4721 Tidewater Avenue, Suite C
Oakland, CA 94614
(510) 535-2445 • FAX (510) 535-2408

GEOMATRIX

18 May 1993
Project 2026.06

Ms. Patricia Murphy
Port of Oakland
530 Water Street
Oakland, California 94607

Subject: Report of Waste Discharge, Landfill Design, and Closure and Port-Closure Maintenance Plan
Berth 30
Port of Oakland
Oakland, California

Dear Ms. Murphy:

Enclosed is the subject report. If you have any questions about this report, please call either of the undersigned. We appreciate the opportunity to work with you on this project and look forward to working with you in the future.

Sincerely yours,

GEOMATRIX CONSULTANTS, INC.

Tom Graf, P.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
TOM GRAF
No. 34719
Exp. 9/95
CIVIL
STATE OF CALIFORNIA

Sarah E. Goodin

Sarah E. Goodin, R.G.
Senior Geologist

EKW/SEG/lam
2026\20266RWD.LTR

Enclosure

Geomatrix Consultants, Inc.
Engineers, Geologists, and Environmental Scientists

GEOMATRIX

REPORT OF WASTE DISCHARGE, LANDFILL DESIGN, AND CLOSURE AND POST-CLOSURE MAINTENANCE PLAN

Berth 30
Port of Oakland
Oakland, California

VOLUME 1 - REPORT

Prepared for

Port of Oakland
530 Water Street
Oakland, California 94607

May 1993
Project No. 2026.06

Geomatrix Consultants

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS
(continued)

LIST OF APPENDICES

REPORT OF WASTE DISCHARGE, LANDFILL DESIGN AND CLOSURE AND POST-CLOSURE MAINTENANCE PLAN

Berth 30
Port of Oakland
Oakland, California

1.0 INTRODUCTION

This report was prepared by Geomatrix Consultants, Inc. (Geomatrix), on behalf of the Port of Oakland (Port) in accordance with Title 23, Chapter 15, of the California Code of Regulations (CCR), for the proposed waste management unit at the Berth 30 site along Seventh Street in Oakland, California (Figure 1). The material proposed for placement in the landfill consists of approximately 14,500 cubic yards of compacted stockpiled soil containing soluble lead at concentrations greater than the Soluble Threshold Limit Concentration (STLC) (CCR, Title 22, Section 66261.24) of 5 milligrams per liter (mg/l) when analyzed by the Waste Extraction Test (WET). The soil will be placed in an engineered waste management unit that will be designed, operated, and closed in accordance with Chapter 15.

This report provides information on waste characteristics, geologic and climatologic characteristics of the proposed waste management unit and surrounding area, design of the waste management unit, precipitation and drainage controls, and closure and post-closure maintenance plans. The report is organized as follows:

- Site setting, including land and groundwater use, topography, climate, geology, hydrogeology, and soil and groundwater quality, is discussed in Section 2.0.
- Waste characteristics are described in Section 3.0.
- The design and operation of the proposed waste management unit are described in Section 4.0.

- The closure plan for the proposed waste management unit, including design, monitoring, and schedule, is presented in Section 5.0.
- A comparison of the proposed waste management unit to Chapter 15 requirements and engineered alternatives is discussed in Section 6.0.

2.0 SITE SETTING

The proposed waste management unit will be located at Berth 30 along Seventh Street at the Port (Figure 1). Current and future land and groundwater use, topography of the site area, climate, site geology, and site hydrogeology are discussed in this section.

2.1 LAND AND GROUNDWATER USE

The site currently is under construction; the proposed waste management unit will be constructed during current construction activities. The land use following completion of construction will be a terminal yard area for storing and shipping containers as part of operations at the Port. Land use within 1 mile of the proposed waste management unit consists of other container terminals, railroad rights-of-way, the U.S. Naval Supply Center, the U.S. Naval Air Station, and the eastern approach to the Oakland Bay Bridge (Figure 1). No dwelling units or residences are within 1 mile of the proposed waste management unit. No crops are cultivated and no livestock are raised within 1 mile of the proposed waste management unit.

Shallow groundwater beneath and within one mile of the proposed waste management unit currently is not used. No water supply wells, geothermal wells, oil wells, or irrigation wells are located within a one-mile radius of the proposed unit (Alameda County Department of Public Works, Alameda County Bay Plain Groundwater Study, January 1993). In addition, it is not expected that groundwater will be used in the future due to its brackish nature. The locations of all monitoring and cathodic protection wells identified within 1 mile of the proposed waste management unit, based on review of readily available agency files, are shown on Figure 2. Table 1 presents the available well information including well owner, well location, well name, total depth, and type of well.

2.2 TOPOGRAPHY

The site area for the proposed waste management unit is located on a peninsula built out into San Francisco Bay in the early 1900s. The site is relatively flat; site elevations before beginning construction ranged from 12 to 13 feet above mean lower low water (MLLW) (Port of Oakland datum, Jim Baker, Surveying Supervisor, Port of Oakland, personal communication, March 1993). Mean lower low water at the Port of Oakland corresponds to -3.20 feet mean sea level (National Geodetic Vertical Datum, 1929). Following completion of construction activities, site elevation in the vicinity of the waste management unit will range from 16.2 to 17.5 feet (MLLW). Topography within 1 mile of the site is shown on Figure 3 (National Geodetic Vertical Datum, 1929) and topography of the site prior to recent construction is shown on Figure 4 (MLLW).

2.3 SURFACE WATER

Surface water currently infiltrates or drains into storm drains and is discharged to San Francisco Bay. No streams, creeks, rivers, or springs are located within 1 mile of the proposed waste management unit. San Francisco Bay is approximately 500 feet south and 500 feet north of the proposed unit. The site is not located within a 100-year floodplain; the elevation of the 100-year tide in the site vicinity is approximately 9.45 feet (MLLW), which is below the current site elevation (12 to 13 feet MLLW) and proposed site elevation (16.2 to 17.5 feet MLLW), respectively (Figure 5; Ralph Johnson, Alameda County Flood Control and Water Conservation District, personal communication, January 1993).

2.4 CLIMATE

The Port area has a marine climate, with precipitation falling primarily during the 6-month period of November to March. Temperature normals (averages) for the 30-year period from 1951 to 1980 ranged from a maximum of 64.2°F to a minimum of 50.9°F, with a mean of 57.6°F (NOAA, 1982). Mean annual precipitation, recorded at the Oakland Museum (approximately 3.5 miles from the site) from 1970 to 1991, ranged from a minimum in 1976 of 9.99 inches to a maximum in 1983 of 44.27 inches (NOAA, 1993a and 1993b). The annual precipitation normal for the 30-year period from 1951 to 1980 is 18.03 inches (NOAA, 1982). The maximum expected 24-hour precipitation for a storm with a 100-year recurrence interval is 4.49 inches (Rantz, 1971). Figure 6 shows the isohyetal contours for the proposed waste management unit area and the surrounding region (Rantz, 1971).

Wind is highly variable in this area, although most commonly it is from a westerly direction. Wind velocities and directions are summarized on Figure 7.

As required by Chapter 15, potential evapotranspiration rates were estimated for the Port area. The Thornthwaite method (Dunne & Leopold, 1978), which estimates evapotranspiration rates graphically, was used. This method utilizes both the mean annual and mean monthly temperatures. We used temperature normals from the Oakland site weather station, operated by the National Oceanic and Atmospheric Administration (NOAA) at the Oakland Museum, from 1951 to 1980. The mean potential evapotranspiration rate was estimated graphically to be 5.20 centimeters per month (cm/mo). The minimum and maximum rates were estimated to be 2.95 cm/mo for January and 7.50 cm/mo for September, respectively.

The projected volume of runoff for the proposed waste management unit area for the 1,000-year, 24-hour storm was calculated as required by Chapter 15. The rational method (Dunne & Leopold, 1978) was used. This method predicts peak runoff rates based on rainfall intensity and drainage-basin characteristics for drainage areas of less than 200 acres. Using the rational method, the peak runoff rate associated with a particular rainfall event is equal to:

$Q_{pk} = CIA$ where Q_{pk} = peak rate of runoff, cubic feet per second (cfs)
C = rational runoff coefficient for the surface material
I = rainfall intensity in inches per hour (in/hr)
A = drainage area in acres

A coefficient of 0.98 (B. Vallerga, B.A. Vallerga, Inc., personal communication, February 1993) for hydraulic asphalt concrete pavement proposed as the cover for the waste management unit was used in the calculations. To calculate the intensity (I) for the 1000-year, 24-hour precipitation event, a depth-frequency curve of storm precipitation for a site having mean annual precipitation of 18 inches was projected to the 1000-year recurrence interval (Rantz, 1971). The resulting volume of 6 inches rainfall over a 24-hour period was used to calculate I (0.25 in/hr). The area of the proposed waste management unit (A) is estimated to be 2.37 acres.

The results of the runoff calculations are presented in Table 2. For a 1000-year event of 24-hour duration, the maximum runoff is estimated to be 0.58 cfs.

2.5 GEOLOGY AND EARTHQUAKE CONSIDERATIONS

The site of the proposed waste management unit is located in a former tidal area west of the former eastern margin of San Francisco Bay. The area was a broad flat plain extending 2 to 3 miles from the shoreline to deep water in the Bay. The site area was first developed in the late 1800s by construction of a pier structure in the approximate location of former Seventh Street. Filling operations to reclaim the area date back to about 1915 (Kaldveer, 1992).

To reach water of sufficient natural depth for operating ferries between Oakland and San Francisco, several railroad companies constructed earth and/or rock fill moles and trestles extending from the shoreline up to three miles into the Bay. Southern Pacific Railroad constructed the Oakland mole located near Seventh Street; the Oakland mole may have covered the former pier (Kaldveer, 1992). The area between the Oakland mole and the Key Terminal Railway trestle, located near the present Bay Bridge approach, was subsequently filled to create the existing Oakland Outer Harbor shoreline to the north of the proposed waste management unit. The Naval Supply Center, located east and south of the site, was reclaimed in the 1930s and 1940s by hydraulic filling methods (Kaldveer, 1992). During the Bay Area Rapid Transit District (BART) system construction in the mid-1960s, the area of the Seventh Street terminals west of the proposed waste management unit area was reclaimed using soil and rock from the BART excavations as fill (Geomatrix, 1986).

Woodward-Clyde Consultants (WCC), of Oakland, California; Levine-Fricke, Inc., of Emeryville, California; and Kaldveer Associates (Kaldveer) of Oakland, California, conducted geotechnical or environmental soil and groundwater investigations at the site (WCC, 1990; Levine-Fricke, 1992; Kaldveer, 1992). Soil borings drilled in the vicinity of the proposed waste management unit indicate the site area is underlain by 10 to 25 feet of fill generally consisting of gravel (aggregate base and railroad ballast) over hydraulically-placed silty sand with shell fragments. The silty sand is underlain by as much as 15 feet of soft clay, known locally as Bay Mud. The Bay Mud overlies silty or clayey sand identified as the Merritt Sand unit. The site is not in an area of rapid geologic change. Idealized geologic cross-sections through the site area are shown on Figures 8 and 9.

Potential sources of earthquakes in the San Francisco Bay region that may have significance with regard to future ground motions at the Berth 30 site include the San Andreas, Hayward, San Gregorio, Healdsburg-Rodgers Creek, Calaveras, Concord, Greenville, and Green Valley faults. None of these active faults, nor any other active or potentially active fault identified by the California Division of Mines and Geology (1991), is located within 200 feet of the proposed waste management unit.

Two faults dominate future-earthquake consideration for the Berth 30 site (Figure 10); the Hayward fault, situated approximately 5.5 miles to the east, and the San Andreas fault, situated approximately 13 miles to the west. For the maximum credible earthquake on either of these faults, peak horizontal ground acceleration levels at the site are expected to be in the range of about 0.30g to 0.35g. This range was estimated using various ground motion attenuation relationships, i.e., Joyner and Boore (1982), Sadigh and others (1986), and Idriss (1987); a summary of these relationships is presented in Joyner and Boore (1988). It should be noted that although the ground acceleration levels are expected to be similar for the maximum credible earthquake on the Hayward and San Andreas faults, the duration of strong shaking associated with the maximum San Andreas event ($M \approx 8^+$) is expected to be significantly longer than that associated with the maximum Hayward event ($M \approx 7$).

Liquefaction is a soil behavior phenomenon in which soil loses a substantial amount of strength in response to high excess pore-water pressure generated by strong earthquake ground shaking. Recently (geologically) deposited and relatively unconsolidated soils and artificial fills located below the groundwater surface are susceptible to liquefaction. Examination of exploratory soil boring logs from the site and immediate vicinity (Geomatrix, 1986, 1992b; WCC, 1990; Kaldveer, 1992) indicates the presence of loose to medium-dense sandy fill materials and native silty sands, clayey sands, sandy silts, and clayey silts below the water table that may be susceptible to liquefaction. For the ground shaking levels and durations expected for large earthquakes on the Hayward and San Andreas faults, liquefaction is anticipated for the loose to medium-dense deposits encountered in the borings. A primary potential consequence of liquefaction at the site would be ground settlement with possible differential movements. WCC (1990) estimated that a maximum probable earthquake event on the Hayward or San Andreas fault may cause 4 to 6 inches of ground surface settlement across the site. Kaldveer (1992) estimated 1½ to 6 inches of total and differential settlement should liquefaction occur at the site. In addition, some lateral spreading movement along the shoreline may occur. Along the southern side, the proposed waste management unit is at least 500 feet from the shoreline at its closest point, and even if lateral spreading along the southern shoreline should occur during a maximum credible earthquake event, it is considered unlikely that significant effects from such an occurrence would extend to the unit area. Along the northern shoreline, the new container terminal dike, approximately 450 feet north of the proposed waste management unit, has been designed to withstand earthquake shaking; therefore, lateral spreading should not occur along this shoreline. Additional earthquake strengthening has been performed at the Seventh Street Marine Terminal west of the proposed waste management unit.

Given the location of the Berth 30 site on the eastern shoreline of San Francisco Bay, potential tsunami and seiche wave hazard to the proposed waste management unit also has been examined. Forty-one tsunamis or seiches have been observed at the San Francisco Tide Gage (located at the Presidio) since it was established in 1854 (NOAA, 1989). Except for the March 1964 Alaska earthquake tsunami, with a wave height recorded to be about 3.6 feet at the Presidio, all of the tsunami or seiche wave heights have been less than 2 feet and more than 85 percent have been equal to or less than 1 foot. It should be noted that for the M8 San Francisco earthquake of 18 April 1906, the recorded tsunami wave height was approximately ⅓-foot. The historical tsunami data also indicate that there is wave height attenuation of tsunami waves within San Francisco Bay. For example, at Alameda, the nearest tide gage to the proposed waste management unit, the wave height for the March 1964 Alaska earthquake tsunami was about 2.6 feet, or less than 75 percent of the wave height at the Presidio. Several authors, including Wilson and Torum (1968) and Wiegel (1970) have discussed tsunami attenuation in San Francisco Bay using data from various locations around the Bay. Based on the tsunami wave height history recorded at the Presidio, the apparent wave height attenuation within San Francisco Bay, and the available freeboard at the site, the hazard due to tsunami and/or seiche is not considered significant.

2.6 SOIL QUALITY

WCC collected soil samples for chemical analysis from 10 soil borings and 34 surface sampling locations at the Berth 30 site in April 1988 (Figure 11). Seven of the soil borings, four of which were converted to monitoring wells, were drilled in the vicinity of the waste management unit. Locations of the seven borings are shown on Figure 4. Soil samples from the 10 borings were analyzed for the Title 22 metals, including hexavalent chromium; volatile organic compounds; semivolatile organic compounds; pesticides and polychlorinated biphenyls (PCBs); fuel hydrocarbons; and total petroleum hydrocarbons. All metal concentrations reported were below the detection limits or less than the STLCs. No other compounds were detected except toluene, up to 0.19 milligrams per kilogram (mg/kg) in two samples, and total xylenes at 0.36 mg/kg in one sample (Levine-Fricke, 1991). Information regarding the number of samples analyzed or sample depths is not available. Analytical data for the surface soil samples collected by WCC are not available.

2.7 HYDROGEOLOGY

WCC installed four shallow groundwater monitoring wells in the vicinity of the proposed waste management unit in 1988 (WCC, 1990). The wells were screened in the fill that consists of clayey gravel and sand, silty sand, and/or silty clay (Bay Mud) beneath the fill. Permeability of the fill material is highly variable; permeabilities of the Bay Mud calculated using results of consolidation test data of samples of silty clay retrieved from borings in the vicinity of the site range from $1x10^{-6}$ to $1x10^{-8}$ centimeters per second (cm/s) (Geomatrix, 1988; Woodward-Clyde, 1990).

The groundwater flow patterns were evaluated using water-level data from the WCC monitoring wells, several borings drilled along former Seventh Street in 1966 by Dames and Moore (D&M) of San Francisco, California, in preparation for BART's Trans Bay Line Oakland approach (Kaldveer, 1992), and temporary piezometers installed within and exterior to the limits of the proposed waste management unit by Geomatrix during March and April 1993. Locations of the WCC wells and Geomatrix piezometers are shown on Figure 4.

Groundwater elevations were not available for the existing monitoring wells located on the Berth 30 site because the top of the well casings were not surveyed. However, depth to groundwater, measured in the WCC monitoring wells and in the D&M borings, which were left open for several days, ranged from 5.0 to 10.0 feet below ground surface. Water elevation data from the D&M borings indicated that the high groundwater elevation was approximately 6.9 feet (MLLW) in the boring drilled closest to the proposed waste management unit. The water-level data in the D&M boring were obtained in late March 1966. Rainfall for 1966 was near normal (U.S. Department of Commerce, 1965 and 1966).

In order to supplement available groundwater level data and further assess groundwater elevations in the vicinity of the proposed waste management unit, temporary piezometers were installed by Geomatrix during March and April 1993. Five piezometers were installed to depths of 14.0 to 14.5 feet during March 1993. Five additional piezometers were subsequently installed during April 1993 to further define the variation in groundwater elevations across the site. Locations of the piezometers are shown on Figure 4.

Groundwater elevations measured in the temporary piezometers as of 6 May indicate that groundwater is present at elevations ranging from 3.27 to 9.93 feet (MLLW). Contours of the groundwater elevations measured in May 1993 are also shown on Figure 4. Water-level measurement data for the uppermost water-bearing zone indicate that groundwater generally flows in a west-southwesterly direction near the proposed waste management unit.

Groundwater elevations measured in piezometers P-1, P-3, P-4, P-6, P-9, P-10, and P-11 between March and May 1993 have all been below 8.0 feet (MLLW). High water levels measured in piezometers P-8, P-5, and P-2 correspond to elevations of 8.86, 9.48, and 9.93 feet (MLLW), respectively.

Several factors at the site are believed to control groundwater elevation variations observed across the site. The high elevation at P-2 is probably related to the clayey nature of the fill in the vicinity of the well combined with the presence nearby of standing water during most of the winter. The standing water allowed the clayey fill to saturate and the low permeability of the unit makes it drain very slowly. This interpretation is supported by the observation that the water levels in P-2 took one month to equilibrate. Relatively high water levels at P-5 and P-8 are believed to be related to the recent installation of stone columns in the vicinity of the eastern boundary of the proposed waste management unit. We understand from the Port that the stone columns were installed during vibroreplacement ground improvement measures using a high pressure water jet to create a space below ground surface into which rock backfill was placed. A significant amount of water is introduced into the surrounding formation during installation; in addition, during the rainy season, these columns likely act as drains in unpaved areas due to their high porosity.

We believe that these water level measurements can be used as the maximum expected groundwater elevations. This belief is based on consideration that the rainfall in this area prior to the water level measurements was well above normal (3.5 inches above normal during October to December, National Weather Records Center); site operations caused significant standing water to be present on the site for long periods; and the site is unpaved. After construction is completed at the site, the entire area will be paved, which will significantly reduce infiltration, especially compared to conditions prior to our water level measurements. Infiltration is likely the primary mechanism for raising water levels at this site, since groundwater recharge is considered likely to be negligible. Based on these factors, we consider future water levels at the site likely to be well below those measured in the piezometers.

2.8 GROUNDWATER QUALITY

On 23 and 24 May 1988, WCC sampled the four monitoring wells they had installed at the Berth 30 site. Groundwater samples were analyzed for volatile and semivolatile organic compounds; pesticides and PCBs; total petroleum hydrocarbons; the 17 total Title 22 metals; and water quality parameters. The groundwater samples contained no volatile or semivolatile compounds, pesticides, PCBs, or total petroleum hydrocarbons above laboratory detection limits. Arsenic and barium were detected in all four samples at concentrations up to 0.02 and 0.21 mg/l, respectively. Chromium III, copper, lead, selenium, and zinc were detected in three of the samples at concentrations up to 0.016, 0.018, 0.059, 0.02, and 0.51 mg/l, respectively. The water quality parameter analyses indicated that the groundwater samples had pH ranging from 6.9 to 7.0; total dissolved solids ranging from 650 to 2200 mg/l; and specific conductance ranging from 940 to 4500 micromhos per centimeter (μmhos/cm). Parameters measured during May 1993 in the temporary piezometers installed by Geomatrix include pH levels of 7.1 to 7.8 and specific conductance of 2700 to 6600 μmhos/cm.

Levine-Fricke collected groundwater samples from the four on-site monitoring wells on 17 March 1992. Groundwater samples were analyzed for total petroleum hydrocarbons as diesel (TPHd), total petroleum hydrocarbons as gasoline (TPHg), benzene, toluene, ethylbenzene, and xylene (BTEX), and lead. TPHg, BTEX, and lead were not reported in the samples. TPHd was detected in two of the samples at concentrations of 0.07 and 0.08 mg/l.

Background quality of shallow groundwater at the site will be evaluated in the groundwater monitoring program to be set up as part of the design and monitoring of the proposed waste management unit. Groundwater samples will be collected from wells up- and downgradient of the unit for chemical analysis, as discussed in Section 4.2 of this report.

3.0 WASTE CHARACTERISTICS

The soil to be placed in the proposed waste management unit consists of some of the material excavated from Berth 30 north of former Seventh Street during Fall 1992 as part of constructing a new pile-supported, reinforced concrete wharf. The soil comes from the post-1950s fill unit, which consisted of a heterogeneous mixture of silt, clay, and sand containing gravel, cobbles, and boulders with some brick, timber, and other miscellaneous materials (Geomatrix, 1992a). Following excavation, the post-1950s fill unit was placed on site in one stockpile. The material subsequently was processed through a rock crusher and screening plant to remove rocks greater than 12 inches in diameter. Following processing, the predominantly 4-inch minus material was placed in stockpiles ranging from approximately 800 to 2500 cubic yards in volume (these volume quantities are based on surveyed volumes; previous volume estimates were based on weight to volume conversions and visual estimation). The stockpiles were sampled and chemically analyzed to identify which piles did or did not contain soluble lead above the STLC by the California Waste Extraction Test (WET). The waste to be placed in the proposed waste management unit consists of a total volume of approximately 14,500 cubic yards of compacted, stockpiled material (12 stockpiles) that contained soluble lead by the WET above the STLC.

Grain size analysis of a representative sample collected from the material following consolidation of the individual stockpiles indicates that the material is a silty gravel (Unified Soil Classification System). A copy of the grain size distribution curve is included in Appendix A.

3.1 SAMPLING AND ANALYTICAL METHODS

Geomatrix collected samples from the stockpiles for chemical analysis. Samples of the predominantly 4-inch minus material were collected directly from the conveyor belt after the material had been processed through the crusher and screening plant. Samples were collected using a systematic random sampling approach in accordance with the U.S. Environmental Protection Agency's (EPA's) Test Methods for Evaluating Solid Waste (SW-846). The first sample was collected randomly; subsequent samples were collected at a rate of approximately one sample per 30 to 50 cubic yards. Soil samples were collected in clean, thin-walled brass tubes that were sealed at both ends with Teflon sheets, plastic end caps, and duct tape; each tube was labeled and placed in an ice-cooled chest. A random number generator was used to select 10 soil samples from each stockpile for chemical analysis. An additional random sample was collected from each stockpile for acute aquatic toxicity testing. All samples were delivered to the laboratory under Geomatrix chain-of-custody procedures. Chain-of-custody records are included in Appendix B, Volumes 2 and 3 of this document.

