecting potentially higher radiation readings between these points. The text has been revised to reflect these procedures.

Comment 6 (Page 32, Section 3.3.1):

Section 3.3.1 It was identified in Section 1.4.2 (pg 6) that chemical drums had been disposed of at the West Beach landfill. Location of the drums should be included within the scope of this RI sampling plan. Geophysical methods can be used in conjunction with the E&E generalized landfill map (Fig. 6-7, Appendix F) to delineate drum disposal areas. The Department considers locating of the drums to be necessary to characterization and remediation of the landfill.

Response 6:

A discussion of the appropriate geophysical methods to delineate drum disposal areas has been provided in Section 3.3.1.1.

Comment 7 (Page 36, Section 3.4):

Section 3.4 The "upgradient" monitor wells will be helpful for determining background water quality provided they are placed in a location where no contamination is present. If these proposed wells are "upgradient" of the landfills, then they are directly downgradient and near sites under investigation (plating shop and power plant).

Response 7:

It is agreed that the "upgradient" monitoring wells will aid in determining background water quality, especially if positioned in a suitable location without contamination. It is also agreed that upgradient locations may be directly downgradient of other sites planned for investigation. Further discussion of this is provided in the response to Comment 8.

Comment 8 (Page 36, Section 3.4):

Section 3.4 The proposed locations for the "upgradient" monitor wells are at least a half mile away from the nearest proposed monitor wells to be installed at the landfills. The Department does not consider this one half mile spacing adequate to aid in determining the local hydrology at the landfills. Six monitor wells are recommended west of the parking aprons (see DHS attached Fig. 3).

Response 8:

The proposed upgradient monitoring wells are positioned within a one mile radius of the study areas, as necessary to meet the requirements of Section 13273 of the Water Code for Solid Waste Assessment Test (SWAT) reports. As outlined under the SWAT Guidance document prepared by the State Water Resources Control Board dated October 1986, this requirement states that an analysis of the surface and ground water, on and under, within one mile of a solid waste disposal site shall be performed to provide a reliable indication whether there is any leakage of hazardous waste. These wells have been proposed in locations for providing additional information on the local and regional hydrogeology and ground water quality, and therefore do meet the SWAT and RI/FS requirements. However, the Navy agrees that the additional upgradient monitoring wells at the six locations recommended by DHS will be useful in characterizing the local hydrogeology and ground water quality. Section 3.4 of the text and Figure 3-3 have been modified to reflect the installation of the additional wells.

Comment 9 (Page 36, Section 3.5.1):

Section 3.5.1 There is no indication that explosives were disposed of at the 1943-1956 landfill. Further sampling within the landfill is required to characterize the landfill under the RI/FS and develop remedial measures.

Response 9:

To characterize the 1943-1956 Disposal Area under the RI/FS and to develop future remedial measures, initial data from within the landfill can be collected using surface geophysical reconnaissance techniques. Geophysical field methods provide a means of rapid reconnaissance in order to initially and spatially characterize landfill sites. Section 3.2.1.1 has been incorporated to reflect that these reconnaissance tools will be implemented during site characterization. Further discussion of this is provided in the response to Comment 11.

Comment 10 (Page 36, Section 3.5.1):

Section 3.5.1 The explosives which were disposed of at the West Beach landfill are, by their properties, considered hazardous waste. There is not enough information on location, nature or quantities of hazardous wastes at the landfills to assist in remediation of the site. Further characterization of the landfill is required. The RI serves as the action to collect enough data to fully characterize the site.

Response 10:

Naval personnel at NAS Alameda state that the reports of disposal of inert ordnance at the West Beach Landfill do not indicate that explosives were buried at the landfill. The draft SWAT Proposal Addendum was in error on this point, and the statement regarding explosives in Section 3.5.1 has been revised. The revised text states that inert ordnance has been disposed of in the landfill, and that while there is no evidence to indicate that actual explosives were buried in the landfill, this possibility will be investigated. Chemical analyses for nitrates to detect evidence of explosives and decay products of explosives are included in the sampling plans for the landfill in Table 3-2. Detection of elevated levels of nitrates will be considered an indicator for the possible presence of explosives and decay products of explosives, and more specific tests for

compounds such as TNT or RDX can be performed as required. Section 3.5.1 has been modified to indicate that characterization of the landfill will initially be undertaken using surface geophysical methods. Discussions addressing both landfills are provided in Sections 3.2.1.1 and 3.3.1.1. Further discussion of this issue is also provided in the response to Comment 11.

Comment 11 (Page 37, Paragraph 2):

Section 3.5.1 As stated in the text, placement of proposed monitor wells will only serve to determine what types of wastes are leaching into the ground water and into the bay. The proposed monitor well locations may fulfill the SWAT requirements but they do not address all the needs of the RI program. Additional monitor wells need to be installed within both landfill areas so site characterization can occur and remedial measures can be taken to remove the threat of hazardous waste contamination.

Response 11:

The Navy agrees that installation of additional monitoring wells may be required within the landfill areas before a site characterization adequate for the design of further remedial measures can be completed. However, as discussed in Sections 3.2.1.1, 3.3.1.1, and 3.5.1, it is the Navy's judgment that both landfill areas should be initially characterized using surface geophysical reconnaissance methods. This would be the most prudent approach and would provide the capability for rapidly characterizing the site. It would also provide a better overall understanding of complex site conditions, as well as offering the benefits of lower costs and reduced health and safety risks associated with the field activities. Once a better-defined spatial characterization of the site is accomplished by implementing this approach, the Navy anticipates that a more thorough, efficient drilling and sampling plan within the landfill areas can be planned and successfully implemented.