The randomly selected samples were analyzed by Clayton Environmental Consultants of Pleasanton, California, a state-certified analytical laboratory. A total of 120 samples (10 samples per stockpile) were analyzed for 17 total Title 22 metals by EPA Methods 6010 and 7471; and for soluble lead using the WET and the Toxic Characteristic Leaching Procedure (TCLP) followed by EPA Method 6010. A total of 24 samples (two samples per stockpile) were analyzed for volatile and semivolatile organic compounds by EPA Methods 8240 and 8270, respectively. One sample from each stockpile (a total of 12 samples) was also analyzed for pesticides and PCBs by EPA Method 8080; reactivity by EPA Method 9010 and Solid Waste Method (SW) 7.3.4.2; corrosivity by EPA Method 9045; and ignitability by SW 7.1.2. Three samples from the entire set of randomly selected samples also were analyzed for soluble mercury by the WET, because the total concentrations of mercury in these samples were greater than 10 times the STLC of 0.2 mg/l. The samples selected for acute aquatic toxicity testing were analyzed by the Title 22 method by Western Bioassay Laboratories of Walnut Creek, California, a state-certified analytical laboratory.

3.2 ANALYTICAL RESULTS

Analytical results are summarized in Tables 3 and 4; analytical laboratory reports are included in Appendix B, Volumes 2 and 3 of this document. All metals concentrations are well below the Total Threshold Limit Concentration (TTLC) used to define a hazardous waste (CCR, Title 22, Section 66261.24). The soil generally contains total metals at concentrations that would be considered within background ranges (Shacklette and Boerngen, 1984; Table 5).

All of the soil samples contained less than 290 mg/kg total lead, except one of seven replicate analyses, which indicated 720 mg/kg lead (as compared to 78 to 150 mg/kg lead in the other six replicate analyses). One hundred sixteen of the 120 samples contained total lead at concentrations less than 200 mg/kg. Soluble lead when analyzed by the WET indicated concentrations ranging from 1.4 to 43 mg/l. Thirty-seven of the 120 samples contained soluble lead when analyzed by the WET at concentrations less than 5 mg/l; 74 of the 120 samples analyzed contained soluble lead when analyzed by the WET at concentrations between 5 and 10 mg/l. In addition, soluble lead tested by the TCLP was not detected in 111 samples and was reported in 9 samples at concentrations between 0.1 and 0.4 mg/l. Soluble mercury by the WET was not detected above the laboratory detection limit of 0.01 mg/l in the 3 samples analyzed.

Volatile organic compounds, including toluene, ethylbenzene, total xylenes, acetone, and 1,2-dichloroethane, were detected in 10 of the 24 samples analyzed at concentrations ranging from 0.005 to 0.065 mg/kg. Semivolatile compounds detected were primarily polynuclear aromatic compounds, including naphthalene, 2-methyl naphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(ghi)perylene at concentrations up to 10 mg/kg. Pesticides detected include DDD, DDE, and DDT at concentrations up to 0.44 mg/kg. PCBs were not detected in any of the samples analyzed. The soil samples did not exhibit reactivity, corrosivity, or ignitability. The results of the aquatic toxicity testing indicated aquatic toxicity greater than 750 mg/l. Title 22 specifies that a material is hazardous if the 96-hour acute aquatic toxicity is less than 500 mg/l. Therefore, the soil is not hazardous according to this criteria.

A statistical analysis of results for all the stockpiles indicates that the entire volume of soil could be classified as hazardous because it contains soluble lead by the WET at concentrations greater than the level used to define a California hazardous waste (5 mg/l). However, based on the analytical results and the waste characteristics, the Port has requested the California Department of Toxic Substances Control (DTSC) reclassify this waste as nonhazardous in accordance with Title 22, Section 66260.200. The Application for Reclassification is included in Appendix C.

4.0 PROPOSED WASTE MANAGEMENT UNIT

Based on the assumption that the material will be reclassified as nonhazardous, the Port proposes to dispose of the excavated soil directly into a Chapter 15 Class II-equivalent waste management unit with Regional Water Quality Control Board (RWQCB) approval of the design. The design and operation of the proposed waste management unit are described in this section.

4.1 UNIT DESIGN

The waste management unit is designed to contain approximately 14,500 cubic yards of compacted, lead-affected soil. The unit will be constructed to maintain the bottom of the unit at least 3 feet above estimated high groundwater elevation. The base of the unit will be constructed at an elevation of 11.0 feet (MLLW) between its western boundary and the location of existing piezometer P-3. The base of the unit will slope upward in an east-west direction from elevation 11.0 feet (MLLW) to elevation 12.29 feet (MLLW) between the locations of temporary piezometers P-3 and the unit's eastern boundary, 40 feet west of P-8. The elevation of the base of the unit will remain constant in a north-south direction. The sides of the excavation will be maintained at a 2:1 horizontal to vertical slope. A polyvinyl chloride (PVC) liner will be placed in the excavation between the waste and the underlying soil, and a layer of sand will be placed over the liner to protect its surface. The sand layer also will provide drainage of leachate in the event some were generated from the soil. A collection point, constructed of 4-inch-diameter schedule 40 PVC, will be installed at the low point of the base of the waste management unit completed in the sand over the liner, which could be pumped if a significant volume of moisture was observed. Typical construction details are shown on Figure 13. Approximately 2.7 to 4.4 feet of soil will be placed on top of the liner within the limits of the toe of the excavated side slopes of the unit. The proposed design, including the areal extent, materials, depths, grades, and construction details, is shown on Figures 11 and 12.

The unit will be closed following placement of the waste. The surface will be covered with an engineered, low-permeability asphalt concrete pavement. The proposed waste management unit will be constructed to a maximum elevation of 17.5 feet (MLLW) along the south-central portion of the waste management unit and will be sloped at a minimum of 1 percent to elevation 16.32 feet on the north side, and to elevation 16.95 feet on the south side. Storm water runoff will flow from the high point of the proposed unit to slotted drains connected to storm drain outfalls to the north, to a concrete swale and storm drain catchbasin to the south, and to a slotted drain connected to the storm drain to the southwest, as shown on Figure 11. Groundwater monitoring will be conducted, as discussed in Section 4.2 of this report. Closure design details are discussed in Section 5.0 of this report.

4.2 GROUNDWATER AND VADOSE ZONE MONITORING

Shallow groundwater quality in the vicinity of the waste management unit will be monitored regularly. A network of five shallow groundwater monitoring wells, on approximately 200- to 500-foot spacings around the proposed waste management unit, will be installed to monitor groundwater quality up- and downgradient of the unit (Figure 11). These well locations have been selected based on the groundwater flow pattern shown on Figure 11; one well is upgradient and four wells are downgradient of the facility. Monitoring wells will be constructed of 2-inch-diameter schedule 40 PVC and will be completed in the shallowest water-bearing zone beneath the site. Typical well construction details are shown on Figure 14.

Water levels will be measured quarterly to assess the depth to groundwater and the direction of groundwater flow. Groundwater samples will be collected from the wells quarterly for analysis for water quality parameters (pH, temperature, and conductivity) and for lead. The data will be submitted to the RWQCB; results and findings will be summarized annually. After the first year, monitoring frequency will be negotiated with the RWQCB.

Vadose zone monitoring, which is required by Chapter 15, is not applicable to this site because a vadose zone monitoring system beneath the proposed waste management unit likely would be within the capillary fringe zone.

4.3 UNIT CONSTRUCTION AND OPERATION

The proposed waste management unit will be constructed to maintain the bottom of the unit at least 3 feet above the estimated high groundwater elevations. Existing fill material beneath the proposed unit is hydraulically placed fill comprised of sand and clayey sand with silt and gravel. Based on available subsurface information, it appears that in some areas of the proposed waste management unit, a layer of gravel fill (aggregate base and railroad ballast) 6 to 12 inches thick may be present over the sand fill. The bottom of the unit will be excavated to a depth of at least 3 feet above the estimated elevation of high groundwater within the limits of the unit to maximize the volume of the unit. Where the existing fill exposed at the base of the proposed excavation contains gravel which could potentially damage the liner, these areas will be overexcavated an additional 6 inches to a depth of approximately 2.5 feet from the estimated high groundwater elevation. The excavation will be backfilled with a 6-inch-thick layer of gravel-free soil to protect the PVC liner and to bring the bottom of the excavation to 3 feet above the estimated high groundwater elevation. A 40-mil PVC liner will be placed over the sand layer along the bottom and side slopes of the excavation and will be placed with a minimum of 6 inches of overlap at the seams. The estimated water vapor transmission rate (WVTR) of the PVC liner of 0.82 $cm^3/(100\ in^2\text{-day})$ correlates to a soil permeability of $1x10^{-9}$ cm/s or less with respect to migration of fluid from the waste management unit. Seams will be achieved by overlapping adjacent strips of the PVC a minimum of 6 inches, and removing all dirt, dust or other substances by wiping the contact surfaces of the panels clean. Vinyl-to-vinyl bodied solvent will be applied to the contact surfaces in the seam area, and the two surfaces pressed together immediately, smoothing out any wrinkles.

The PVC liner will be secured in a trench two feet deep and one foot wide excavated two feet from the crest of the excavated slope (Figure 12). The PVC liner will be anchored by clean backfill in the trench over the liner to prevent slippage during construction and to protect the liner at the edges of the unit.

The PVC liner will be inspected daily before material is placed on it. Any lining surface showing injury due to scuffing, penetration by foreign objects, or distress from rough subgrade will be repaired by placing patches of 40-mil PVC, cut with rounded corners over the tears with a minimum of 4 inches of overlap, and sealed with cold-applied vinyl-to-vinyl splicing adhesives before placement of the sand layer and the soil. The splicing adhesive will be applied to the contact surface between the patch and the lining, and the surfaces pressed together immediately, smoothing out any wrinkles.

A 6-inch layer of clean coarse sand will be placed over the PVC liner before placement of soil. The sand should provide protection for the liner during construction and also serve as a barrier between the liner and stockpiled soil containing gravel. A collection point will be placed in the anticipated lowest portion of the clean coarse sand layer at the south-central boundary. The stockpiled soil will be placed over the clean coarse sand layer in uniform lifts, not exceeding 8 inches in uncompressed thickness. Prior to compaction, the soil will be moisture conditioned as necessary to permit proper compaction by either (1) aerating the material if it is too moist, or (2) adding moisture if it is too dry. The soil to be placed over the sand will be compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D-1557. The last lift of soil will be compacted to a minimum of 98 percent of maximum dry density. Results of a compaction test performed on the soil in accordance with ASTM D-1557 are included in Appendix A.

Stability analyses for the excavated slopes of the landfill were not conducted. The sidewalls of the proposed waste management unit will be excavated at a 2:1 horizontal to vertical slope, and the sidewalls will be exposed for a short time only (less than one month) before being covered with backfill. Therefore, it is anticipated that the slopes of the unit will be stable during operation and construction of the unit.

If, during fill placement, damage to the PVC liner is observed or suspected, the liner will be repaired. The soil and the top several inches of the underlying fill in the vicinity of the damage will be re-excavated and the PVC liner will be replaced. The excavated soil will be recompacted over the PVC liner. The RWQCB will be notified in the event of releases of the chemical of concern (lead) from the unit during construction and operation activities.

The closure plan and post-closure monitoring program are discussed in Section 5.0 of this report.

5.0 PROPOSED CLOSURE PLAN

5.1 DESIGN OF CLOSURE UNIT

The proposed closure design for the waste management unit, including final cover, monitoring and maintenance programs, estimated closure and post-closure costs, and closure schedule are discussed in this section.

5.1.1 Unit Configuration

The closed waste management unit will be located beneath the container storage area of the terminal. The unit will consist of one disposal area containing a total of approximately 14,500 cubic yards of compacted soil within an area of 2.37 acres, as shown on Figure 11. Final elevations of the closed unit will range from 16.2 to 17.5 feet (MLLW). The final grade will route surface drainage to slotted drains.

5.1.2 Final Cover Design

The final cover will consist of an asphalt concrete pavement section over the soil contained in the unit. The foundation layer and the asphalt pavement are described in this section.

5.1.2.1 Foundation Layer. A 2-foot-thick foundation layer, consisting of 4 inches of aggregate base and 20 inches of the landfill soil, will serve as the foundation layer beneath the final cover. The soil in the foundation layer will be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D-1557. The last lift of soil and the aggregate base will be compacted to a minimum of 98 percent of maximum dry density. Results of resistance-value (R-value) tests performed on the soil are included in Appendix A.

5.1.2.2 Asphalt Concrete Pavement. The asphalt concrete pavement, which was designed by Jordan Woodman Dobson (JWD) of Oakland, California, to support the traffic and container storage loads at the terminal, is proposed as a cap for the landfill. To this pavement section, a low-permeability layer, developed by B.A. Vallerga, Inc. (Vallerga), of Oakland, California, has been added. This layer was designed to limit infiltration in the pavement section over the proposed waste management unit. Details of the design of this low-permeability layer, consisting of hydraulic asphalt concrete, are presented in a separate report by Vallerga, included in Appendix D.

Resistance to infiltration will be provided by the asphalt concrete pavement and additionally by the 3-inch-thick layer of hydraulic asphalt concrete placed over the aggregate base at the surface of the foundation layer. The hydraulic asphalt concrete, when placed as specified, is anticipated to achieve a permeability of 1×10^{-7} cm/sec or less. The final pavement section will consist of 8½ inches of dense-graded asphalt concrete over 3 inches of hydraulic asphalt concrete, which will be over 4 inches of aggregate base.

5.1.3 Long-Term Settlement

The soil to be contained is not organic or compressible in nature and will be compacted during placement. Therefore, it is not expected to settle as a result of decomposition or consolidation following closure of the unit. Settlement anticipated in the area of the closed unit will result from consolidation of the relatively soft Bay Mud that underlies the area (Figures 8 and 9).

Both WCC (1990) and Kaldveer (1992) conducted analyses to estimate the long-term settlement at the site as a result of consolidation of the Bay Mud. WCC estimated that about 1½ inches of settlement would occur for every foot of fill placed over a 15-foot-thick Bay Mud layer. Kaldveer estimated that settlement of up to 2 inches would occur for each foot of new fill placed on the site. Actual settlement will vary based on the thicknesses of both the new fill layer and the Bay Mud, and on the compressibility of the Bay Mud beneath the unit.

5.1.4 Groundwater Protection

To protect groundwater at the site, the soil will be placed an average of 3 feet above the highest known groundwater elevation within the proposed waste management unit area to prevent contact with the waste. In addition, a low-permeability PVC liner (having a permeability of 1×10^{-9} cm/s) will be placed between the new soil and native soil in the proposed waste management unit. As part of the closure plan, a sloped asphalt concrete cover (having a permeability of 1×10^{-7} cm/s or less) will be placed over the unit to limit infiltration of precipitation.

As reported in Appendix C, lead, the constituent of concern in the soil, generally is immobile and is unlikely to leach from the soil under site conditions. Studies conducted to evaluate the mobility of lead indicate that lead is strongly adsorbed and exhibits little mobility in soil (Korte, et. al., 1976; Miller, et. al., 1983; Abd-Elfattah and Wada, 1981). Additional studies indicated that lead remained in the surface horizons of soil and sludge after several years of application of lead (Brown, et. al., 1983; Chang, et. al., 1984; Williams, et. al, 1980). The TCLP results indicate that, even under acidic conditions, very little lead leaches from the material, except under the more aggressive conditions of the WET. Acidic conditions are unlikely to occur in the proposed waste management unit. The soil will be placed essentially dry and the final cover will provide protection from infiltration. Therefore, based on the combination of a low-permeability asphalt concrete cover and the PVC liner, and the low mobility of lead in the soil, it is unlikely that the proposed waste management unit would create leachate that could affect groundwater.

Groundwater quality will be monitored up- and downgradient of the waste management unit. Groundwater samples will be collected from the monitoring well network, described in Section 4.2 of this report (Figure 11), for chemical analysis for lead. Groundwater samples will be collected quarterly for the first year and the analytical results will be reported annually to the RWQCB. Subsequent monitoring frequency will be negotiated with the RWQCB.

5.1.5 Precipitation and Drainage Control

The final cover of the waste management unit will be sloped at 1 percent to allow rainfall to run off; localized ponding will be prevented by routine maintenance. The runoff will be routed to the slotted drains, concrete swales, and storm drains, as shown on Figure 11; these collection systems are located outside the waste management unit.

5.2 POST-CLOSURE LAND USE

Following closure of the unit, the site will be part of the new container storage terminal for Berth 30 at the Port of Oakland. The design use for the site consists of moderate to heavy traffic to move and place containers and a storage area for containers. No buildings will be located over the proposed waste management unit. The final site plan for the container terminal following closure of the proposed waste management unit is shown on Figure 11.

5.3 POST-CLOSURE MONITORING AND MAINTENANCE PLAN

The waste management unit will be monitored and maintained following closure. The plans include monitoring and maintenance of surface settlement and asphalt concrete pavement, and groundwater monitoring. Post-closure monitoring generally will be performed quarterly and reported annually. The elements of each monitoring program are described in this section.

5.3.1 Monitoring of Surface Settlement and Asphalt

As required by Chapter 15, permanent survey markers will be placed at the locations shown on Figure 11. Two survey markers will be installed on pile supported structures, and three survey markers will be installed on the proposed waste management unit. The markers will be surveyed regularly to evaluate differential settlement in the area of the closed unit. If necessary, differential settlements will be corrected to maintain the surface slopes and prevent ponding.

5.3.2 Groundwater Monitoring

As discussed in Section 4.2, shallow groundwater quality in the vicinity of the waste management unit will be regularly monitored following closure of the unit. Water levels will be measured to assess the depth to groundwater and the direction of groundwater flow. Groundwater samples will be collected from the wells for analysis for total lead. The results of the monitoring will be reported to the RWQCB. If elevated concentrations of the chemical of concern (lead) are detected in the monitoring wells as a result of a release from the proposed waste management unit, a corrective action plan will be developed and submitted to the RWQCB for approval. The collection of free moisture within the waste management unit will be monitored by measuring the presence of any fluid in the collection point within the unit. If a significant volume of fluid is present, the fluid will be pumped and properly disposed.

5.4 ESTIMATED COSTS FOR CLOSURE AND POST-CLOSURE

Estimated costs for closure of the unit and for post-closure monitoring are summarized in Table 6. The estimated cost to close the waste management unit, including design and implementation, is $429,000. Annual post-closure monitoring costs are estimated to be $18,000. Costs for post-closure maintenance are not included.

5.5 CLOSURE SCHEDULE

The proposed closure schedule is presented in Table 7. It is anticipated that the waste management unit will be constructed between August 1 and August 15, 1993. The soil will be placed in the unit in August 1993. The unit will be closed, including placement of the foundation layer and asphalt concrete cover, between August and September 1993. Post-closure monitoring will be initiated following completion of closure in September 1993. An as-built design report will be submitted to the RWQCB within 3 months of completing closure construction activities, by December 1993.

6.0 DISCUSSION OF ENGINEERED ALTERNATIVE

The Chapter 15 standard design components, performance goals, and proposed engineered alternative for the subject waste management unit are summarized in Table 8. Chapter 15 specifies that an engineered alternative to the construction or prescriptive standards may be used if the standards are not feasible and the alternative is consistent with the performance goals and affords equivalent protection of water quality. The equivalency of the proposed waste management unit design and closure plan to the Chapter 15 requirements is discussed in this section.

Siting criteria for a Class II waste management unit require that the unit be separated from the anticipated high groundwater elevation by 5 feet. The siting criteria also specify that the unit must be underlain and confined laterally by either natural or artificial barriers having permeabilities of less than 1×10^{-6} cm/s. These criteria are intended to prevent vertical and lateral movement of fluid from the waste management unit to waters of the state. To accommodate the volume of soil within the space available at the site, the bottom of the proposed waste management unit will be placed an average of 3 feet above the anticipated high groundwater, and a PVC liner having a maximum permeability of 1×10^{-9} cm/s will underlie the soil. The soil will be placed essentially dry. The PVC liner underlying the unit and the overlying asphalt concrete cover, which contains a hydraulic asphalt concrete layer (1×10^{-7} cm/s permeability), should prevent infiltration into or out of the unit, which will protect waters of the state and meet the intent of the criteria for siting for a Class II waste management unit.

In addition, the siting criteria require that the unit be designed and constructed to withstand inundation or flooding if within a 100-year flood plain, and that it be no closer than 200 feet to a Holocene fault. The proposed waste management unit is not within a 100-year flood plain (Figure 5) and is 5.5 miles from the nearest identified Holocene fault (Figure 10). Chapter 15 indicates that the unit must be located outside areas of rapid geologic change and/or tidal wave influence. The proposed waste management unit is not located in an area of rapid geologic change and is not likely to be affected by rises in elevation of the Bay as a result of tidal waves.

Chapter 15 specifies that a Class II disposal facility must have a 2-foot-thick clay liner compacted to 90 percent relative compaction with a permeability of less than 1×10^{-6} cm/s. Because of the volume of soil requiring placement in the unit and the constraints on the final elevation and grade of the site governed by the planned future use for container storage, a 2-foot-thick clay liner is not feasible. A PVC liner having a maximum permeability of 1×10^{-9} cm/s and a minimum thickness of 40 mils (1/25 inch) will be placed beneath the waste instead of the clay liner. This liner is at least equivalent to a 2-foot-thick layer of soil with a permeability of 1×10^{-6} cm/sec.

In addition, a leachate collection and removal system (LCRS) is required at new Class II disposal facilities. Chapter 15 allows exemption from the LCRS requirement for Class II landfills if the unit contains only dry waste and site conditions indicate that leachate will not form in or migrate from the unit. The materials in the proposed waste management unit will be placed essentially dry, and the asphalt concrete cover together with the PVC liner should prevent formation or migration of leachate. Although significant leachate generation is not anticipated within the unit, a collection point is being completed in the sand layer over the PVC liner at the low point of the liner as a backup system. Fluid will be pumped if a significant amount of moisture is collected. Shallow groundwater in the vicinity of the proposed waste management unit also will be monitored.

Final cover requirements specified by Chapter 15 include a 2-foot-thick foundation layer to provide support for the final cover, a 1-foot-thick clay cover over the foundation layer having a permeability of 1×10^{-6} cm/s to minimize infiltration, and a 1-foot-thick soil layer over the clay cover having a 3 percent slope to prevent ponding. The foundation layer at the proposed waste management unit meets Chapter 15 specifications and will consist of 20 inches of compacted soil and 4 inches of compacted aggregate base. The soil will be compacted to a minimum of 95 percent maximum dry density in accordance with ASTM D-1557. The last lift of the soil and the aggregate base will be compacted to a minimum of 98 percent maximum dry density. Asphalt concrete pavement, consisting of 3 inches of hydraulic asphalt concrete having a permeability of 1×10^{-7} cm/s under 8½ inches of dense-graded asphalt concrete with a 1 percent slope, will be placed over the foundation layer, instead of the clay cover and upper soil layer. The purpose of a clay cover having a permeability less than 1×10^{-6} cm/s is to prevent infiltration into the unit. The 3 percent slope is intended to prevent ponding. The hydraulic asphalt concrete pavement included in the design of the subject waste management unit is designed to achieve a permeability of 1×10^{-7} cm/s. The 3-inch layer of hydraulic asphalt concrete is at least equivalent to a 2.5-foot-thick layer of 1×10^{-6} cm/s permeability soil. The surface of the asphalt concrete cover design is constrained by requirements for use as a container storage area within the Port terminal; the slope may not be greater than 1 percent or deformation and distress of the containers could occur. However, a regular inspection and maintenance program has been proposed to maintain the condition and slope of the asphalt concrete pavement and prevent ponding. These provisions are expected to meet the performance goals of Chapter 15.

In summary, the proposed waste management unit meets most Chapter 15 siting and construction criteria for a new Class II landfill and, where the siting and construction criteria cannot be met, the performance goals of Chapter 15 are met. The proposed design should provide equivalent protection against water quality impairment.

7.0 REFERENCES

Abd-Elfattah, A., and Wada, K., 1981, Adsorption of lead, copper, zinc, cobalt, and cadmium by soils in cation exchange materials, J. Soil Sci., 32(2):271-283.

Brown, K., Thomas, J., and Slowley, J., 1983, The movement of metals applied to soils in sewage effluent, Water Air Soil Pollutant, 19(1):43-54.

California Division of Mines and Geology, 1991, Geologic Map of the San Francisco-San Jose Quadrangle, Sheet 5, Map Showing Recency of Faulting: Compiled by E.J. Bortugno, R.D. McJunkin, and D.L. Wagner.

Chang, A., Page, A., Warneke, J., and Grgurevic, E., 1984, Sequential extraction of soil heavy metals following a sludge application, J. Environ. Qual., 13(1):33-38.

Chang, A., Warneke, J., Page, A., and Lund, L., 1984, Accumulation of heavy metals in sewage sludge treated soils, J. Environ. Qual., 13(1):87-91.

Dunne, T., and Leopold, L.B. (Dunne and Leopold), 1978, Water in Environmental Planning, W.H. Freeman and Company, New York.

Geomatrix Consultants, Inc. (Geomatrix), 1986, Geotechnical Study, Carnation Container Terminal Wharf, Oakland, California, April.

Geomatrix, 1988, Geotechnical Study, Berth 22 Wharf Reconstruction, Oakland, California, June.

Geomatrix, 1992a, Preliminary Soil Sampling Results and Excavation and Stockpiling Plan, Berth 30, Port of Oakland, 22 September.

Geomatrix, 1992b, Supplemental Geotechnical Study, Road and Rail Platform, Seventh Street Terminal Perimeter Dike Repairs, Oakland, California: Report Prepared for the Port of Oakland, April.

Idriss, I.M., 1987, Earthquake Ground Motions, Lecture Notes: Course on Strong Motion, Earthquake Engineering Research Institute, Pasadena, California, 10-11 April, 1987.

Jordan, Woodman, Dobson, 1992, Berth 30, Port of Oakland, Construction Documents, Yard Drawings.

Joyner, W.B., and Boore, D.M., 1988, Measurement, Characterization and Prediction of Strong Ground Motion: Earthquake Engineering and Soil Dynamics II, Recent Advances in Ground-Motion Evaluation, ASCE Geotechnical Special Publication 20, pp. 43-102.

Kaldveer Associates, Inc. (Kaldveer), 1992, Geotechnical Investigation for Berth 30 Terminal Improvements, Port of Oakland, Oakland, California, January.

Korte, N., Fuller, W., Niebla, E., Skopp, G., and Alsei, B., 1976, Trace element migration in soils: Desorption of attenuated ions and effects of solution flux, Residual Management by Land Disposal, EPA-600/9-75-015, U.S. Environmental Protection Agency, Cincinnati.

Levine-Fricke, Inc. (Levine-Fricke), 1991, Phase I Environmental Site Assessment, Carnation Terminal Redevelopment Project, Port of Oakland, Oakland, California, 3 December.

Levine-Fricke, 1992, Results of Phase II Investigation of Soils and Ground Water at the Berth 30 Redevelopment Project Site, Port of Oakland, Oakland, California, 8 June.

National Oceanic and Atmospheric Administration (NOAA), 1982, Climatology of the United States No. 81, Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1951-1980.

NOAA, 1989, United States Tsunamis, 1960-1988, Publication 41-2, 265 p.

NOAA, 1993a, Annual Climatological Summary, Oakland Museum, Oakland, California, 1970-1991.

NOAA, 1993b, Monthly Precipitation Summaries for Oakland, California, January to December 1992.

Rantz, S.E., 1971, Mean Annual Precipitation and Precipitation Depth-Duration-Frequency Data for the San Francisco Bay Region, California, U.S. Geological Survey, Basic Data Contribution 32.

Sadigh, K., Egan, J.A., and Youngs, R.R., 1986, Specification of Ground Motion for Seismic Design for Long Period Structures: Earthquake Notes, v. 57, n. 1, 13 p.

San Francisco Bay Area Rapid Transit District (BART), 1966, Trans Bay Line Oakland Approach, Logs of Borings, Location and Classification Chart, Contract Package 1B0021-B002, pages 5-9, 7 November.

Shacklette, H.T., and Boerngen, J.G. (Shacklette and Boerngen), 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270.

U.S. Department of Commerce, 1965, Local Climatological Data, Annual Summary With Comparative Data, Oakland, California, Environmental Sciences Services Administration.

U.S. Department of Commerce, 1966, Local Climatological Data, Annual Summary With Comparative Data, Oakland, California, Environmental Sciences Services Administration.

U.S. Geological Survey, 1929

Wiegel, R.L., 1970, Tsunamis, Earthquake Engineering, Prentice-Hall, Englewood Cliffs, N.J., Chapter 11, pp. 253-306.

Williams, D., Vlamis, J., Pukiter, A., and Coprey, J., 1980, Trace element accumulation, movement, and distribution in the soil profile from massive application of sewage sludge, Soil Sci., 129(2):119-132.

Wilson, B.W., and Torum, A., 1968, The Tsunami of the Alaskan Earthquake, 1964, Engineering Evaluation, Technical Memorandum No. 25, U.S. Corps of Engineers, Coastal Engineering Research Center.

Woodward-Clyde Consultants (WCC), 1990, Draft Report, Geotechnical Engineering Study, 7th Street Realignment and Carnation Terminal Yard, Port of Oakland, Oakland, California, October.

TABLE 1

WELL INFORMATION
Berth 30
Port of Oakland
Oakland, California

Location on Figure 2	No. of Wells	Owner	Location	Use	Depth (ft)
1	3	Mobil Oil	Petroleum St. & Ferry St.	Monitoring	16
				Monitoring	16
				Monitoring	16
2	6	Southern Pacific Pipelines Co.	7th St. & Maritime St.	Cathodic Protection	300
		Southern Pacific Transportation Co.	7th St. & Maritime St.	Monitoring	17
				Monitoring	24
				Monitoring	24
				Monitoring	20
				Monitoring	20
3	1	U.S. Navy	Naval Supply Center	Monitoring	37
4	1	Southern Pacific Pipelines Co.	Maritime St. & 8th St. Subway	Cathodic Protection	300
5	3	Port of Oakland	Petroleum St. & Ferry St.	Monitoring	22
				Monitoring	22
				Monitoring	21
6	1	BART	Alber's Mill	Monitoring	79
7	5	Matson Terminals Inc.	3050 7th St.	Monitoring	15
				Monitoring	15
				Monitoring	15
				Monitoring	14
				Monitoring	15
8	1	U.S. Navy	Naval Supply Center	Monitoring	98

Note:

1. Based on information from Alameda County Bay Plain Groundwater Study - Well Inventory Report from Alameda County Public Works Agency, 1993.

TABLE 2

RUNOFF RATE FOR PROPOSED WASTE MANAGEMENT UNIT

Berth 30
Port of Oakland
Oakland, California

Design Storm: 1,000-Year Event, 24-Hour Duration	
C	0.98
I (in/hr)	0.25
A (acres)	2.37
Q_{pk} (cfs)	0.58

Notes:

1. Q_{pk} = CIA where:
   - Q_{pk} = Peak runoff in cubic feet per second (cfs)
   - C = Rational runoff coefficient
   - I = Rainfall intensity in inches per hour (in/hr)
   - A = Drainage area (acres)

2. Q_{pk} calculated using the Rational Method, Dunne & Leopold, 1978.

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES
Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
2	2-2	6.3	0.1	2	4	98	0.1	0.3	24	8	41	98	0.9	ND	28	ND	ND	8	26	120
	2-8	5.4	ND	3	8	110	0.1	0.3	22	7	50	110	1.5	ND	30	ND	ND	7	26	170
	2-9	6.8	ND	2	4	100	0.1	0.3	24	7	48	130	1.0	1	27	ND	ND	6	26	130
	2-16	5.9	ND	5	5	120	0.1	0.4	24	11	41	130	1.4	ND	32	ND	ND	8	31	140
	2-17	8.0	ND	2	5	120	0.1	0.4	26	8	45	210	0.8	ND	31	ND	ND	7	30	130
	2-21	4.4	ND	3	6	93	ND	0.3	23	9	49	91	0.8	ND	31	ND	ND	7	26	150
	2-24	9.9	ND	2	5	83	0.1	0.4	21	7	110	96	1.4	ND	27	ND	ND	6	24	120
	2-26	4.1	0.1	2	7	87	0.1	0.5	25	7	41	110	1.8	ND	31	ND	ND	6	26	140
	2-29	4.7	ND	3	5	86	0.2	0.5	26	8	47	110	1.0	ND	30	ND	ND	9	27	130
	2-34	7.7	ND	4	7	85	0.1	0.3	23	8	42	110	1.2	ND	30	ND	ND	7	25	130
3	3-1	6.5	ND	2	6	85	0.2	0.2	23	7	71	100	1.4	ND	26	ND	ND	8	27	130
	3-13	4.9	ND	2	6	78	0.2	0.2	24	7	53	79	1.8	ND	30	ND	ND	8	28	110
	3-16	4.5	0.1	2	8	73	0.2	0.4	22	7	66	76	2.4	ND	28	ND	ND	9	27	120
	3-21	6.8	0.1	2	4	72	0.3	0.2	21	7	35	65	2.4	ND	27	ND	ND	8	24	100
	3-26	5.0	ND	2	6	100	0.2	0.2	25	8	240	75	1.7	ND	34	ND	ND	8	29	110
	3-27	6.6	ND	3	6	91	0.2	0.3	22	7	37	84	1.1	ND	28	ND	ND	5	26	130
	3-29	5.7	ND	3	6	88	0.1	0.4	27	8	64	90	1.2	ND	35	ND	ND	9	28	130
	3-30	9.6	ND	2	4	81	0.2	0.3	22	7	100	97	1.8	ND	26	ND	ND	6	27	140

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
3	3-35	7.5	ND	2	5	120	0.2	0.3	21	6	69	97	1.2	ND	27	ND	ND	7	25	120
	3-36	7.4	ND	3	5	98	0.2	0.5	22	7	35	87	1.1	ND	29	ND	ND	8	27	130
4	4-1	6.2	ND	2	5	95	ND	0.2	25	7	43	81	1.5	ND	32	1	ND	5	26	120
	4-4	3.6	ND	2	4	92	ND	0.2	23	8	54	57	0.6	ND	32	ND	ND	7	33	110
	4-9	8.9	ND	2	8	110	ND	0.6	25	8	47	160	0.5	ND	30	ND	ND	10	28	160
	4-11	4.6	ND	3	7	110	ND	0.4	31	8	55	160	0.3	ND	32	ND	ND	9	29	160
	4-14	21	ND	3	6	110	ND	0.4	29	9	68	110	0.6	ND	36	ND	ND	11	32	140
	4-15	5.6	ND	2	5	94	ND	0.3	21	8	58	88	1.5	ND	25	ND	ND	9	30	120
	4-21	32	ND	2	5	93	ND	0.4	22	8	51	100	0.9	ND	28	ND	ND	11	28	130
	4-22	43	ND	3	6	130	0.1	0.4	28	7	41	100	0.9	ND	29	ND	ND	10	30	150
	4-24	5.5	ND	2	5	94	ND	0.4	26	7	38	91	0.5	ND	33	ND	ND	11	26	140
	4-27	4.1	ND	2	3	84	ND	0.2	27	7	32	70	0.7	ND	29	ND	ND	9	25	110
5	5-5	9.4	ND	3	8	110	ND	0.3	24	8	51	150	0.5	ND	31	ND	ND	5	29	180
	5-10	8.6	ND	3	6	110	ND	0.2	25	7	76	140	1.1	ND	29	ND	ND	2	26	180
	5-11	11	ND	3	5	100	ND	0.2	23	7	46	100	0.7	ND	29	ND	ND	4	26	140
	5-17	5.9	ND	2	6	83	ND	0.2	26	7	110	160	1.2	ND	27	ND	ND	4	26	120
	5-19	1.4	ND	2	5	61	ND	0.2	32	10	34	32	0.1	ND	29	ND	ND	6	23	84
	5-25	4.9	ND	2	3	74	ND	ND	27	6	29	210	1.1	ND	27	ND	ND	2	22	100
	5-26	2.7	ND	1	5	63	ND	ND	27	8	24	41	0.3	ND	29	ND	ND	4	26	66

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
5	5-39	5.9	ND	2	2	92	ND	ND	25	8	43	110	0.6	ND	27	ND	ND	4	30	130
	5-44	10	ND	3	8	110	ND	0.3	26	8	39	170	0.4	ND	33	ND	ND	4	29	150
	5-49	12	ND	3	8	75	ND	0.2	21	9	53	120	1.1	ND	28	ND	ND	5	25	130
7	7-6	3.8	ND	2	5	95	0.1	0.2	28	8	44	67	0.4	ND	41	ND	ND	6	33	140
	7-7	5.8	ND	3	8	120	0.2	0.3	40	10	58	95	0.5	ND	62	ND	ND	9	36	130
	7-15	5.3	ND	3	8	110	0.1	0.2	34	9	42	81	0.3	ND	44	ND	ND	6	31	130
	7-16	8.5	ND	2	5	110	0.1	0.3	27	8	39	76	0.3	ND	38	ND	ND	7	29	120
	7-17	5.2	ND	2	4	110	0.1	0.5	29	8	45	86	0.4	ND	39	ND	ND	8	30	160
	7-18	5.2	ND	3	9	100	0.1	ND	50	12	93	86	0.4	ND	100	ND	ND	7	33	95
	7-33	3.4	ND	3	7	100	0.1	0.6	37	9	38	60	0.4	3	49	ND	ND	6	31	95
	7-34	5.0	ND	3	6	110	0.1	0.3	29	9	40	120	0.7	ND	40	ND	ND	8	32	120
	7-39	7.1	ND	2	6	110	0.1	0.2	27	8	65	120	0.8	ND	37	ND	ND	7	29	170
	7-40	9.6	ND	3	6	110	0.1	0.3	33	9	61	230	0.6	ND	48	ND	ND	9	32	140
8	8-2	7.4	ND	1	6	90	ND	0.2	21	6	36	67	0.5	ND	30	ND	ND	10	26	90
	8-6	7.0	ND	3	8	85	0.1	0.3	25	8	49	76	0.7	ND	31	ND	ND	10	28	110
	8-12	6.9	ND	2	7	88	ND	0.3	22	8	41	81	0.5	ND	32	ND	ND	11	27	110
	8-29	3.1	ND	2	8	74	ND	ND	28	8	24	24	0.3	ND	56	ND	ND	9	28	58
	8-31	7.5	ND	3	13	120	ND	0.3	34	9	33	70	0.4	ND	46	ND	ND	13	31	96
	8-34	7.1	ND	3	5	88	ND	0.2	24	7	53	94	1.6	ND	29	ND	ND	7	26	120

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
8	8-35	5.5	ND	2	11	85	ND	0.3	29	9	44	86	0.3	ND	45	ND	ND	13	29	110
	8-37	5.3	ND	3	2	100	0.1	0.3	26	10	36	75	0.3	1	82	ND	ND	12	32	120
	8-44	7.9	ND	2	3	110	ND	0.2	41	11	28	58	0.4	ND	53	ND	ND	8	25	95
	8-47	7.6	ND	2	8	88	ND	0.2	23	7	34	93	0.6	ND	33	ND	ND	9	25	110
9	9-1	8.2	ND	2	3	120	ND	0.4	21	8	62	79	0.1	ND	38	1	ND	5	19	120
	9-2	15	ND	3	10	110	0.2	0.3	30	9	60	150	0.3	ND	40	ND	ND	9	28	150
	9-4	9.2	ND	5	5	100	0.2	0.5	30	9	51	110	0.3	ND	38	2	ND	8	26	160
	9-10	5.4	ND	2	5	98	0.2	0.6	44	11	37	84	0.3	ND	72	ND	ND	7	31	130
	9-12	7.2	ND	3	15	100	0.3	0.5	29	9	64	120	0.2	ND	36	ND	ND	8	31	190
	9-14	14	ND	3	12	100	0.2	0.2	21	9	46	99	0.4	ND	27	ND	ND	7	36	130
	9-22	5	ND	3	8	180	0.2	0.7	62	14	50	110	0.3	ND	100	ND	ND	9	36	160
	9-27	9.4	0.3	3	7	120	0.2	0.5	33	9	47	110	0.7	ND	46	3	ND	8	30	150
	9-30	5.4	ND	7	17	89	0.1	1.4	26	9	42	110	1.3	3	38	8	ND	18	30	130
	9-31	8.5	ND	5	15	110	0.2	0.5	29	10	70	120	0.8	ND	42	2	ND	26	32	130
10	10-4	5.2	ND	3	7	71	0.2	0.4	25	7	120	86	0.3	ND	32	ND	ND	11	25	140
	10-7	5.7	ND	3	9	100	0.2	0.4	22	9	83	100	0.2	ND	28	ND	ND	10	25	130
	10-11	6	ND	3	8	76	0.2	0.3	27	7	95	94	0.2	ND	31	ND	ND	9	25	240
	10-12	3.7	ND	2	7	130	0.3	0.4	23	8	99	100	0.3	ND	29	2	ND	16	29	180
	10-13	7.1	ND	3	8	130	0.4	0.6	33	9	120	140	0.3	ND	36	ND	ND	15	36	190

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
10	10-15	3.7	ND	2	16	73	0.2	1.3	23	9	130	110	0.3	ND	33	ND	ND	15	25	1300
	10-19	11	ND	3	7	100	0.2	0.6	29	8	67	130	0.3	ND	37	ND	ND	8	28	130
	10-24	5.6	ND	2	10	91	0.2	0.6	23	7	55	95	0.3	ND	32	ND	ND	11	25	350
	10-29	16	ND	3	8	85	0.2	0.5	25	8	46	120	0.4	ND	32	ND	ND	11	29	130
	10-48	6.8	ND	2	7	78	0.2	0.3	21	6	58	120	0.7	ND	27	ND	ND	9	25	120
11	11-2	11	ND	4	1	100	0.2	0.4	20	8	120	150	0.4	1	32	ND	ND	3	29	210
	11-12	5	ND	3	6	83	0.2	0.4	22	8	120	180	0.2	1	35	ND	ND	4	24	180
	11-19	7.3	ND	2	5	88	0.2	0.3	24	7	65	110	0.3	ND	28	ND	ND	ND	26	150
	11-27	5.3	ND	2	5	80	0.2	0.4	28	9	52	73	0.2	ND	37	ND	ND	4	28	110
	11-28	2.9	ND	2	6	97	0.3	0.2	42	10	40	70	0.2	ND	56	ND	ND	4	35	120
	11-30	4.7	ND	2	5	91	0.2	0.4	27	8	45	86	0.3	ND	35	ND	ND	3	27	170
	11-31	4.9	ND	3	5	120	0.3	0.6	31	9	51	100	0.3	1	50	ND	ND	3	34	140
	11-32	6.5	ND	7	12	110	0.2	0.6	32	11	120	190	0.2	6	43	ND	ND	14	26	210
	11-34	6.2	ND	3	6	97	0.3	0.3	24	8	54	290	ND	ND	38	ND	ND	3	29	120
	11-43	4.9	ND	3	6	110	0.3	0.3	35	10	46	80	0.3	1	60	ND	ND	2	37	120
14	14-6	7.4	ND	2	4	85	0.2	0.5	26	9	100	71	0.5	ND	36	ND	ND	ND	27	140
	14-19	2.6	ND	3	3	180	0.2	0.3	33	8	61	70	0.4	ND	37	ND	ND	ND	28	170
	14-20	3.9	ND	2	4	94	0.2	0.3	35	8	43	59	1.1	ND	34	ND	ND	ND	26	98
	14-21	2.7	ND	3	6	140	0.4	0.3	24	9	44	59	1.9	ND	45	1	ND	ND	27	120

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
14	14-24	2.5	0.3	2	5	69	0.2	0.3	19	8	110	57	1.1	ND	27	ND	ND	ND	23	130
	14-28	4.7	ND	2	4	75	0.2	0.3	23	7	130	67	1.2	ND	28	ND	ND	ND	24	170
	14-30	4.6	0.4	2	5	75	0.2	0.3	24	8	74	72	1.3	ND	34	ND	ND	ND	26	120
	14-37	6.6	ND	2	4	51	0.2	0.2	26	7	78	76	1.6	ND	30	ND	ND	ND	20	110
	14-39	9.4	0.3	2	4	68	0.2	0.3	20	7	94	67	0.4	ND	30	ND	ND	ND	22	140
	14-40	4.1	ND	2	5	62	0.2	0.3	22	8	81	57	1.7	ND	32	ND	ND	ND	24	170
16	16-1	8.1	ND	2	6	74	0.1	0.3	23	7	55	81	0.5	ND	27	ND	ND	ND	22	150
	16-3	3.1	ND	2	6	55	0.1	0.3	30	8	37	50	0.4	ND	38	ND	ND	ND	25	90
	16-5	6.5	ND	3	6	74	0.1	0.4	23	8	53	92	0.6	ND	28	1	ND	ND	25	130
	16-15	4.4	ND	2	8	64	0.1	0.3	17	6	77	65	0.4	ND	23	ND	ND	ND	17	110
	16-16	2.0	ND	2	5	57	0.2	0.3	25	8	95	60	1.2	ND	32	ND	ND	ND	26	120
	16-18	5.8	ND	3	6	82	0.1	0.4	25	9	58	100	0.6	ND	37	ND	ND	ND	26	130
	16-26	4.4	ND	3	5	63	0.3	0.4	21	8	86	130	1.1	ND	29	ND	ND	ND	25	160
	16-27	3.7	ND	2	4	62	0.2	0.4	21	8	73	88	2.6	ND	28	ND	ND	ND	23	130
	16-33	4.6	ND	4	9	61	ND	0.5	16	9	75	100	0.4	ND	26	ND	ND	ND	23	200
	16-42	6.1	ND	3	5	81	0.1	0.3	23	7	69	120	0.9	ND	27	ND	ND	ND	25	140
17	17-2	4.7	ND	3	10	71	0.1	0.2	33	12	85	81	0.7	ND	40	ND	ND	ND	44	130
	17-7	6.5	ND	2	6	89	0.2	0.3	28	8	78	110	0.3	ND	32	ND	ND	ND	29	170
	17-11	7.8	ND	2	5	87	0.2	0.3	29	10	65	100	0.3	ND	36	ND	ND	ND	30	140

TABLE 3

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
17	17-12	8.1	ND	2	5	79	0.1	0.3	20	8	66	120	0.4	ND	28	ND	ND	ND	24	150
	17-13	7.9	ND	2	5	80	0.1	0.2	23	7	66	110	0.5	ND	28	ND	ND	ND	24	150
	17-21	5.1	ND	2	6	76	0.1	0.3	26	8	91	92	1.1	ND	32	ND	ND	ND	28	170
	17-23	4.8	0.2	2	6	58	0.1	0.2	24	8	75	72	0.7	ND	31	ND	ND	ND	23	130
	17-30	2.7	ND	3	6	72	0.2	0.6	26	8	60	90	0.7	ND	33	ND	ND	ND	25	140
	17-32	5.2	ND	2	5	75	0.1	0.3	24	8	69	110	0.9	ND	29	ND	ND	ND	25	140
	17-36	2.5	ND	3	5	64	0.1	0.4	24	7	130	65	1.8	ND	30	ND	ND	ND	24	120

Notes:

1. Samples collected by Geomatrix Consultants, Inc., and analyzed by Clayton Environmental Consultants of Pleasanton, California.
2. Analyses performed in accordance with U.S. Environmental Protection Agency (EPA) Methods 6010 and 7471 for total metals and the Waste Extraction Test (WET) and EPA Method 1311 (TCLP) followed by EPA Method 6010 for soluble lead.
3. WET - Waste Extraction Test
   TCLP - Toxic Characteristic Leaching Procedure
   Sb - Antimony
   As - Arsenic
   Ba - Barium
   Be - Beryllium
   Cd - Cadmium
   Cr - Chromium
   Co - Cobalt
   Cu - Copper
   Pb - Lead
   Hg - Mercury
   Mo - Molybdenum
   Ni - Nickel
   Se - Selenium
   Ag - Silver
   Tl - Thallium
   V - Vanadium
   Zn - Zinc
   ND - Not detected
4. Samples 2-2, 3-27, 4-22, 5-10, 7-18, 8-34, 9-1, 10-29, 11-2, 14-19, 16-1, and 17-11 also analyzed for reactivity, corrosivity, and ignitability. Results indicate soil is not reactive (reactive cyanide not detected, and sulfide ranged from not detected to 30 ppm), corrosive (pH ranged from 8.5 to 11.1), or ignitable.
5. Samples 3-16, 3-21, and 16-27 also analyzed for soluble mercury by the WET followed by EPA Method 7471. Soil samples contained no soluble mercury above the detection limit of 0.01 mg/l.
6. The replicate analysis for 11-2 had a concentration of 720 mg/kg. An additional 5 replicate analyses indicated concentrations ranging from 78 to 110 mg/kg.