Comment 12 (Table 3-1):

Table 3-1, 1943-1956 Disposal Area. Include mercury analysis for soil and water samples (chemical disposal).

Response 12:

Table 3-1 has been modified to reflect this comment.

Comment 13 (Table 3-2):

Table 3-2 West Beach Landfill. Include mercury analysis for soil and water samples (chemical disposal).

Response 13:

Table 3-2 has been modified to reflect this comment.

Comment 14 (Table 3-3):

Table 3-3 Analytical Methods. Use of the EPA Method 624 (Gas Chromatograph/Mass Spectrometer-GC/MS) for Volatile Organics in water will not be acceptable to the Department. The 624 Method has higher detection limits for several of the Volatile Organics (Benzene, Carbon Tetrachloride, Vinyl Chloride, etc.) than the concentration given for Maximum Contaminant Levels in Title 22, Article 5.5, Section 64444.5. The Department recommends use of EPA methods 601 and 602 for analysis of Volatile Organics in water.

Response 14:

Table 3-4 (formerly Table 3-3) has been modified to show that analyses for volatile organics will be performed using EPA Methods 601 and 602 for water samples and EPA Methods 8010 and 8020 for soil samples. However, one of

the data gaps issues discussed in Section 7.1 of the Public Health and Environmental Evaluation Plan (PHEE) (Volume 7 of the RI/FS Work Plan) requested that "each organic analysis should also include identification by GC/MS of the 10 largest unidentified chromatographic peaks. Subsequent rounds of sampling may then be limited to those compound classes that have been shown to be present in the initial samples." In discussions regarding this question January 19, 1990, DHS agreed to a procedure where during the first sampling event at each location, water and soil samples analyzed for volatile organic compounds will be analyzed by GC/MS methods (EPA Methods 624, 625, 8240 and 8270). During subsequent sampling events at each location, water and soil samples analyzed for volatile organic compounds will be analyzed by GC methods (EPA Methods 601, 602, 8010, and 8020). The use of Methods 624 and 625 for the initial chemical analysis is also in accordance with the standard protocol recommended by the California Regional Water Quality Control Board (RWQCB) for newly installed monitoring wells. Table 3-4 has been modified to reflect this dual approach.

The Navy's responses to the 14 comments from DHS have been outlined above. In addition to these responses, additional revisions to the SWAT Proposal Addendum have been made to address those data gaps issues which concern the landfill areas which were outlined in Chapter 7.0 of the PHEE. These data gaps issues, along with each Navy response, are outlined in the paragraphs which follow.

Data Gaps Issue 1:

Table 7-1 of the PHEE has listed additional laboratory analyses which will be necessary to provide the data needed to perform the public health and environmental evaluation. Additional discussion of these data needs is presented in the PHEE in Section 7.1. Tables 3-1, 3-2, 3-3, and 3-4 of the SWAT Proposal Addendum have been revised to cover the additional analyses needed.

Data Gaps Issue 2:

As discussed in the response to DHS Comment 14 above, the PHEE states that "each organic analysis should also include identification by GC/MS of the 10 largest unidentified chromatographic peaks." Table 3-4 of the SWAT Proposal Addendum has been revised to incorporate the requirements.

Data Gaps Issue 3:

Section 7.1.1 of the PHEE has requested that surface soil samples and background samples from the upper two inches of the soil column be collected for analyses. The text of Sections 3.1.2.3, 3.3.2, and 3.4 has been revised to include this sampling. In addition, tests for extra physical and chemical properties, sieve analyses, soil bulk density (dry density), and permeability tests have been requested and will be performed to aid in evaluation of leaking potential. This additional testing is shown in Tables 3-1 and 3-2.

Section 7.1.2 of the PHEE also requests pH and TOC analyses on some subsurface soil samples. Sections 3.2.2.1, 3.2.2.2, and 3.3.2 and Tables 3-1 and 3-2 have been revised to address these data needs.

Data Gaps Issue 4:

Section 7.1.3 of the PHEE has requested the analyses of certain indicator parameters and common inorganic species (General Minerals) in ground water at the site. Tables 3-1, 3-2, and 3-3 of the SWAT Proposal Addendum have been revised to include these analyses.

Data Gaps Issue 5:

Section 7.1.5 of the PHEE requests that surface water in the wetlands area of the West Beach Landfill be analyzed for several parameters. These have been incorporated into Tables 3-1, 3-2, and 3-3 of the SWAT Proposal Addendum.

Data Gaps Issues 6:

Sections 7.1.5 and 7.1.6 of the PHEE have requested a number of analyses of sediment and biota in wetlands areas. This sampling has been addressed in Sections 3.3.5 and 3.3.6 and Table 3-3 in the SWAT Proposal Addendum.

Finally, in addition to the revisions to address the comments from DHS and the data gaps issues noted above, revisions to the text of the SWAT Proposal Addendum concerning sampling procedures have been made to bring this volume in line with the procedures in the revised QAPP for the RI/FS Work Plan. Portions of Sections 3.1.2.2 and 3.1.2.3 have been revised for this purpose.