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES
Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
2	2-17	--		--		4,4'-DDE	0.06
						4,4'-DDD	0.16
						4,4'-DDT	0.29
	2-29	ND		ND		--	
	2-34	ND		Acenaphthene	2	--	
				Dibenzofuran	1		
				Fluorene	2		
				Phenanthrene	5		
				Anthracene	1		
				Fluoranthene	3		
				Pyrene	2		
3	3-13	Ethylbenzene	0.009	Naphthalene	8	--	
		Total Xylenes	0.018	2-methyl naphthalene	2		
		Acetone	0.03	Acenaphthene	3		
				Dibenzofuran	2		
				Fluorene	3		
				Phenanthrene	8		
				Anthracene	2		
				Fluoranthene	3		
				Pyrene	2		
	3-29	--		--		4,4'-DDE	0.07
						4,4'-DDD	0.12
						4,4'-DDT	0.22

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
3	3-36	1,2-DCA	0.008	Naphthalene	3	--	
		Ethylbenzene	0.006	Acenaphthene	2		
		Total Xylenes	0.007	Phenanthrene	3		
				Fluoranthene	2		
				Pyrene	2		
4	4-15	ND		Naphthalene	2.0	--	
				2-methyl naphthalene	0.7		
				Acenaphthene	1.4		
				Dibenzofuran	0.7		
				Fluorene	1.2		
				Phenanthrene	2.9		
				Anthracene	0.8		
				Fluoranthene	1.7		
				Pyrene	1.8		
				Benzo(a)anthracene	0.3		
				Chrysene	0.4		
				Benzo(b)fluoranthene	0.8		
				Benzo(k)fluoranthene	0.2		
				Benzo(a)pyrene	0.3		
				Indeno(1,2,3-cd)pyrene	0.2		
				Benzo(ghi)perylene	0.3		
	4-24	--		--		4,4'-DDE	0.22
						4,4'-DDD	0.17
						4,4'-DDT	0.44

TABLE 4

EPA METHODS 8240, 8270, AND 8080 ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
4	4-27	ND	Naphthalene	1.0	--	
			2-methyl naphthalene	0.3		
			Acenaphthene	0.6		
			Dibenzofuran	0.3		
			Fluorene	0.6		
			Phenanthrene	1.9		
			Anthracene	0.7		
			Fluoranthene	2.0		
			Pyrene	1.7		
			Benzo(a)anthracene	0.5		
			Chrysene	0.5		
			Benzo(b)fluoranthene	0.7		
			Benzo(k)fluoranthene	0.2		
			Benzo(a)pyrene	0.3		
5	5-25	--	--		4,4'-DDE	0.19
					4,4'-DDD	0.08
					4,4'-DDT	0.11
	5-26	ND	Naphthalene	0.6	--	
			Acenaphthene	0.3		
			Fluorene	0.3		
			Phenanthrene	0.8		
			Anthracene	0.2		
			Fluoranthene	0.5		
			Pyrene	0.4		
			Benzo(b)fluoranthene	0.2		
	5-44	ND	ND		--	
7	7-6	ND	ND		--	

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
7	7-15	ND	ND		--	
	7-39	--	--		4,4'-DDE	0.07
					4,4'-DDD	0.15
					4,4'-DDT	0.26
8	8-31	--	--		4-4'-DDE	0.02
					4,4'-DDD	0.05
					4,4'-DDT	0.08
	8-34	ND	Naphthalene	4	--	
			Acenaphthene	4		
			Dibenzofuran	2		
			Fluorene	3		
			Phenanthrene	8		
			Anthracene	2		
			Fluoranthene	3		
			Pyrene	2		
	8-47	ND	Phenanthrene	2	--	

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
9	9-2	ND	Naphthalene	0.5	--	
			Acenaphthene	0.6		
			Fluorene	0.5		
			Phenanthrene	1.5		
			Anthracene	0.3		
			Fluoranthene	0.8		
			Pyrene	0.6		
			Benzo(a)anthracene	0.2		
			Chrysene	0.2		
			Benzo(b)fluoranthene	0.4		
			Benzo(a)pyrene	0.2		
	9-12	--	--		4,4'-DDE	0.05
					4,4'-DDD	0.13
					4,4'-DDT	0.14
	9-14	ND	Naphthalene	0.4	--	
			Acenaphthene	0.2		
			Fluorene	0.2		
			Phenanthrene	0.6		
			Fluoranthene	0.5		
			Pyrene	0.4		
			Chrysene	0.2		
			Benzo(b)fluoranthene	0.4		
			Benzo(k)fluoranthene	0.2		
			Benzo(a)pyrene	0.3		
10	10-4	--	--		4,4'-DDE	<0.003
					4-4'-DDD	0.06
					4-4'-DDT	0.08

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds
10	10-13	Ethylbenzene	0.016	Naphthalene	6	--
		Total Xylenes	0.027	2-methyl naphthalene	1	
				Acenaphthene	4	
				Dibenzofuran	2	
				Fluorene	3	
				Phenanthrene	9	
				Anthracene	2	
				Fluoranthene	3	
				Pyrene	2	
	10-19	Total Xylenes	0.006	Naphthalene	2	--
				Acenaphthene	1	
				Fluorene	1	
				Phenanthrene	3	
				Fluoranthene	1	
				Pyrene	1	

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds
11	11-12	Ethylbenzene	0.007	Naphthalene	2.1	--
		Total Xylenes	0.013	2-methyl naphthalene	0.6	
				Acenaphthene	1.5	
				Dibenzofuran	0.6	
				Fluorene	1.2	
				Phenanthrene	3.2	
				Anthracene	1.0	
				Fluoranthene	1.8	
				Pyrene	1.4	
				Benzo(a)anthracene	0.5	
				Chrysene	0.5	
				Benzo(b)fluoranthene	0.6	
				Benzo(k)fluoranthene	0.3	
				Benzo(a)pyrene	0.4	
	11-32	ND		Naphthalene	1.5	--
				2-methyl naphthalene	0.3	
				Acenaphthene	0.8	
				Dibenzofuran	0.4	
				Fluorene	0.7	
				Phenanthrene	2.4	
				Anthracene	0.6	
				Fluoranthene	1.3	
				Pyrene	1.0	
				Benzo(a)anthracene	0.4	
				Chrysene	0.4	
				Benzo(b)fluoranthene	0.4	
				Benzo(k)fluoranthene	0.2	
				Benzo(a)pyrene	0.3	

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
11	11-34	--		--		4,4'-DDE	0.031
						4,4'-DDD	0.040
						4,4'-DDT	0.19
14	14-6	Toluene	0.007	Naphthalene	3.6	--	
		Ethylbenzene	0.017	2-methyl naphthalene	1.0		
		Total Xylenes	0.035	Acenaphthene	1.2		
				Dibenzofuran	0.8		
				Fluorene	1.0		
				Phenanthrene	2.8		
				Anthracene	0.6		
				Fluoranthene	1.2		
				Pyrene	1.2		
				Benzo(a)anthracene	0.3		
				Chrysene	0.3		
				Benzo(b)fluoranthene	0.3		
				Benzo(k)fluoranthene	0.4		
	14-20	--		--		4,4'-DDE	0.020
						4,4'-DDD	0.026
						4,4'-DDT	0.072

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
14	14-24	Toluene	0.012	Naphthalene	9.8	--	
		Ethylbenzene	0.032	2-methyl naphthalene	3.2		
		Total Xylenes	0.065	Acenaphthene	4.0		
				Dibenzofuran	2.9		
				Fluorene	3.4		
				Phenanthrene	10		
				Anthracene	2.3		
				Fluoranthene	2.8		
				Pyrene	2.8		
				Benzo(a)anthracene	0.5		
				Chrysene	0.5		
				Benzo(b)fluoranthene	0.3		
				Benzo(k)fluoranthene	0.3		
				Benzo(a)pyrene	0.3		
16	16-15	Toluene	0.005	Naphthalene	4	--	
		Ethylbenzene	0.019	Phenanthrene	4		
		Total Xylenes	0.036				
	16-16	Ethylbenzene	0.019	Naphthalene	6	--	
		Total Xylenes	0.028	Acenaphthene	2		
				Phenanthrene	4		
	16-26	--		--		4,4'-DDE	0.05
						4,4'-DDD	0.11
						4,4'-DDT	0.36
17	17-7	Ethylbenzene	0.007	Fluoranthene	2	--	
		Total Xylenes	0.016	Naphthalene	4		
				Phenanthrene	4		

TABLE 4

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
17	17-23	ND	Naphthalene	3	--	
			Phenanthrene	2		
	17-32	--	--		4,4'-DDE	0.045
					4,4'-DDD	0.095
					4,4'-DDT	0.20

Notes:

1. Samples collected by Geomatrix Consultants, Inc., and analyzed by Clayton Environmental Consultants of Pleasanton, California in accordance with the analytical methods indicated. Two samples from each stockpile were analyzed by EPA Methods 8240 and 8270, and one sample from each stockpile was analyzed by EPA Method 8080.
2. -- = not analyzed
   ND = not detected
   1,2-DCA = 1,2-dichloroethane

TABLE 5

SUMMARY OF METALS CONCENTRATIONS, BACKGROUND CONCENTRATIONS, AND REGULATORY CRITERIA

Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/kg)

Metal	Range	Mean[1]	Background[2]	TTLC[3]	10 x STLC[3]
Antimony	1-7	2.6	<1-10	500	150
Arsenic	1-17	6.3	6.5-65	500	50
Barium	51-180	92.7	500-3000	10000	1000
Beryllium	<0.1-0.4	0.1	<1	75	7.5
Cadmium	<0.1-1.4	0.4	--	100	10
Chromium	16-62	26.5	100-1000	2500	5600
Cobalt	6-14	8.2	15-70	8000	800
Copper	24-240	63.1	30-500	2500	250
Lead	24-290	100.4	30-300	1000	50
Mercury	<0.1-2.6	0.8	0.082-1.3	20	2
Molybdenum	<1-6	0.6	<3	3500	3500
Nickel	25-100	35.6	30-300	2000	200
Selenium	<1-8	0.2	<0.1-0.5	100	10
Silver	<0.5	--	--	500	50
Thallium	<1-26	6.1	--	700	70
Vanadium	17-44	27.5	150-500	2400	240
Zinc	58-1300	146.5	120-400	5000	2500

Notes:

[1] Mean concentrations calculated using half the detection limit for samples reported as non-detect.

[2] Shacklette, H.T., and Boerngen, J.G., 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270.

[3] TTLC = Total Threshold Limit Concentration and STLC = Soluble Threshold Limit Concentration, California Code of Regulations, Title 22, Section 66261.24.

TABLE 6

ESTIMATED COSTS FOR CLOSURE AND POST-CLOSURE

Page 1 of 1

Berth 30
Port of Oakland
Oakland, California

Description		Cost x 1000
Unit Closure		
Design		$ 100
Construction	- Excavation and Perimeter Berm Construction/Grading	30
	- Installation of PVC Liner	62
	- Waste Placement and Compaction	100
	- Construction of Hydraulic Asphalt Concrete	121
	- Well Installation	16
	Total:	$ 429
Post-Closure (Annual)		
Groundwater Monitoring Program		16
Data Evaluation and Reporting		
Monitoring of Asphalt Concrete Pavement		2
Surveying, Inspections, Reporting		
	Total Annual:	$ 18

TABLE 7

PROPOSED CLOSURE SCHEDULE
Berth 30
Port of Oakland
Oakland, California

Description	Date
Construct Unit, Place Waste and Construct Final Cover	1 August - 15 August 1993
Install Monitoring Wells	September 1993
Initiate Post-Closure Monitoring	September 1993
Submit As-built Design Report	December 1993

TABLE 8

COMPARISON OF ENGINEERED ALTERNATIVE TO CHAPTER 15 REQUIREMENTS

Berth 30
Port of Oakland
Oakland, California

Chapter 15 Standard Design Component	Performance Goal	Proposed Design
Siting Criteria		
- Waste to be a minimum of 5 feet above highest anticipated underlying groundwater	Provide substantial isolation from groundwater	Waste to be placed on top of synthetic liner, an average of 3 feet above highest estimated elevation of underlying groundwater
- Unit to be immediately underlain by natural geologic materials that have maximum permeability of $1x10^{-6}$ cm/s and are of sufficient thickness, or a clay liner having a permeability of less than $1x10^{-6}$ cm/s	Prevent vertical movement of fluid	40-mil PVC liner having permeability of $1x10^{-9}$ cm/s to be placed beneath waste
- Subsurface barriers (natural or artificial)	Prevent lateral movement of fluid	40-mil PVC liner having permeability of $1x10^{-9}$ cm/s to be placed on side slopes of unit
- Design and construction appropriate for location if within a 100-year flood plain	Prevent of inundation or washout	Unit outside of 100-year flood plain
- Unit shall have a 200-foot setback from any known Holocene fault	Prevent of ground rupture	Unit 5.5 miles from nearest Holocene fault
- Design and construction appropriate for location if within area subject to tidal waves	Prevent inundation or washout	Unit higher than potential wave elevation
- Design and construction appropriate for location if within area of rapid geologic change	Prevent failure of unit	Unit outside area of rapid geologic change

TABLE 8

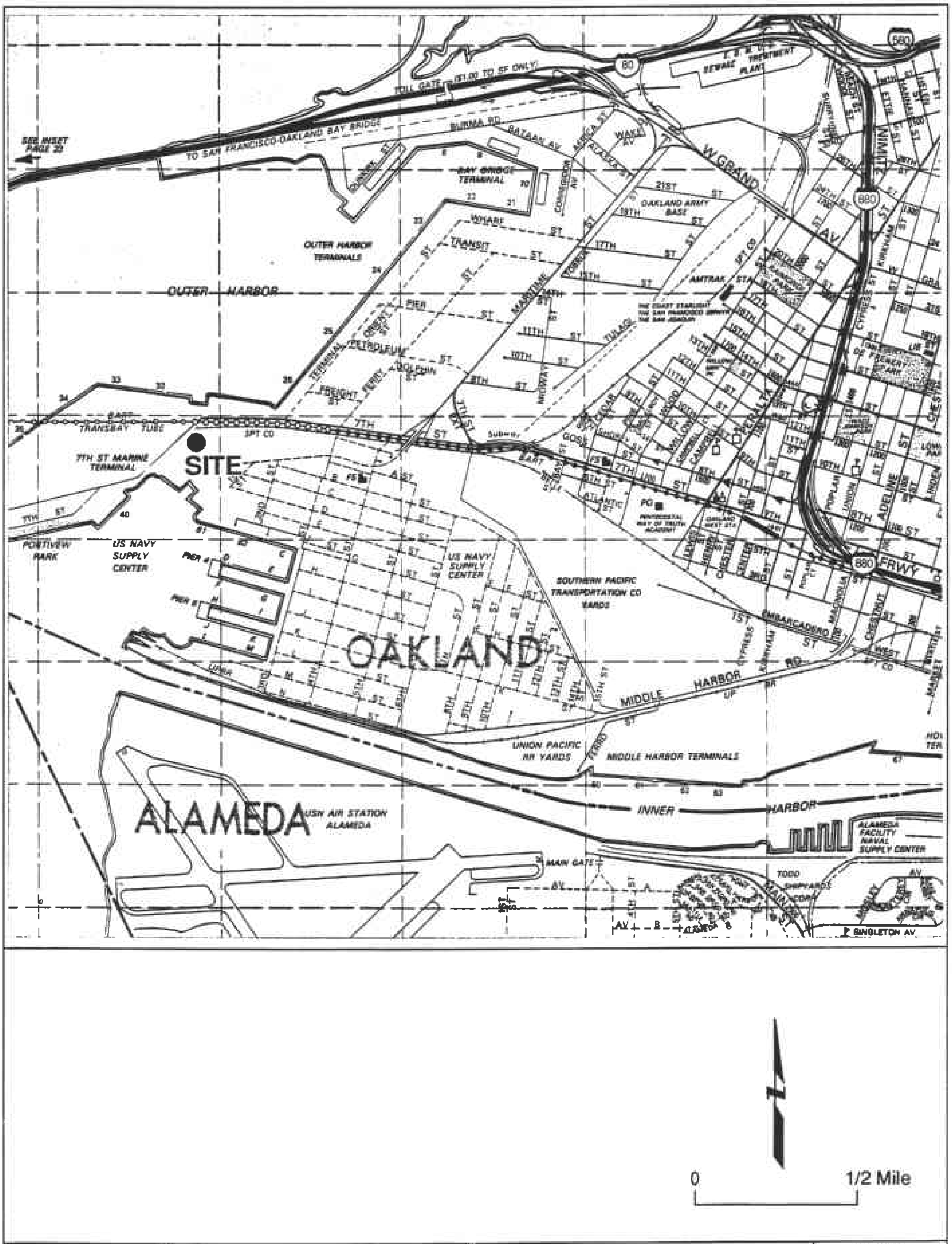
COMPARISON OF ENGINEERED ALTERNATIVE TO CHAPTER 15 REQUIREMENTS

Chapter 15 Standard Design Component	Performance Goal	Proposed Design
Liner		
- 2-foot-thick clay liner at 90% relative compaction with permeability of less than 1x10^{-6} cm/s	Prevent vertical movement of fluid	40-mil PVC liner with permeability of 1x10^{-9} cm/s will be installed beneath waste
- Leachate collection and removal system (LCRS) - LCRS not required if wastes are placed dry and site conditions indicate leachate will not be formed	Collect and remove leachate along sides and bottom of unit	No LCRS will be installed. Asphalt-concrete, including hydraulic asphalt-concrete pavement layer will be placed over waste to prevent infiltration; site will be sloped to 1% to prevent ponding. Cover will be inspected and maintained as necessary to prevent ponding and infiltration. No leachate should form. Provision for collection of any moisture buildup within the unit is provided by installation of collection well completed within sand layer over liner.
Seismic Design		
- Withstand maximum credible earthquake without damage to structures; control leachate, surface drainage, erosion, or gas.	Prevent migration from unit	No earthquake source within 5 miles of unit. Unit constructed using flexible components; unit should not fail in response to ground shaking or liquefaction.

TABLE 8

COMPARISON OF ENGINEERED ALTERNATIVE TO CHAPTER 15 REQUIREMENTS

Chapter 15 Standard Design Component	Performance Goal	Proposed Design
<u>Final Cover</u>		
- 2-foot-thick foundation layer	Provide support for final cover	Foundation layer of 20 inches of waste soil and 4 inches of aggregate base compacted to a minimum of 95% of maximum dry density
- 1-foot-thick clay cover	Minimize infiltration via permeability of 1x10^{-6} cm/s or less	Asphalt pavement, which includes 3-inch layer of hydraulic asphalt-concrete pavement having a permeability of 1x10^{-7} cm/s.
- 1-foot-thick topsoil layer with 3% slope	Prevent contact with waste	8½ inches of dense-graded asphalt-concrete pavement; 1% slope to prevent ponding and meet Port of Oakland requirements for container storage

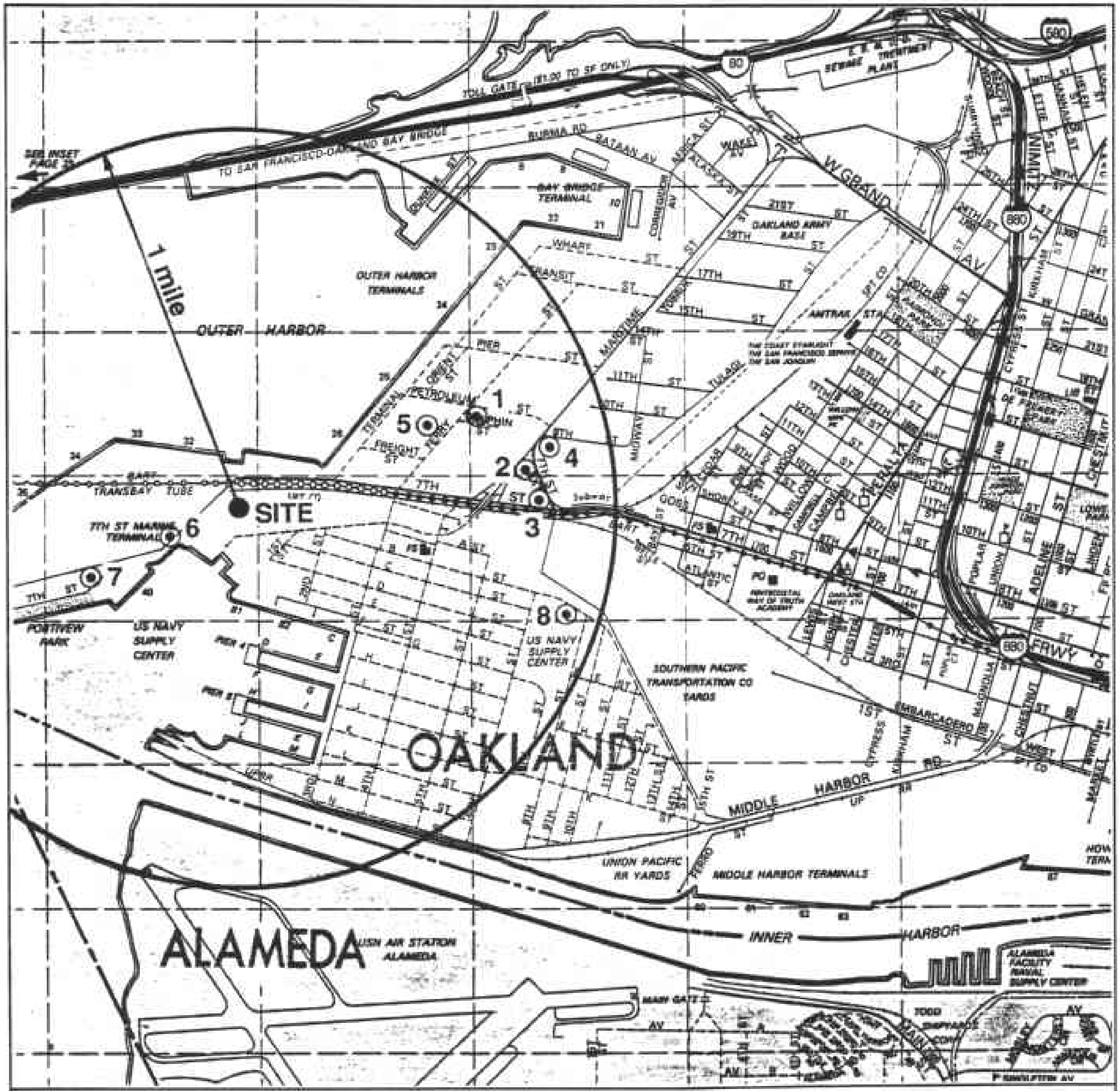


GEOMATRIX

SITE LOCATION MAP
Berth 30
Port of Oakland
Oakland, California

Figure
1

Project No.
2026.06



EXPLANATION

◉ Well location

Notes

1. Well locations based on Alameda County Bay Plain Groundwater Study - Well Inventory Report from Alameda County Public Works Agency, 1993.
2. Well locations are approximate.
3. See Table 1 for well information.
4. Base Map: Thomas Guide: San Francisco, Alameda, and Contra Costa Counties, 1990 edition.

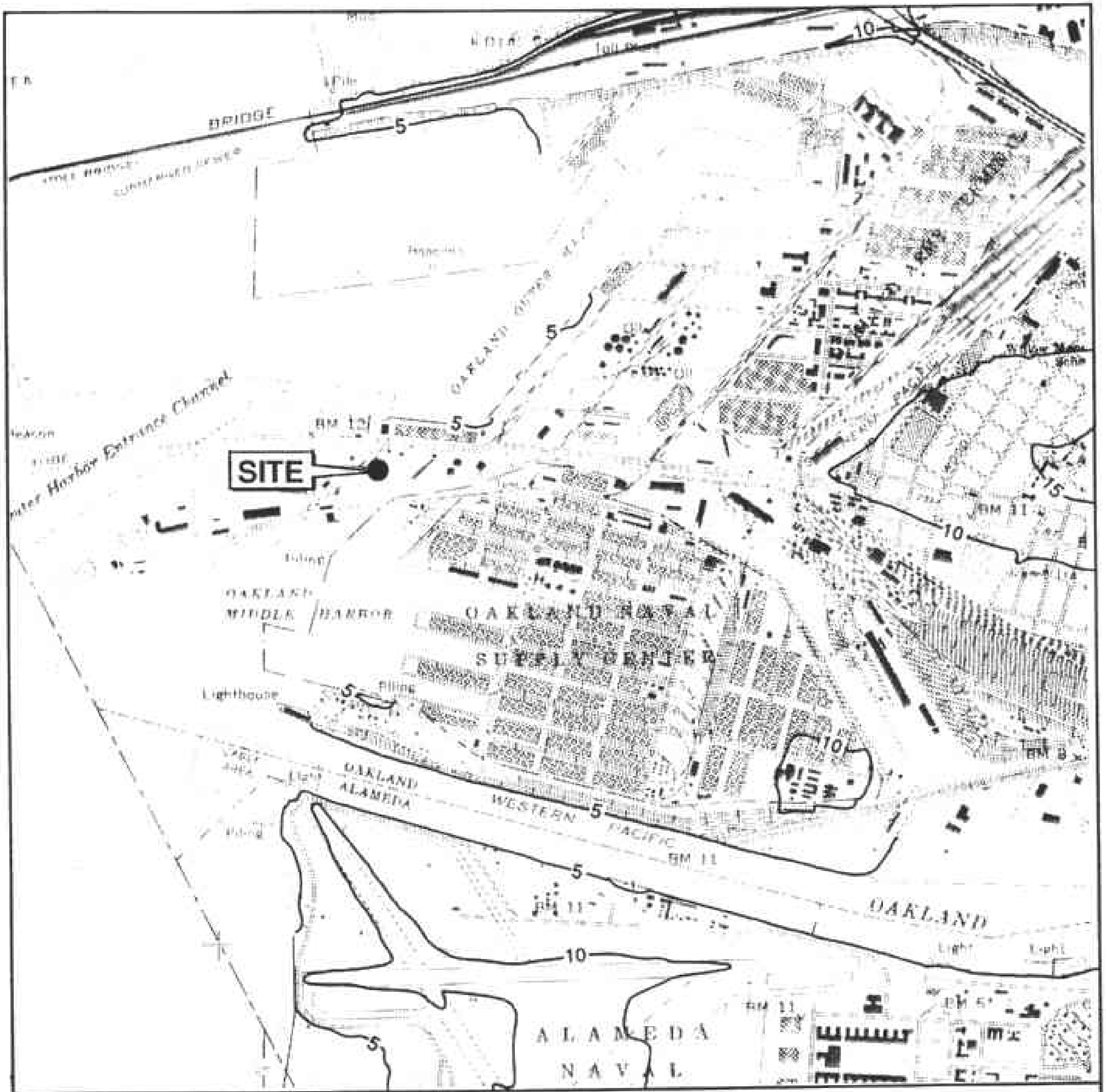
0 1/2 Mile

GEOMATRIX

WELL LOCATION MAP
Berth 30
Port of Oakland
Oakland, California

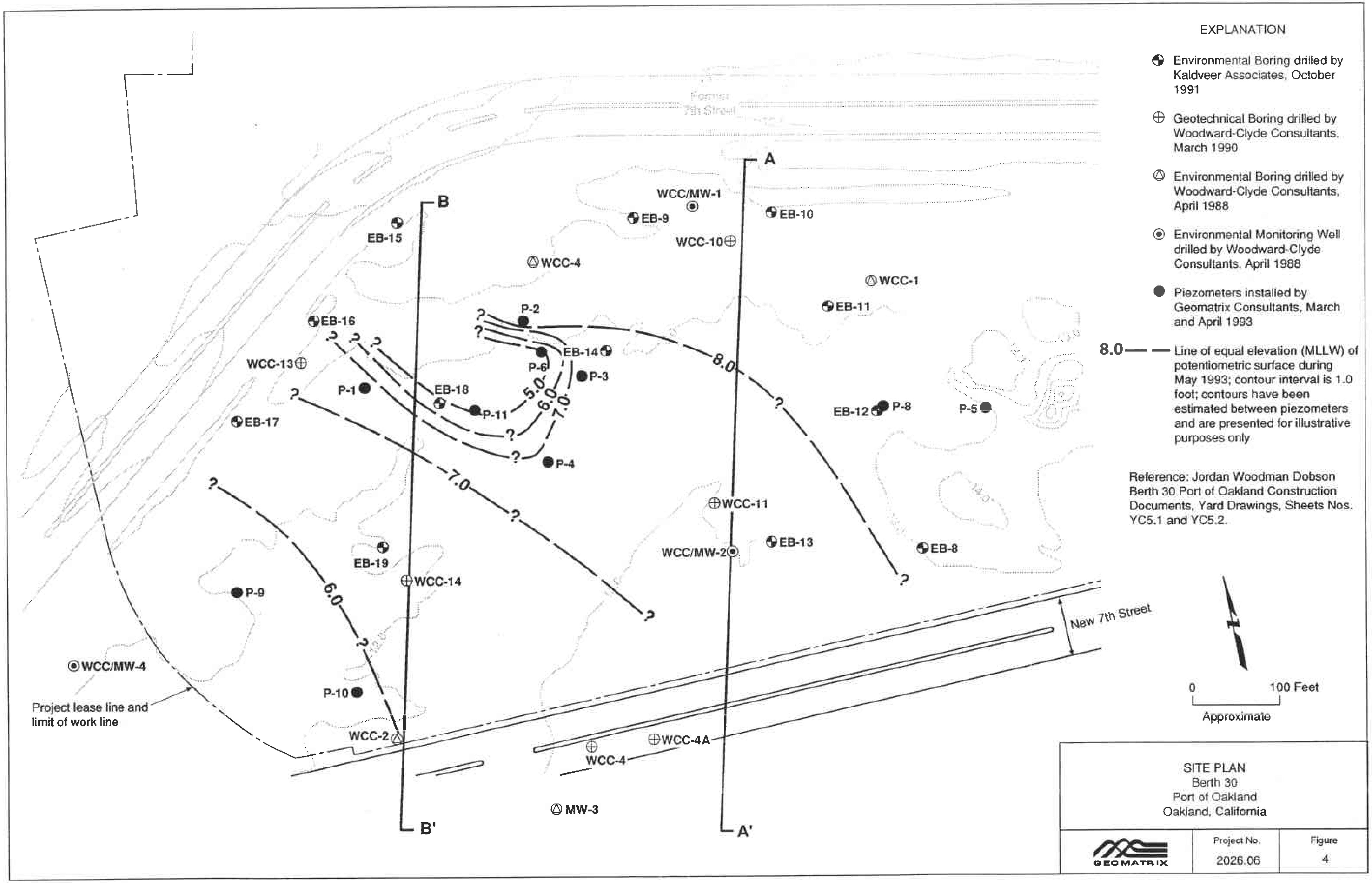
Figure
2

Project No.
2026.06



Source: United States Geological Survey, Oakland West Quadrangle, 7.5-minute series, 1959, photorevised 1980, National Geodetic Vertical Datum of 1929.

GEOMATRIX	SITE VICINITY TOPOGRAPHY Berth 30 Port of Oakland Oakland, California	Figure 3 Project No. 2026.06



EXPLANATION

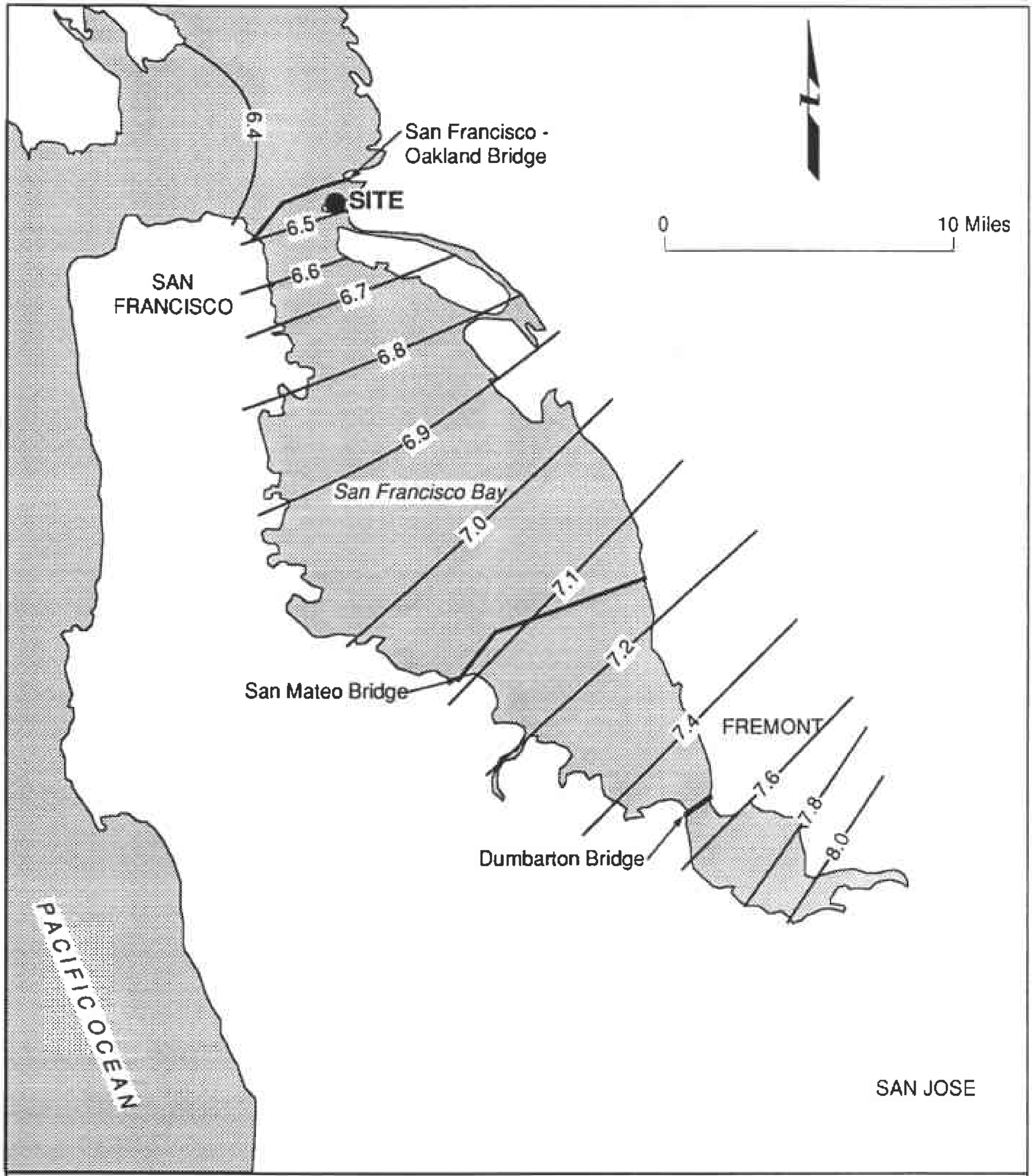
- Environmental Boring drilled by Kaldveer Associates, October 1991
- ⊕ Geotechnical Boring drilled by Woodward-Clyde Consultants, March 1990
- Environmental Boring drilled by Woodward-Clyde Consultants, April 1988
- ⊙ Environmental Monitoring Well drilled by Woodward-Clyde Consultants, April 1988
- ● Piezometers installed by Geomatrix Consultants, March and April 1993
- 8.0 — — Line of equal elevation (MLLW) of potentiometric surface during May 1993; contour interval is 1.0 foot; contours have been estimated between piezometers and are presented for illustrative purposes only

Reference: Jordan Woodman Dobson Berth 30 Port of Oakland Construction Documents, Yard Drawings, Sheets Nos. YC5.1 and YC5.2.

SITE PLAN
Berth 30
Port of Oakland
Oakland, California

GEOMATRIX

Project No.	Figure
2026.06	4



EXPLANATION

——6.5—— Line of 100-year tide elevation (NGVD)

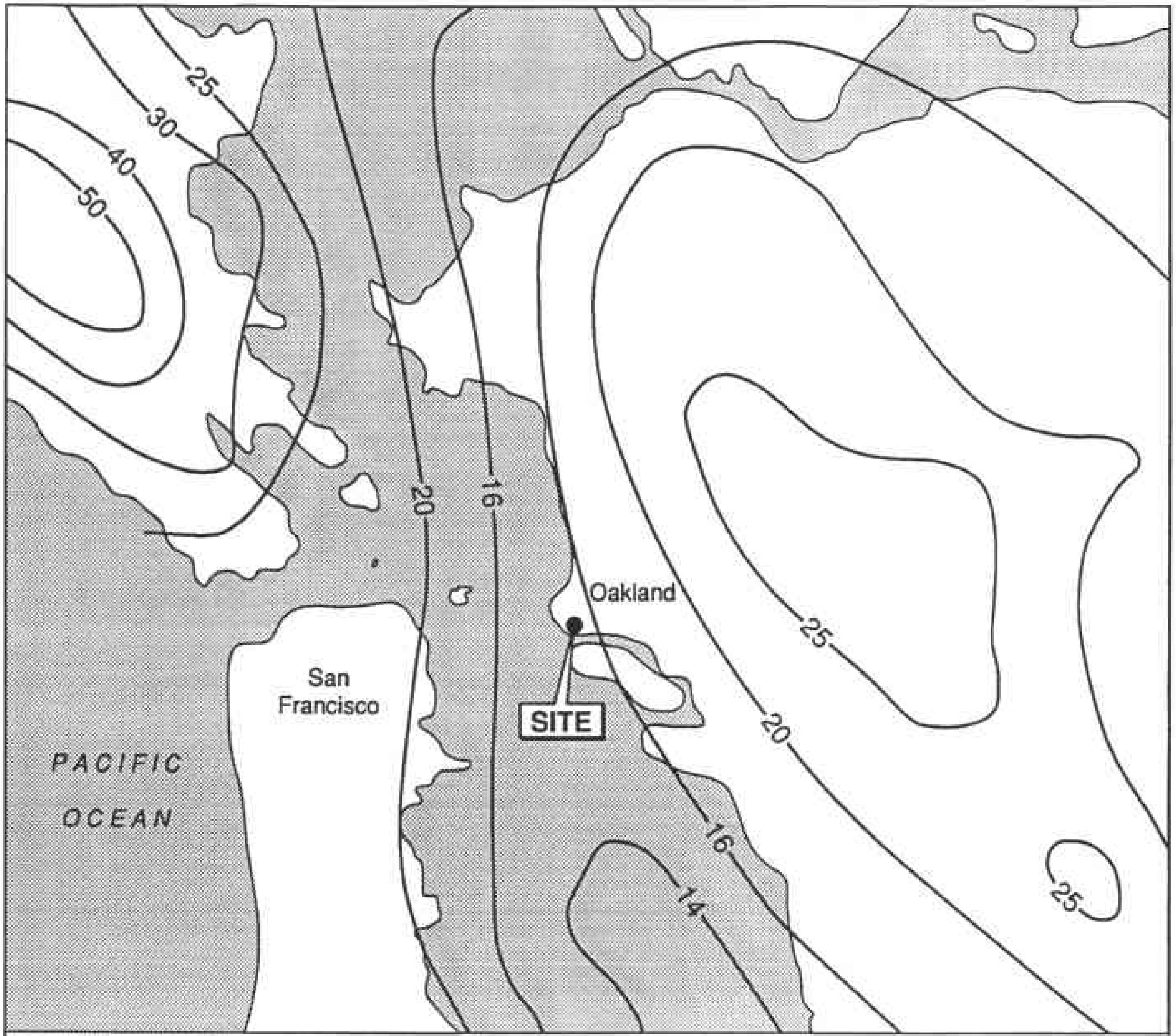
Source: Alameda County Flood Control and Water Conservation District 1987

GEOMATRIX

100-YEAR TIDE ELEVATIONS
Berth 30
Port of Oakland
Oakland, California

Figure
5

Project No.
2026.06



EXPLANATION

20 —— Line of mean annual precipitation in inches

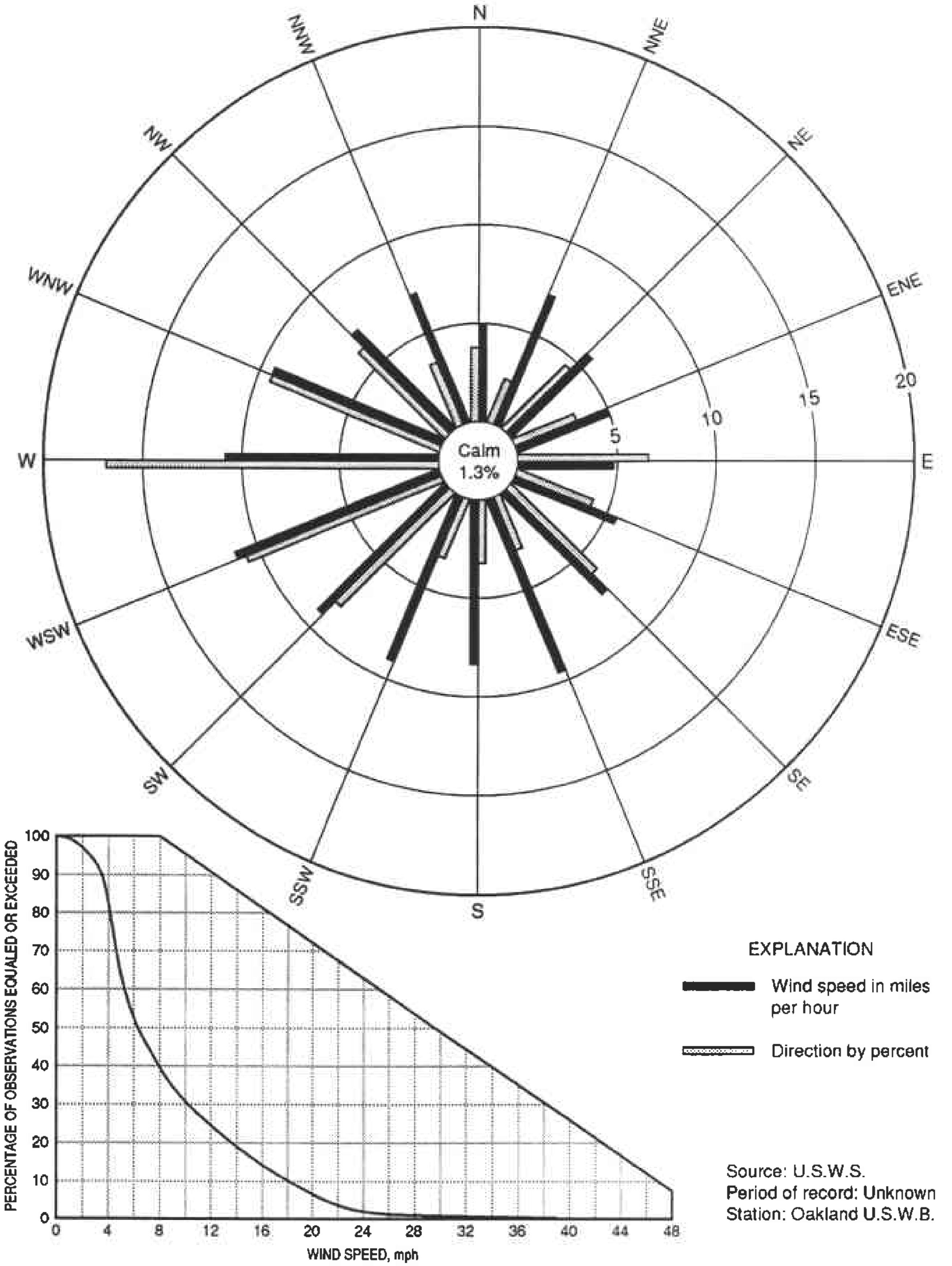
Source: Modified from Rantz, 1971.

GEOMATRIX

REGIONAL PRECIPITATION CONTOURS
Berth 30
Port of Oakland
Oakland, California

Figure
6

Project No.
2026.06



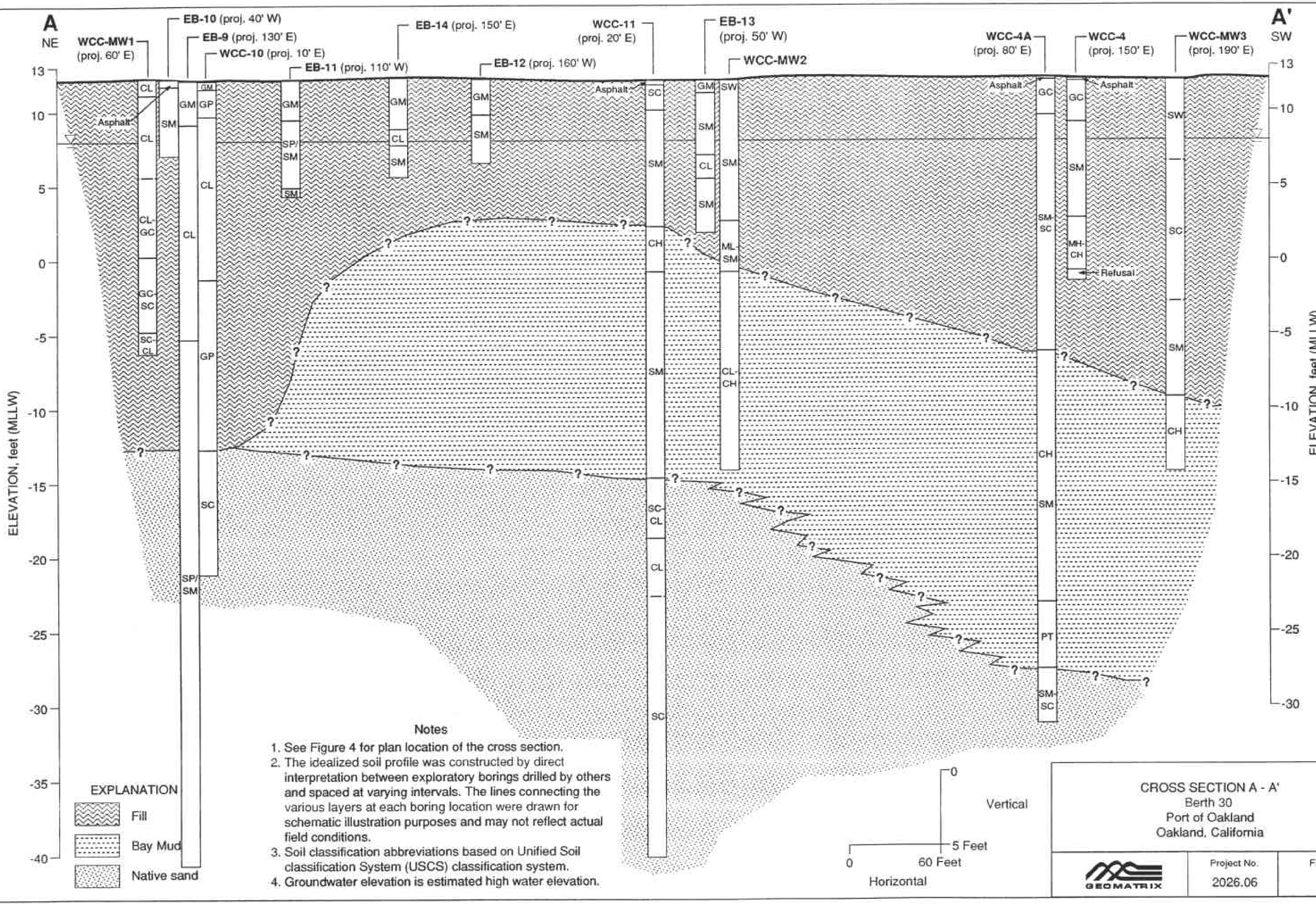
Source: U.S.W.S.
Period of record: Unknown
Station: Oakland U.S.W.B.

GEOMATRIX

ANNUAL WIND ROSE
Berth 30
Port of Oakland
Oakland, California

Figure
7

Project No.
2026.06



EXPLANATION

- ▨ Fill
- ▤ Bay Mud
- ░ Native sand

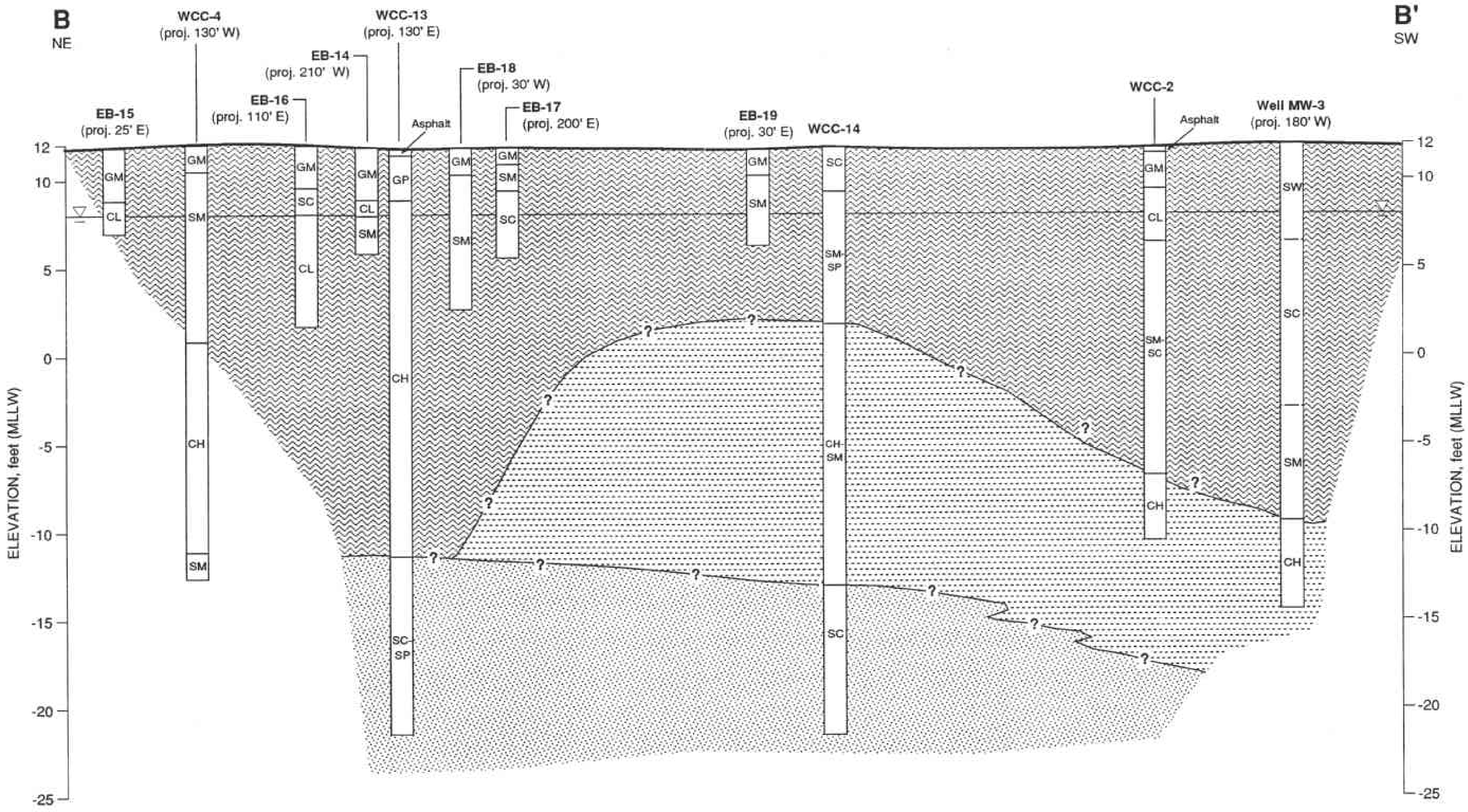
Notes

1. See Figure 4 for plan location of the cross section.
2. The idealized soil profile was constructed by direct interpretation between exploratory borings drilled by others and spaced at varying intervals. The lines connecting the various layers at each boring location were drawn for schematic illustration purposes and may not reflect actual field conditions.
3. Soil classification abbreviations based on Unified Soil classification System (USCS) classification system.
4. Groundwater elevation is estimated high water elevation.

CROSS SECTION A - A'
Berth 30
Port of Oakland
Oakland, California

GEOMATRIX

Project No.	Figure
2026.06	8



Notes

1. See Figure 4 for plan location of the cross section.
2. The idealized soil profile was constructed by direct interpretation between exploratory borings drilled by others and spaced at varying intervals. The lines connecting the various layers at each boring location were drawn for schematic illustration purposes and may not reflect actual field conditions.
3. Soil classification abbreviations based on Unified Soil classification System (USCS) classification system.
4. Groundwater elevation is estimated high water elevation.

EXPLANATION

▨ Fill

▤ Bay Mud

░ Native sand

0
Vertical
5 Feet
0
60 Feet
Horizontal

CROSS SECTION B - B'
Berth 30
Port of Oakland
Oakland, California

GEOMATRIX

Project No.	Figure
2026.06	9

Source:
Map showing recency of faulting,
San Francisco - San Jose Quadrangle,
California, 1: 250,000

Compilation by
E.J. Bortugno, R.D. McJunkin,
and D.L. Wagner

Published 1991

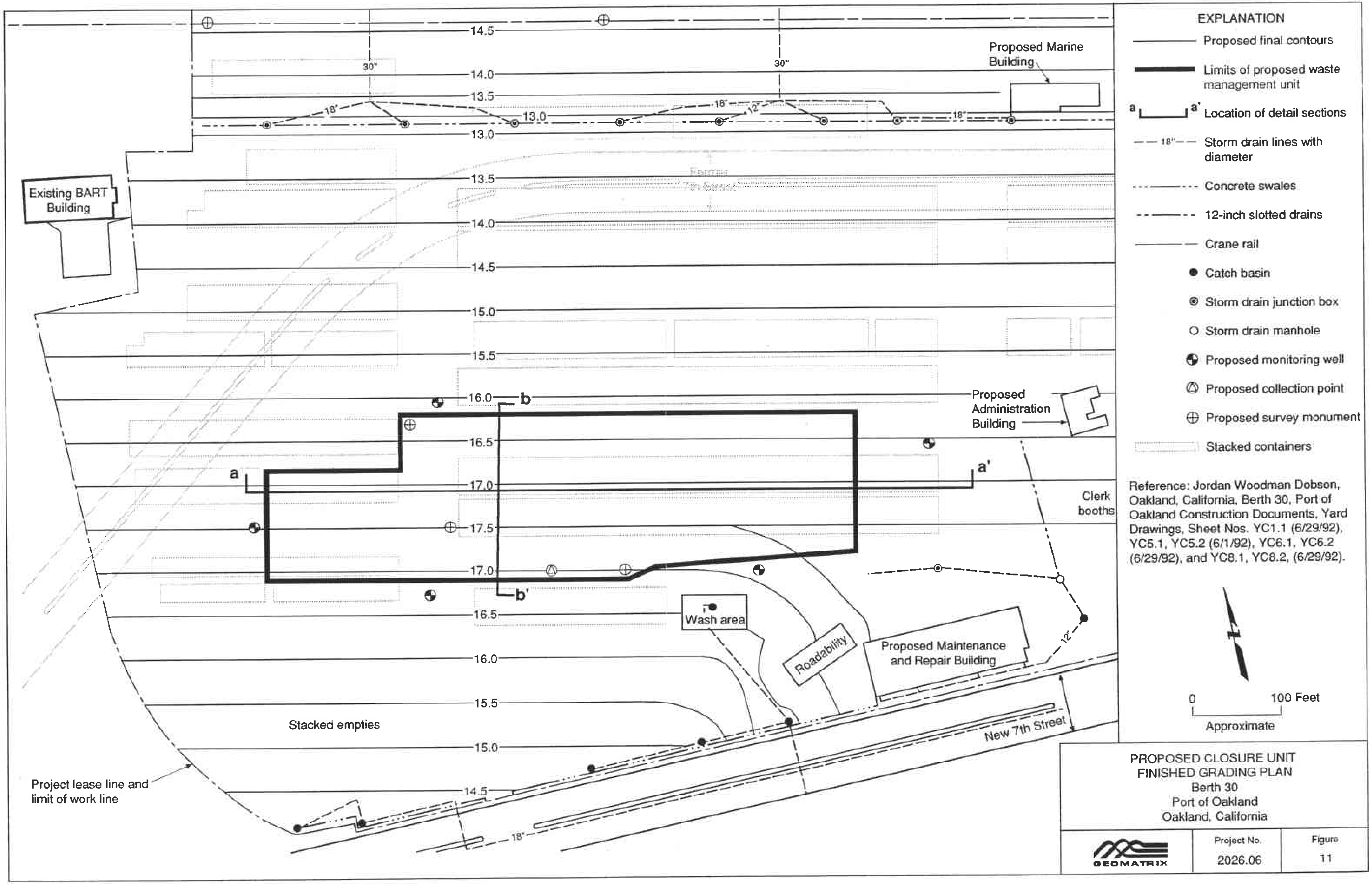
0 5 Miles

GEOMATRIX

REGIONAL FAULT MAP
Berth 30
Port of Oakland
Oakland, California

Figure
10

Project No.
2026.06

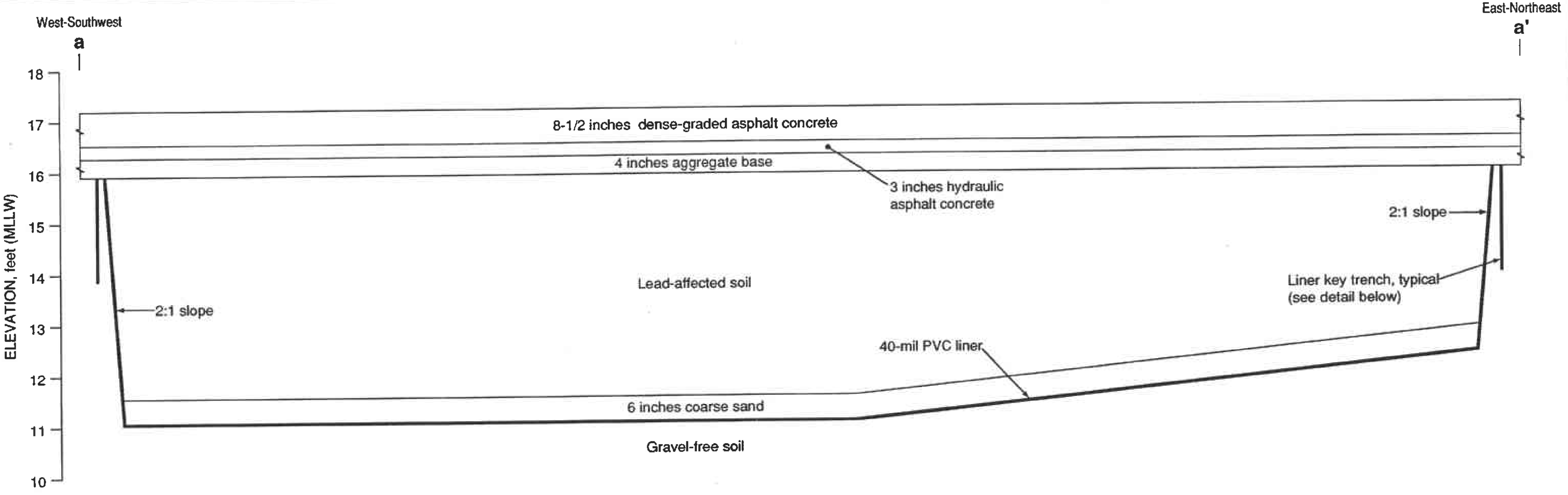


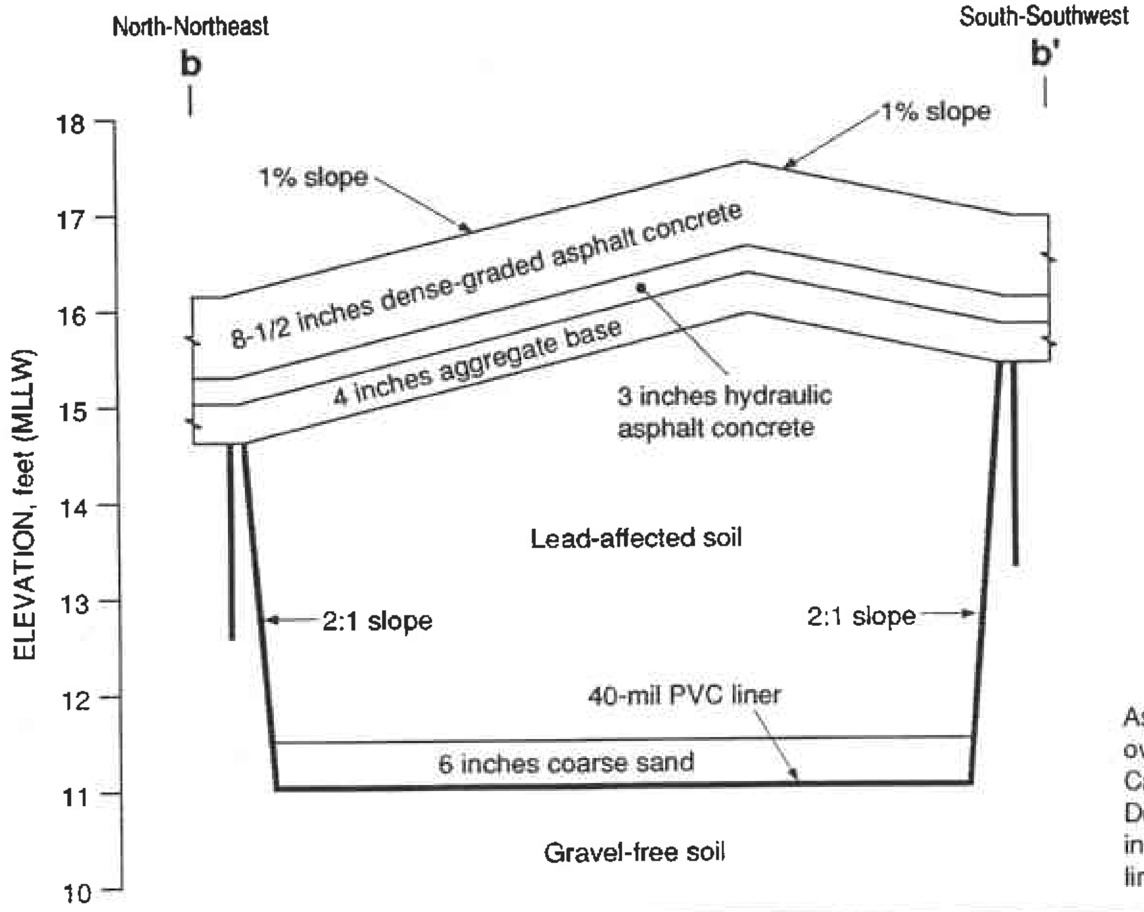
Reference: Jordan Woodman Dobson, Oakland, California, Berth 30, Port of Oakland Construction Documents, Yard Drawings, Sheet Nos. YC1.1 (6/29/92), YC5.1, YC5.2 (6/1/92), YC6.1, YC6.2 (6/29/92), and YC8.1, YC8.2, (6/29/92).

PROPOSED CLOSURE UNIT
FINISHED GRADING PLAN
Berth 30
Port of Oakland
Oakland, California

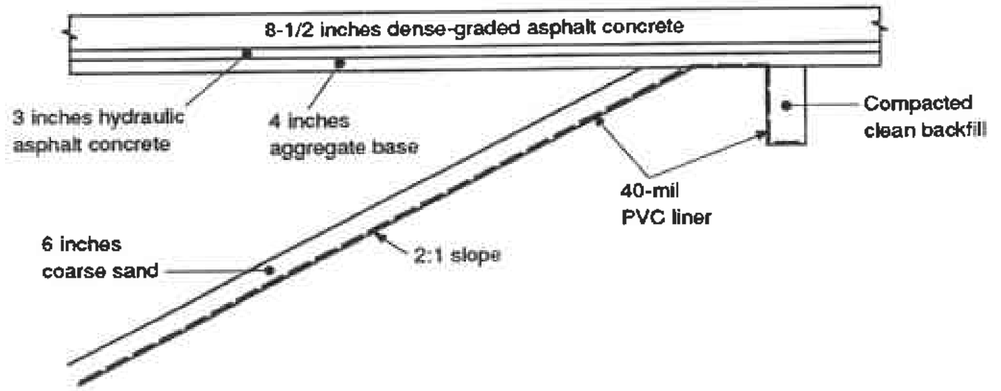
GEOMATRIX

Project No.	Figure
2026.06	11





Scale for Sections
a–a' and b-b':
Horizontal 1" = 50'
Vertical 1" = 2'



Liner Key Trench Detail
Scale: 1" = 5'

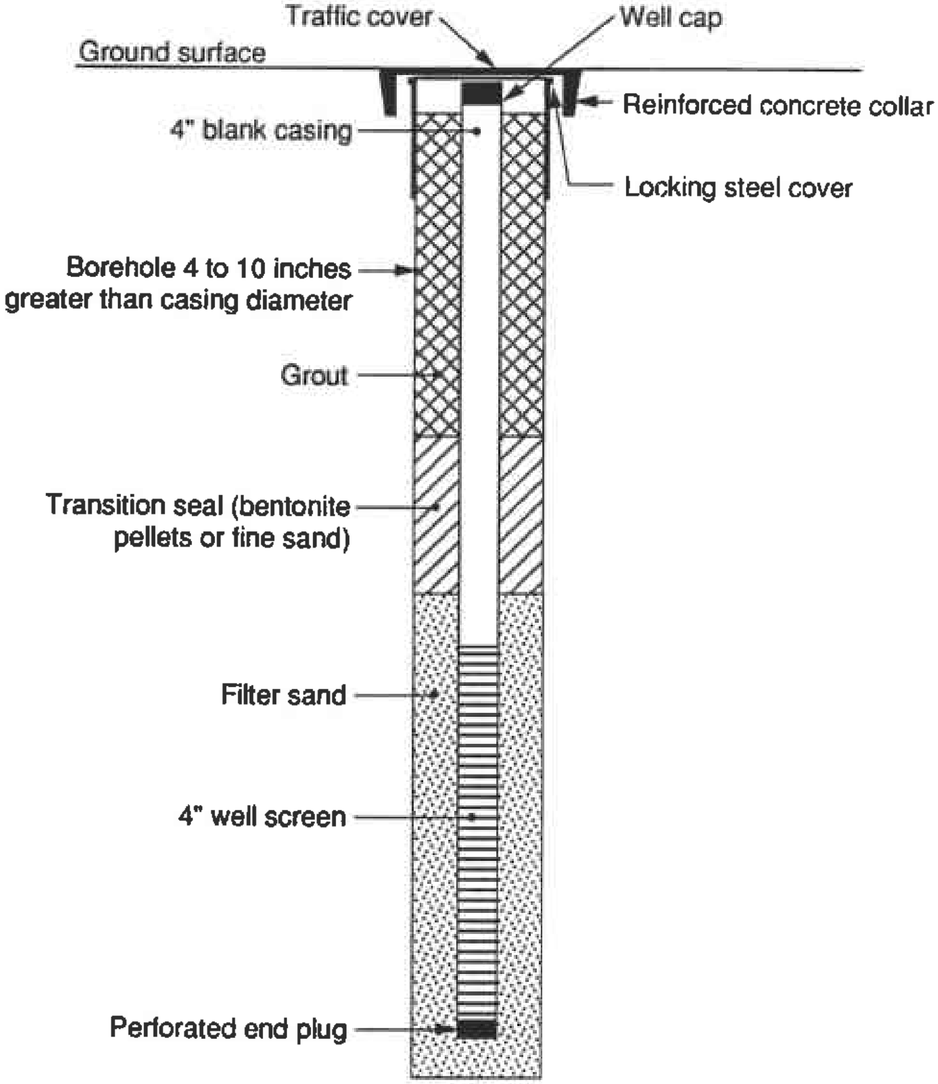
Note:

Asphalt concrete pavement section of 8-1/2 inches dense-graded asphalt concrete over 4 inches aggregate base submitted by Jordan Woodman Dobson of Oakland, California, Typical AC Paving Section, Berth 30 Yard Area, on Berth 30 Construction Documents, Yard Drawings Sheet No. YC12.1 (6/29/92). Low-permeability layer of 3 inches hydraulic asphalt concrete developed by B. A. Vallerga of Oakland, California to limit infiltration over proposed waste managment unit.

PROPOSED CLOSURE UNIT SECTIONS
AND DETAILS
Berth 30
Port of Oakland
Oakland, California

GEOMATRIX

Project No.	Figure
2026.06	12



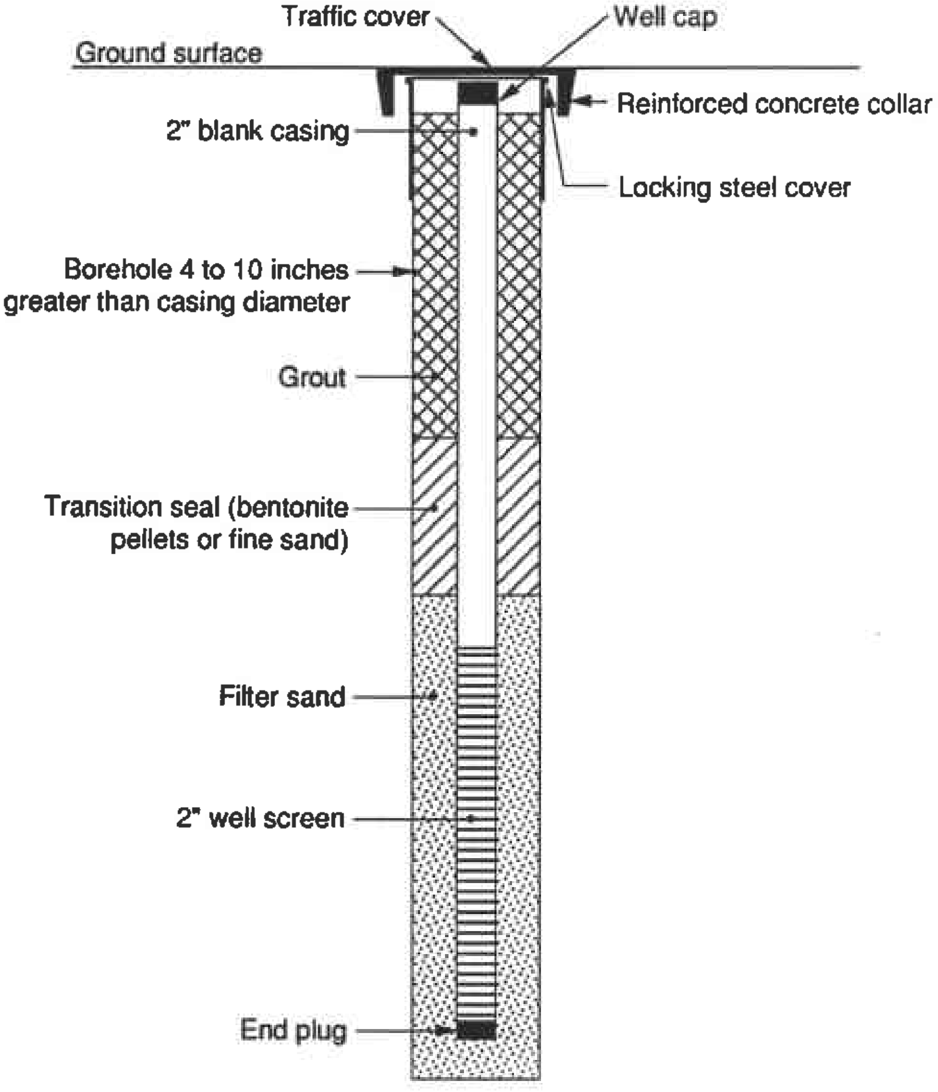
Not to scale

GEOMATRIX

COLLECTION POINT CONSTRUCTION DIAGRAM
Berth 30
Port of Oakland
Oakland, California

Figure
13

Project No.
2026.06



Not to scale

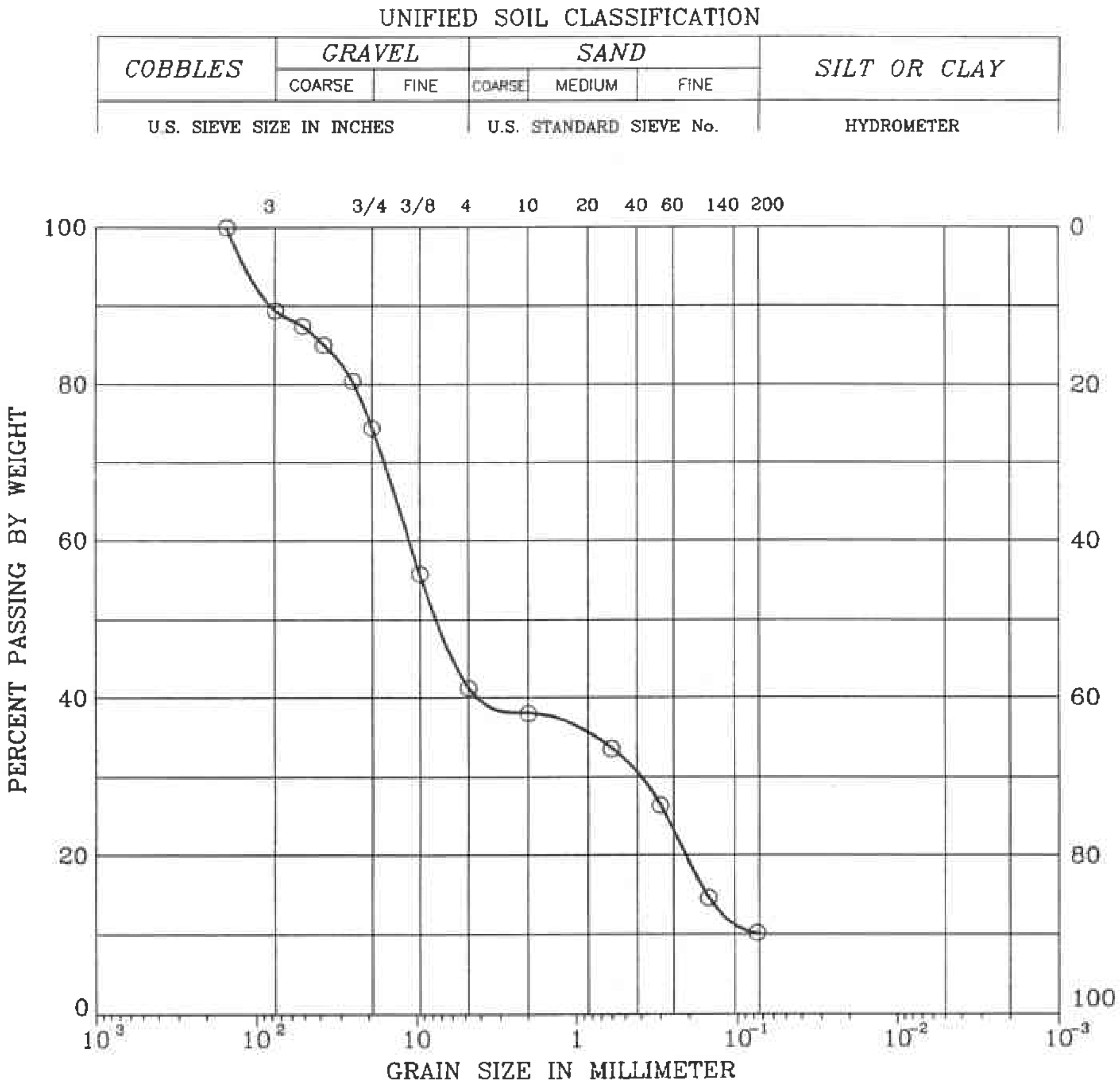
GEOMATRIX

TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM
Berth 30
Port of Oakland
Oakland, California

Figure	14
Project No.	2026.06

APPENDIX A

GRAIN SIZE DISTRIBUTION CURVE, AND COMPACTION AND R-VALUE TEST RESULTS



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	1				Brown gravel w/silt (GM-GP)

Remark :

Project No.109.024	Geomatrix 2026.06I
Cooper Testing Labs Mountain View CA	GRAIN SIZE DISTRIBUTION Figure No.

MOISTURE-DENSITY TEST DATA

PROJECT DATA

Date:	2-04-1993
Project No.:	109-024 Geomatrix
Project:	2026.06I
Location 1:	
2:	
Remarks 1:	
2:	
3:	
Material 1:	Brown silty gravel (GM)
Description 2:	
Elevation or depth:	
Figure No.:	

SPECIMEN DATA

USCS Classification: AASHTO Classification:

Natural moisture: Specific gravity: 2.7

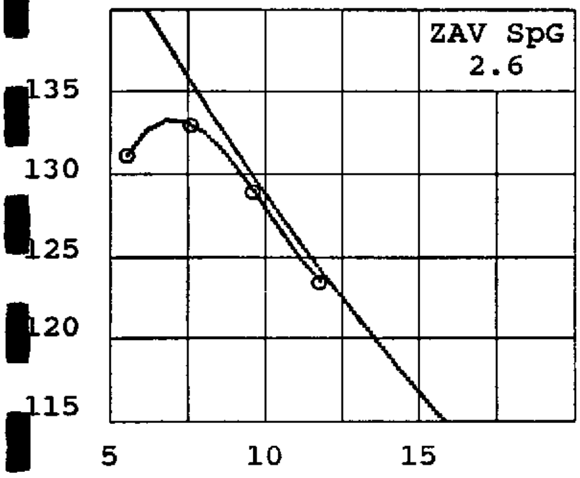
Percent retained on 3/4 in sieve: 25.2

Percent passing No. 200 seive:

Liquid limit: Plastic limit: Plasticity index:

TEST DATA AND RESULTS

Type of test: Modified, ASTM D 1557-91 Method: C



POINT NO.	1	2	3	4
WM + WS	16.62	16.97	16.84	16.59
WM	6.23	6.23	6.23	6.23
WW+T #1	1594.00	1394.60	1296.60	1322.60
WD+T #1	1520.40	1309.50	1199.80	1203.60
WT #1	190.60	191.70	191.30	190.10
MOIST #1	5.5	7.6	9.6	11.7
MOISTURE	5.5	7.6	9.6	11.7
DRY DEN	131.3	133.1	129.1	123.6

Max dry den= 133.4 pcf Opt moisture= 7.0 %

ASTM D 4718 Correction Data:
Bulk Specific Gravity of oversize material = 2.700
~~Estimated Opt~~. Moisture for oversize material = 1.5 %
Corrected Maximum Density = 140.8 pcf
Corrected Optimum Moisture = 5.6 %

COOPER TESTING LABORATORY

COOPER TESTING LABORATORIES

R-VALUE TEST

JOB #: 109-023
DATE: 1/6/92
CLIENT: Geomatrix
SAMPLE #: 2026-06I
SOIL TYPE: Brown silty sand w/gravel

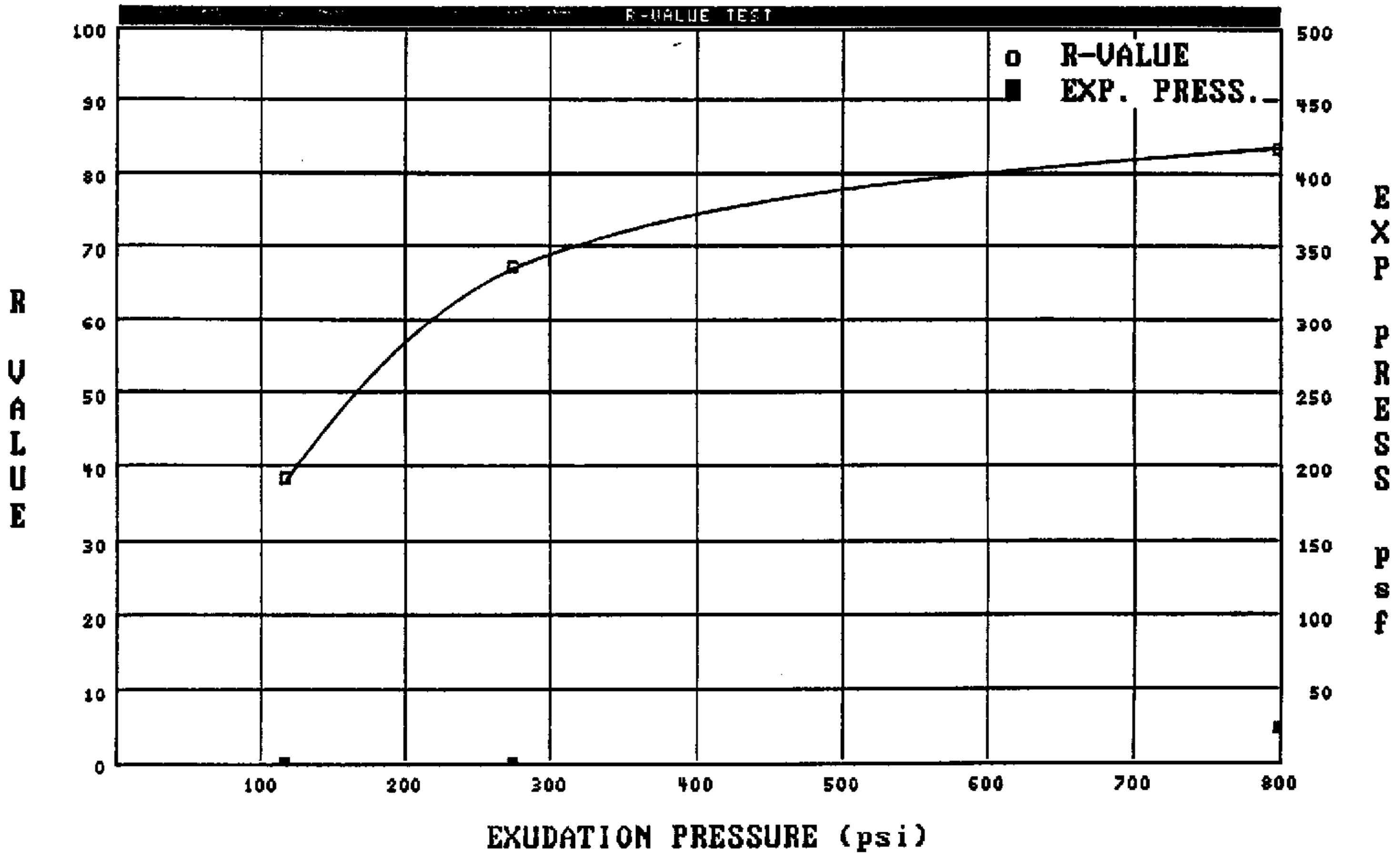
DISH WEIGHT: 45.9
WET: 445.2
DRY: 425.9
INITIAL MOISTURE: 0.0508

SPECIMEN	A	B	C	D
EXUDATION PRESSURE	274	800	117	0
PREPARED WEIGHT	1200	1200	1200	0
FINAL WATER ADDED	50	40	60	0
WEIGHT, SOIL & MOLD	3212	3215	3259	0
WEIGHT, MOLD	2083	2103	2072	0
HEIGHT	2.45	2.43	2.58	0.00
MOISTURE CONTENT	9.5	8.6	10.3	0.0
DRY DENSITY	127.5	127.6	126.3	0.0
EXPANSION DIAL	0	6	0	0
EXPANSION PRESSURE	0	26	0	0
STABILOMETER @ 2000 lb	36	16	82	0
TURNS DISPLACEMENT	3.94	4.09	4.04	0.00
R-VALUE	69	85	37	0
R-VALUE (corrected)	68	84	39	0

VALUES AT 300 EXUDATION

R-VALUE: 69
EXP. PRESSURE: 1

REMARKS:



COOPER TESTING LABORATORIES

R-VALUE TEST

JOB #: 109-023a
DATE: 1/6/92
CLIENT: Geomatrix
SAMPLE #: 2026-06I RV-2
SOIL TYPE: Gray-brown silty sand w/gv

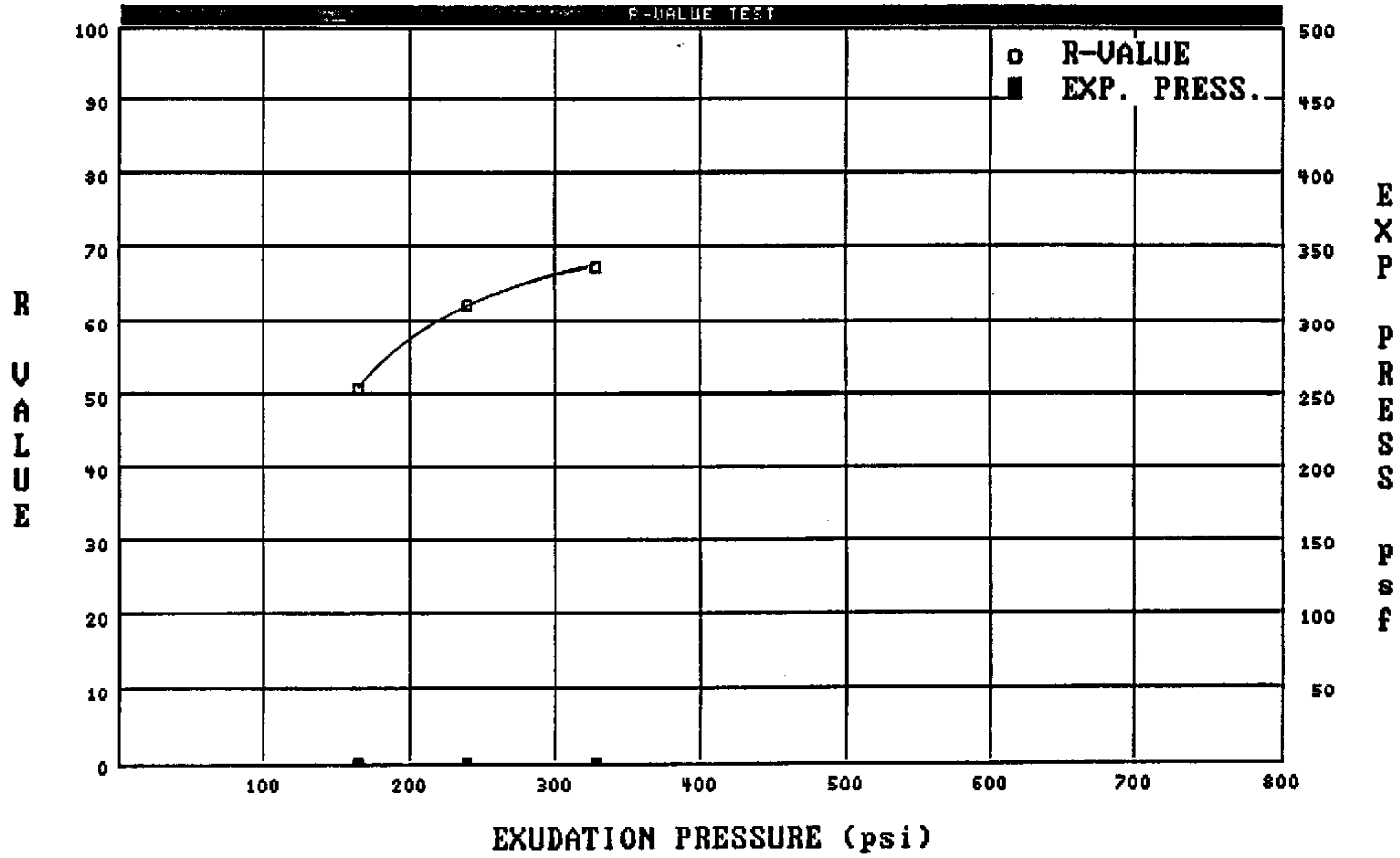
DISH WEIGHT: 192.0
WET: 655.3
DRY: 627.3
INITIAL MOISTURE: 0.0643

SPECIMEN	A	B	C	D
EXUDATION PRESSURE	164	328	239	0
PREPARED WEIGHT	1200	1200	1200	0
FINAL WATER ADDED	41	30	35	0
WEIGHT, SOIL & MOLD	3261	3210	3253	0
WEIGHT, MOLD	2108	2101	2091	0
HEIGHT	2.50	2.42	2.50	0.00
MOISTURE CONTENT	10.1	9.1	9.5	0.0
DRY DENSITY	126.9	127.2	128.5	0.0
EXPANSION DIAL	0	0	0	0
EXPANSION PRESSURE	0	0	0	0
STABILOMETER @ 2000 lb	60	38	46	0
TURNS DISPLACEMENT	3.99	3.58	3.68	0.00
R-VALUE	51	69	63	0
R-VALUE (corrected)	51	68	63	0

VALUES AT 300 EXUDATION

R-VALUE: 66
EXP. PRESSURE: 0

REMARKS:



APPENDIX B

CHAIN-OF-CUSTODY RECORDS AND ANALYTICAL LABORATORY REPORTS

(SEE VOLUMES 2 AND 3)

APPENDIX C

APPLICATION FOR RECLASSIFICATION OF SOIL

GEOMATRIX

APPLICATION FOR RECLASSIFICATION OF HAZARDOUS SOIL

Berth 30
Port of Oakland
Oakland, California

VOLUME 1 - REPORT

Prepared for

Port of Oakland
530 Water Street
Oakland, California

March 1993
Project No. 2026.06

Geomatrix Consultants

100 Pine Street, 10th Floor
San Francisco, CA 94111
(415) 434-9400 • FAX (415) 434-1365

GEOMATRIX

2 March 1993
Project 2026.06

Ms. Patricia Murphy
Port of Oakland
530 Water Street
Oakland, California 94607

Subject: Application for Reclassification of Hazardous Soil
Berth 30
Port of Oakland
Oakland, California

Dear Ms. Murphy:

Enclosed is the subject report. If you have any questions about this report, please call either of the undersigned. We appreciate the opportunity to work with you on this project and look forward to working with you in the future.

Sincerely yours,

GEOMATRIX CONSULTANTS, INC.

Elizabeth K. Wells
Elizabeth K. Wells, P.E.
Project Engineer

Sally E. Goodin
Sally E. Goodin, R.G.
Senior Geologist

EKW/SEG/lam
20266RHS.LTR

Enclosure

Geomatrix Consultants, Inc.
Engineers, Geologists, and Environmental Scientists

GEOMATRIX

APPLICATION FOR RECLASSIFICATION OF HAZARDOUS SOIL

Berth 30
Port of Oakland
Oakland, California

VOLUME 1 - REPORT

Prepared for

Port of Oakland
530 Water Street
Oakland, California

March 1993
Project No. 2026.06

Geomatrix Consultants

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF APPENDICES

APPLICATION FOR RECLASSIFICATION OF HAZARDOUS SOIL
Berth 30
Port of Oakland
Oakland, California

1.0 INTRODUCTION

The Port of Oakland is submitting this application prepared by Geomatrix Consultants, Inc., for reclassification of a non-RCRA hazardous waste. This application has been prepared in accordance with the California Code of Regulations (CCR), Title 22, Section 66260.200 and includes information on the generator, waste material, sample collection, chemical testing, analytical laboratories, and analytical results.

2.0 GENERATING FACILITY

The generating facility is: Port of Oakland
530 Water Street
Oakland, California 94607

The contact person at the Port is: Ms. Patricia Murphy
(510) 272-1373

3.0 DESCRIPTION OF THE WASTE

The waste consists of a portion of material excavated from Berth 30 north of Seventh Street during Fall 1992 as part of construction for a new container terminal and loading berth at the Port (Figure 1). The waste comes from the post-1950s fill unit formerly underlying the shoreline adjacent to Berth 30, which consisted of a heterogeneous mixture of rubble, boulders, cobbles, gravel, sand, and clay, with some brick, timber and other miscellaneous materials. This material was segregated during excavation and placed across Seventh Street on another portion of the Berth 30 property because preliminary sampling data (Geomatrix, 1992) had indicated that the matrix material of this unit potentially contained soluble lead at concentrations greater than the Soluble Threshold Limit Concentration (STLC, 5 mg/l) used to define a California hazardous waste (CCR, Title 22, Section 66261.24). The material was subsequently processed through a rock crusher to remove rocks and materials greater than 4 inches in diameter. The predominantly 4-inch-minus material was sampled for chemical analysis and placed in a total of 25 stockpiles ranging from approximately 1800 to 3000 cubic yards of soil per stockpile. Following receipt of analytical results, a determination was made for each stockpile as to whether the stockpile would be considered hazardous waste according to Title 22. Twelve of the 25 stockpiles of soil, which were considered hazardous, were combined into one pile consisting of a total volume of approximately 26,700 cubic yards. The stockpile is currently located on-site with plastic sheeting beneath and covering the stockpile.

Grain size analysis of a representative sample collected from the hazardous stockpile indicates the soil is a silty gravel (Unified Soil Classification System). A copy of the grain size distribution curve is included in Appendix A.

The waste material is proposed for placement in a Class II landfill to be constructed at the Berth 30 site (Figure 1). The landfill will be designed, constructed, operated, and closed in accordance with CCR, Title 23, Chapter 15.

4.0 SAMPLING INFORMATION

Soil samples were collected for chemical testing by:

Geomatrix Consultants, Inc.
100 Pine Street, 10th Floor
San Francisco, California 94111

The following Geomatrix employees collected the samples: James Abitz, Matthew Blankenship, James Carolan, Jeffrey Hasan, Timothy Keuscher, Michael Keim, Elizabeth Wells, Timothy Wood, and Paul Zianno. Soil samples were collected from a sampling platform located next to a conveyor belt of the rock crushing plant. Soil samples were collected directly from the flow of processed soil (the predominantly 4-inch-minus material) moving along the conveyor belt. Samples were collected using a systematic random sampling approach in accordance with the U.S. Environmental Protection Agency's (EPA's) Test Methods for Evaluating Solid Waste (SW-846). The first sample was collected randomly; subsequent samples were collected at a rate of approximately one sample per 50 cubic yards. An additional random sample was collected from each stockpile for acute aquatic toxicity testing. Soil samples were collected in clean, thin-walled brass tubes and sealed at each end with Teflon sheets, plastic end caps, and duct tape. Each sample was labeled with sample number, date, time, and sampler initials, and placed in an ice-cooled chest until delivery to the analytical laboratory under Geomatrix chain-of-custody procedures. The date and time of sample collection, and sample number are listed on the chain-of-custody records (Appendix B).

5.0 ANALYTICAL METHODS AND LABORATORIES

All of the soil samples collected from each stockpile were transported to the analytical laboratory under chain-of-custody procedures. Ten soil samples from each stockpile were selected for chemical analysis using a random number generator. A request for analysis form indicating which ten samples to analyze was transmitted to the laboratory. A copy of the form is shown in Appendix B. A total of 120 samples (10 samples per stockpile) were analyzed for 17 total Title 22 metals, and for soluble lead using the California Waste Extraction Test (WET) and Toxic Characteristic Leaching Procedure (TCLP). A total of 24 samples (two samples per stockpile) were analyzed for volatile and semivolatile organic compounds. One sample from each stockpile (a total of 12 samples) was also analyzed for pesticides and polychlorinated biphenyls (PCBs); reactivity, corrosivity, and ignitability;

and acute aquatic toxicity testing. Three samples from the entire set of randomly selected samples were also analyzed for soluble mercury by the WET because the total concentrations were greater than 2 (10 times the STLC of 0.2 mg/l). The preparation methods, test methods, and references for the methods are presented in Table 1. Two analytical laboratories conducted chemical analyses of the soil samples. Aquatic toxicity tests were conducted by:

Western Bioassay Laboratories (WBL)
2950 Buskirk Avenue, Suite 120
Walnut Creek, California 94596
State Certification Number 1812

All other chemical analyses were conducted by:

Clayton Environmental Consultants (Clayton)
1252 Quarry Lane
P.O. Box 9019
Pleasanton, California 94566
State Certification Number 1196

Resumes for the individuals from each laboratory responsible for testing the soil samples are presented in Appendix C.

Samples were transferred under Geomatrix chain-of-custody procedures from the sampling personnel to the analytical laboratory. Following receipt of the samples by the laboratories, the laboratories conducted sample control procedures described below.

Samples received by Clayton were identified by batch and by individual sample. The group of samples was assigned a work order number and each sample was given a unique laboratory identification number. At the time of sample log-in, the following information was recorded in the master sample log and the laboratory's information management system: date logged, date received, laboratory work order number, laboratory sample number, client sample number, client name, sample type, analyses requested number of containers, size and type of container, preservatives, sample custodian initials, storage location, and analytical data. Labels containing this information were placed on the samples, the samples were placed in storage, and necessary information regarding analyses to be performed was distributed to the appropriate laboratory department.

Samples received by WBL were logged into the laboratory sample log book upon receipt. Each sample was given a sequential laboratory number. At the time of sample log-in, the following information was recorded in the sample log book: laboratory sample number, client sample number, date of receipt, time of receipt, initials of sample receiver, project name and number, client contact and billing number. Each sample was labeled with the laboratory sample number, date of receipt, and expiration date of the sample. The samples were placed in storage and information regarding analyses to be performed was placed in a new project file.

6.0 ANALYTICAL RESULTS

The number of randomly selected samples analyzed for each analyte is presented in Table 1. Analytical results are summarized in Tables 2 and 3.

All metals concentrations are well below the Total Threshold Limit Concentration (TTLC) used to define a California hazardous waste (CCR, Title 22, Section 66261.24). Metals concentrations are below 10 times the STLC for all metals except mercury in 3 samples and lead in 117 samples. Comparison of the analytical results with background concentration ranges (Shacklette and Boerngen, 1984), shown on Table 4, indicates that the soil generally contains total metals at concentrations that would be considered within background ranges.

All of the soil samples contained total lead at concentrations less than 290 milligrams per kilogram (mg/kg) (except one of seven replicate samples, which indicated lead at 720 mg/kg, as compared to 78 to 150 mg/kg for the other six replicate samples). One hundred sixteen of the 120 samples contained total lead at concentrations less than 200 mg/kg.

Soluble lead by the WET indicated concentrations ranging from 1.4 to 43 milligrams per liter (mg/l). Thirty-seven of the 120 samples contained soluble lead when analyzed by the WET at concentrations less than the STLC of 5 mg/l; 109 of the 120 samples analyzed contained soluble lead when analyzed by the WET at concentrations less than 10 mg/l. In addition, soluble lead tested by the TCLP was not detected in 111 samples and was reported in 9 samples at concentrations between 0.1 and 0.4 mg/l. Soluble mercury by the WET, analyzed for in three samples, was not detected above the laboratory detection limit of 0.01 mg/l.

Volatile organic compounds (VOCs), including toluene, ethylbenzene, total xylenes, acetone, and 1,2-dichloroethane, were detected in 10 of the 24 samples analyzed at concentrations ranging from 0.005 to 0.065 mg/kg. Semivolatile compounds detected are polynuclear aromatic (PNA) compounds including naphthalene, 2-methyl naphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(ghi)perylene at concentrations up to 10 mg/kg.

Pesticides detected include DDD, DDE, and DDT at concentrations up to 0.44 mg/kg, all below the TTLC of 1.0 mg/kg. Polychlorinated biphenyls (PCBs) were not detected in any of the samples analyzed. The soil samples did not exhibit reactivity, corrosivity, or ignitability. The results of the aquatic toxicity indicated that the acute aquatic toxicity level is greater than 500 mg/l. The waste does not contain any of the carcinogens listed in Title 22.

Acute oral and dermal toxicities were calculated for the constituents reported in the material. These calculations are presented on Table 5. The mean concentration for each compound was converted into a percentage value. LD50 values were obtained for each compound if available. For compounds for which no LD50 values were available, the lowest LD50 value for a similar compound or the LDLo was used (e.g. the oral LD50 for naphthalene was used for 2-methyl naphthalene); this approach should over-estimate toxicity. The percent concentration for each compound was divided by its respective LD50. The resulting values for every compound were summed and the sum was divided into 100 to provide a total calculated LD50 value (in mg/kg) for the waste material. The acute oral and dermal LD50s for the waste were calculated to be 185,619 and 104,867,647 mg/kg, respectively. Title 22 specifies that a waste is not hazardous if the oral and dermal LD50s are greater than 5,000 and 4,300 mg/kg, respectively; therefore, the material is not considered hazardous based on these results.

In summary, the only constituent in the waste that exceeds regulatory thresholds is soluble lead by the WET; a statistical evaluation of these data is presented in the next section, followed by a discussion of the mobility of lead. The PNAs and volatile organic compounds detected, which do not have regulatory thresholds, were detected at low concentrations. A discussion of the toxicity of PNAs and VOCs, and an assessment of the potential for these compounds to leach from the soil is presented below.

7.0 STATISTICAL EVALUATION OF SOLUBLE LEAD DATA

Statistical evaluation of the analytical results is appropriate for constituents for which there are regulatory criteria. The standard statistical analysis for evaluation of solid waste is presented in the EPA's Test Methods for Evaluating Solid Waste (EPA, 1986). If the concentrations of particular constituents are all less than the regulatory criteria, then the statistical analysis is not required to establish that the material is not hazardous. As discussed above, soluble lead by the WET is the only constituent in the waste that exceeds regulatory criteria.

A statistical analysis of soluble lead results (by the WET) for all the stockpiles was conducted in accordance with SW-846 to evaluate soluble lead concentrations of the total volume of soil to be reclassified. The analysis was conducted to evaluate whether the results are statistically representative of the waste material. A summary of the calculations performed is presented in Table 6.

A total of 120 soil samples were analyzed by the WET (Table 2). The mean concentration was calculated to be 6.90 mg/l. The upper confidence level (UCL) was calculated to be 7.48 mg/l. The UCL concentration of 7.48 mg/l is greater than the STLC of 5 mg/l.

The number of samples required to characterize the waste was calculated as 12. The number of samples analyzed was greater than the number required, therefore, the results are representative of the waste.

8.0 EVALUATION OF LEAD MOBILITY

Studies conducted on lead-containing soil have indicated that lead is essentially immobile when contained in soil. These studies evaluated the mobility of lead in soil; the results indicated that lead is strongly adsorbed and exhibits little mobility in soil (Korte, et al., 1976; Miller, et al., 1983; Abd-Elfattah and Wada, 1981). Additional studies conducted by Brown, et al. (1983), Chang, et al. (1984), and Williams, et al. (1980) indicated that lead remained in the surface horizons of soil and sludge after several years of application of lead to the soil. It is also important to note that the average and upper confidence level concentrations for the WET results, 6.9 and 7.48 mg/l, respectively, are close to the STLC of 5 mg/l. The TCLP results (which are all less than 0.4 mg/l) indicate that very little lead leaches from the material, except under the specific conditions of the WET. The acidic conditions of the WET are unlikely to occur at the site, particularly in the proposed Class II landfill. These results, together with the relatively low total lead concentrations (97% of the samples had total lead concentrations less than 200 mg/kg), suggest that lead in soil is not likely to leach and that a regulatory threshold greater than the current STLC of 5 mg/l would be more appropriate for classifying the waste described in this application.

9.0 TOXICITY EVALUATION AND LEACHING POTENTIAL OF PNAs AND VOCs

There are no regulatory thresholds for the specific PNAs and VOCs identified in this material. In order to evaluate the implications of the presence of these compounds with respect to waste classification, Geomatrix has calculated acute oral and dermal toxicities for the sum of the organic compounds. In addition, acute aquatic toxicity testing was performed on the waste material. We have also estimated the potential leachable quantities of these compounds, applied a site attenuation factor, and compared these results with available regulatory criteria. It is important to note that no leachate is expected to be produced because the material will be placed in a Class II landfill, which will be immediately closed with an impermeable cap.

Acute oral and dermal LD50s were calculated for the waste material using the compounds that do not have regulatory thresholds. The calculations are shown in Table 7. The acute oral and dermal LD50s for PNAs and VOCs were calculated to be 18,569,134 and 106,176,727 mg/kg, respectively. Title 22 specifies that a waste is not hazardous if the oral and dermal LD50s are greater than 5,000 and 4,300 mg/kg, respectively. In addition, the aquatic toxicity testing indicated 96-hour acute aquatic toxicity of greater than 750 mg/l for all of the samples analyzed. Title 22 specifies that a waste is not hazardous if the 96-hour acute aquatic toxicity is greater than 500 mg/l. Therefore, the waste material at the site has is not hazardous with respect to the toxicity criteria and the estimated exposure quantity in order to be toxic is 4 to 5 orders of magnitude greater than the regulatory limit.

In order to evaluate the possible hazards to human health and safety and wildlife, the potential concentrations of the organic compounds in leachate, if any formed, have been estimated. The potential concentrations in the leachate have been estimated by calculating the soil/water partition coefficient (Kp) based on the aqueous solubility of each compound and using this ratio to convert the concentrations in soil to a potential concentration in pore water. The aqueous solubility and estimated Kp values for each compound are presented in Table 8. On Table 9, an attenuation factor of 10 is applied to the pore water concentrations and the results are compared to drinking water standards and the Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB) effluent limitations for point discharges to San Francisco Bay.

It is important to note that appropriate water quality criteria are not available for the Berth 30 site, where the waste is proposed to be placed. The groundwater in the vicinity of Berth 30 is brackish, with conductivities ranging from 900 to 5000 (WCC, 1990); this water could not be used as drinking water. Based on this, drinking water standards would not be appropriate water quality standards for comparison. Groundwater at the site ultimately discharges to San Francisco Bay. The SFRWQCB has established effluent limitations for point discharges to the Bay in the Basin Plan (SFRWQCB, 1992). However, these effluent limitations are not applicable to groundwater discharge. Water quality goals for groundwater discharge to the Bay would be expected to be higher than the Basin Plan limits based on the significantly higher mixing ratios (of receiving water to effluent water) associated with groundwater discharge as compared to point discharges. Effluent limitations for discharges with diffusers were selected because they were developed assuming a 10 to 1 mixing ratio of receiving to effluent water; these are considered more comparable to site conditions of the proposed landfill than the shallow Basin Plan water effluent limitations (which do not assume a mixing ratio), because groundwater discharge would be expected to have a significantly higher mixing ratio than any point discharge.

The mean attenuated concentrations, together with drinking water criteria and the Basin Plan effluent limitations for discharges with diffusers are presented in Table 9. The mean attenuated concentrations are all less than the Basin Plan effluent limitations and drinking water criteria, except 1,2-dichloroethane at 0.009, which is above the EPA drinking water level of 0.005 mg/l and the state drinking water level of 0.0005 mg/l; and benzo(a)pyrene at 0.002, which is equal to the EPA drinking water standard that becomes effective in

January 1994. These results indicate that potential leachable concentrations are very low and meet Basin Plan effluent limitations and generally meet drinking water standards. These data indicate that the waste should not represent a significant threat to human health and safety or wildlife.

10.0 DISCUSSION AND CONCLUSIONS

The DTSC may approve non-hazardous classification of a waste which is determined to be hazardous by the criteria specified in Title 22, Article 11 of the CCR if the waste possesses mitigating physical or chemical characteristics that render it insignificant as a hazard to human health and safety and wildlife.

The analytical results for the waste material indicate that the only constituent which exceeds Title 22 regulatory criteria is soluble lead with a mean concentration of 6.9 mg/l. The material is not toxic with respect to oral or dermal exposures; is not reactive, corrosive, or ignitable; and does not contain Title 22 listed carcinogens. The material does contain low concentrations of VOCs and PNAs, for which there are no regulatory criteria.

The soluble lead concentrations are not considered a significant hazard to human health and safety and/or wildlife because of the established immobility of lead, the low concentrations of total lead (with 97 percent of the samples less than 200 mg/kg), and the very low concentrations of soluble lead by the TCLP. The low levels of VOCs and PNAs are not considered a significant hazard to human health and safety and/or wildlife based on the very low toxicities of the observed concentrations and the very low estimated pore water concentrations (if any water entered the Class II landfill, which is not expected). The Port of Oakland therefore requests the soil be classified as non-hazardous.

11.0 REFERENCES

Abd-Elfattah, A., and Wada, K., 1981, Adsorption of lead, copper, zinc, cobalt, and cadmium by soils that differ in cation-exchange materials, J. Soil Sci, 32(2): 271-283.

Brown, K., Thomas, J., and Slowley, J., 1983, The movement of metals applied to soils in sewage effluent, Water Air Soil Pollutant, 19(1):43-54.

California Regional Water Quality Control Board, San Francisco Bay Region (SFRWQCB), 1989, Basin Plan Amendments

Chang, A., Page, A., Warneke, J., and Grgurevic, E., 1984, Sequential extraction of soil heavy metals following a sludge application, J. Environ. Qual., 13(1):33-38.

Chang, A., Warneke, J., Page, A., and Lund, L., 1984, Accumulation of heavy metals in sewage sludge treated soils, J. Environ. Qual., 13(1):87-91.

Geomatrix Consultants, Inc. (Geomatrix), 1992, Preliminary Soil Sampling Results and Excavation and Stockpiling Plan, Berth 30, Oakland, California, 22 September.

Korte, N., Fuller, W., Niebla, E., Skopp, G., and Alsei, B., 1976, Trace element migration in soils: Desorption of attenuated ions and effects of solution flux, Residual Management by Land Disposal, EPA-600/9-75-015, U.S. Environmental Protection Agency, Cincinnati.

Miller, W., McFee, W., and Kelley, J., 1983, Mobility and retention of heavy metals in sandy soils, J. Environ. Qual., 12(4):579-584.

Shacklette, H.T., and Boerngen, J.G. (Shacklette and Boerngen), 1984, Element Concentrations in Soils and Other Surficial Materials of the Conterminus United States, U.S. Geological Survey Professional Paper 1270.

U.S. Environmental Protection Agency (EPA), 1986, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition.

Williams, D., Vlamis, J., Pukiter, A., and Coprey, J., 1980, Trace element accumulation, movement, and distribution in the soil profile from massive applications of sewage sludge, Soil Sci., 129(2):119-132.

Woodward-Clyde Consultants (WCC), 1990, Draft Report, Geotechnical Engineering Study, 7th Street Realignment and Carnation Terminal Yard, Port of Oakland, Oakland, California, October.

TABLE 1

SOIL SAMPLE PREPARATION AND TEST METHODS

Berth 30
Port of Oakland
Oakland, California

Analyte	Preparation Method	Test Method	Number of Samples Analzed	Laboratory
California Title 22 Total Metals	EPA 3050	EPA 6010	120	Clayton
Total Mercury	EPA 7471	EPA 7471	120	Clayton
Soluble Lead by the WET	CAM WET	EPA 6010	120	Clayton
Soluble Lead by the TCLP	EPA 1311	EPA 6010	120	Clayton
Soluble Mercury by the WET	CAM WET	EPA 7471	2	Clayton
Purgeable Organic Compounds	EPA 5030	EPA 8240	24	Clayton
Base/Neutral Acid Extractables	EPA 3550	EPA 8270	24	Clayton
Organochlorine Pesticides and Polychlorinated Biphenyls	EPA 3550	EPA 8080	12	Clayton
Ignitability	NA	SW 7.1.2	12	Clayton
Reactive Cyanide	NA	EPA 9010	12	Clayton
Reactive Sulfide	NA	SW 7.3.4.2	12	Clayton
pH	NA	EPA 9045	12	Clayton
Bioassay (Acute Aquatic Toxicity)	APHA 105 and ASTM E729	DHS ELAP Test No. 8.1	12	WBL

TABLE 1

SOIL SAMPLE PREPARATION AND TEST METHODS

Notes:

1. EPA = U.S. Environmental Protection Agency
   WET = Waste Extraction Test
   TCLP = Toxicity Characteristic Leaching Procedure
   NA = Not applicable
   SW = Solid Waste
   APHA = American Public Health Association
   ASTM = American Society for Testing and Materials
   DHS = Department of Health Services
   ELAP = Environmental Laboratory Accreditation Program
2. Clayton = Clayton Environmental Consultants of Pleasanton, California
   WBL = Western Bioassay Laboratory of Walnut Creek, California
3. References for preparation and test methods:
   - U.S. Environmental Protection Agency Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 2nd Edition.
   - California Code of Regulations, Title 22, Section 66700.
   - California Code of Regulations, Title 22, Section 66261.24(a)(6)
   - Kopperdahl, F.R., Guidelines for Performing Static Acute Toxicity Fish Bioassays in Municipal and Industrial Waste Waters, California Department of Fish and Game Water Pollution Control Laboratory, 1976.
   - Polisini, J.M, and Miller, R.G., Static Acute Bioassay Procedures for Hazardous Waste Samples, California Department of Fish and Game Water Pollution Control Laboratory, November 1988.
   - American Public Health Association, 1992, Standard Methods for the Examination of Water and Wastewater, 18th Edition.
   - American Society for Testing and Materials, 1980, Standard Practice for Conducting Acute Toxicity Tests with Fishes, Macroinvertebrates, and Amphibians.

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES
Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
2	2-2	6.3	0.1	2	4	98	0.1	0.3	24	8	41	98	0.9	ND	28	ND	ND	8	26	120
	2-8	5.4	ND	3	8	110	0.1	0.3	22	7	50	110	1.5	ND	30	ND	ND	7	26	170
	2-9	6.8	ND	2	4	100	0.1	0.3	24	7	48	130	1.0	1	27	ND	ND	6	26	130
	2-16	5.9	ND	5	5	120	0.1	0.4	24	11	41	130	1.4	ND	32	ND	ND	8	31	140
	2-17	8.0	ND	2	5	120	0.1	0.4	26	8	45	210	0.8	ND	31	ND	ND	7	30	130
	2-21	4.4	ND	3	6	93	ND	0.3	23	9	49	91	0.8	ND	31	ND	ND	7	26	150
	2-24	9.9	ND	2	5	83	0.1	0.4	21	7	110	96	1.4	ND	27	ND	ND	6	24	120
	2-26	4.1	0.1	2	7	87	0.1	0.5	25	7	41	110	1.8	ND	31	ND	ND	6	26	140
	2-29	4.7	ND	3	5	86	0.2	0.5	26	8	47	110	1.0	ND	30	ND	ND	9	27	130
	2-34	7.7	ND	4	7	85	0.1	0.3	23	8	42	110	1.2	ND	30	ND	ND	7	25	130
3	3-1	6.5	ND	2	6	85	0.2	0.2	23	7	71	100	1.4	ND	26	ND	ND	8	27	130
	3-13	4.9	ND	2	6	78	0.2	0.2	24	7	53	79	1.8	ND	30	ND	ND	8	28	110
	3-16	4.5	0.1	2	8	73	0.2	0.4	22	7	66	76	2.4	ND	28	ND	ND	9	27	120
	3-21	6.8	0.1	2	4	72	0.3	0.2	21	7	35	65	2.4	ND	27	ND	ND	8	24	100
	3-26	5.0	ND	2	6	100	0.2	0.2	25	8	240	75	1.7	ND	34	ND	ND	8	29	110
	3-27	6.6	ND	3	6	91	0.2	0.3	22	7	37	84	1.1	ND	28	ND	ND	5	26	130
	3-29	5.7	ND	3	6	88	0.1	0.4	27	8	64	90	1.2	ND	35	ND	ND	9	28	130
	3-30	9.6	ND	2	4	81	0.2	0.3	22	7	100	97	1.8	ND	26	ND	ND	6	27	140

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
3	3-35	7.5	ND	2	5	120	0.2	0.3	21	6	69	97	1.2	ND	27	ND	ND	7	25	120
	3-36	7.4	ND	3	5	98	0.2	0.5	22	7	35	87	1.1	ND	29	ND	ND	8	27	130
4	4-1	6.2	ND	2	5	95	ND	0.2	25	7	43	81	1.5	ND	32	1	ND	5	26	120
	4-4	3.6	ND	2	4	92	ND	0.2	23	8	54	57	0.6	ND	32	ND	ND	7	33	110
	4-9	8.9	ND	2	8	110	ND	0.6	25	8	47	160	0.5	ND	30	ND	ND	10	28	160
	4-11	4.6	ND	3	7	110	ND	0.4	31	8	55	160	0.3	ND	32	ND	ND	9	29	160
	4-14	21	ND	3	6	110	ND	0.4	29	9	68	110	0.6	ND	36	ND	ND	11	32	140
	4-15	5.6	ND	2	5	94	ND	0.3	21	8	58	88	1.5	ND	25	ND	ND	9	30	120
	4-21	32	ND	2	5	93	ND	0.4	22	8	51	100	0.9	ND	28	ND	ND	11	28	130
	4-22	43	ND	3	6	130	0.1	0.4	28	7	41	100	0.9	ND	29	ND	ND	10	30	150
	4-24	5.5	ND	2	5	94	ND	0.4	26	7	38	91	0.5	ND	33	ND	ND	11	26	140
	4-27	4.1	ND	2	3	84	ND	0.2	27	7	32	70	0.7	ND	29	ND	ND	9	25	110
5	5-5	9.4	ND	3	8	110	ND	0.3	24	8	51	150	0.5	ND	31	ND	ND	5	29	180
	5-10	8.6	ND	3	6	110	ND	0.2	25	7	76	140	1.1	ND	29	ND	ND	2	26	180
	5-11	11	ND	3	5	100	ND	0.2	23	7	46	100	0.7	ND	29	ND	ND	4	26	140
	5-17	5.9	ND	2	6	83	ND	0.2	26	7	110	160	1.2	ND	27	ND	ND	4	26	120
	5-19	1.4	ND	2	5	61	ND	0.2	32	10	34	32	0.1	ND	29	ND	ND	6	23	84
	5-25	4.9	ND	2	3	74	ND	ND	27	6	29	210	1.1	ND	27	ND	ND	2	22	100
	5-26	2.7	ND	1	5	63	ND	ND	27	8	24	41	0.3	ND	29	ND	ND	4	26	66

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
5	5-39	5.9	ND	2	2	92	ND	ND	25	8	43	110	0.6	ND	27	ND	ND	4	30	130
	5-44	10	ND	3	8	110	ND	0.3	26	8	39	170	0.4	ND	33	ND	ND	4	29	150
	5-49	12	ND	3	8	75	ND	0.2	21	9	53	120	1.1	ND	28	ND	ND	5	25	130
7	7-6	3.8	ND	2	5	95	0.1	0.2	28	8	44	67	0.4	ND	41	ND	ND	6	33	140
	7-7	5.8	ND	3	8	120	0.2	0.3	40	10	58	95	0.5	ND	62	ND	ND	9	36	130
	7-15	5.3	ND	3	8	110	0.1	0.2	34	9	42	81	0.3	ND	44	ND	ND	6	31	130
	7-16	8.5	ND	2	5	110	0.1	0.3	27	8	39	76	0.3	ND	38	ND	ND	7	29	120
	7-17	5.2	ND	2	4	110	0.1	0.5	29	8	45	86	0.4	ND	39	ND	ND	8	30	160
	7-18	5.2	ND	3	9	100	0.1	ND	50	12	93	86	0.4	ND	100	ND	ND	7	33	95
	7-33	3.4	ND	3	7	100	0.1	0.6	37	9	38	60	0.4	3	49	ND	ND	6	31	95
	7-34	5.0	ND	3	6	110	0.1	0.3	29	9	40	120	0.7	ND	40	ND	ND	8	32	120
	7-39	7.1	ND	2	6	110	0.1	0.2	27	8	65	120	0.8	ND	37	ND	ND	7	29	170
	7-40	9.6	ND	3	6	110	0.1	0.3	33	9	61	230	0.6	ND	48	ND	ND	9	32	140
8	8-2	7.4	ND	1	6	90	ND	0.2	21	6	36	67	0.5	ND	30	ND	ND	10	26	90
	8-6	7.0	ND	3	8	85	0.1	0.3	25	8	49	76	0.7	ND	31	ND	ND	10	28	110
	8-12	6.9	ND	2	7	88	ND	0.3	22	8	41	81	0.5	ND	32	ND	ND	11	27	110
	8-29	3.1	ND	2	8	74	ND	ND	28	8	24	24	0.3	ND	56	ND	ND	9	28	58
	8-31	7.5	ND	3	13	120	ND	0.3	34	9	33	70	0.4	ND	46	ND	ND	13	31	96
	8-34	7.1	ND	3	5	88	ND	0.2	24	7	53	94	1.6	ND	29	ND	ND	7	26	120

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
8	8-35	5.5	ND	2	11	85	ND	0.3	29	9	44	86	0.3	ND	45	ND	ND	13	29	110
	8-37	5.3	ND	3	2	100	0.1	0.3	26	10	36	75	0.3	1	82	ND	ND	12	32	120
	8-44	7.9	ND	2	3	110	ND	0.2	41	11	28	58	0.4	ND	53	ND	ND	8	25	95
	8-47	7.6	ND	2	8	88	ND	0.2	23	7	34	93	0.6	ND	33	ND	ND	9	25	110
9	9-1	8.2	ND	2	3	120	ND	0.4	21	8	62	79	0.1	ND	38	1	ND	5	19	120
	9-2	15	ND	3	10	110	0.2	0.3	30	9	60	150	0.3	ND	40	ND	ND	9	28	150
	9-4	9.2	ND	5	5	100	0.2	0.5	30	9	51	110	0.3	ND	38	2	ND	8	26	160
	9-10	5.4	ND	2	5	98	0.2	0.6	44	11	37	84	0.3	ND	72	ND	ND	7	31	130
	9-12	7.2	ND	3	15	100	0.3	0.5	29	9	64	120	0.2	ND	36	ND	ND	8	31	190
	9-14	14	ND	3	12	100	0.2	0.2	21	9	46	99	0.4	ND	27	ND	ND	7	36	130
	9-22	5	ND	3	8	180	0.2	0.7	62	14	50	110	0.3	ND	100	ND	ND	9	36	160
	9-27	9.4	0.3	3	7	120	0.2	0.5	33	9	47	110	0.7	ND	46	3	ND	8	30	150
	9-30	5.4	ND	7	17	89	0.1	1.4	26	9	42	110	1.3	3	38	8	ND	18	30	130
	9-31	8.5	ND	5	15	110	0.2	0.5	29	10	70	120	0.8	ND	42	2	ND	26	32	130
10	10-4	5.2	ND	3	7	71	0.2	0.4	25	7	120	86	0.3	ND	32	ND	ND	11	25	140
	10-7	5.7	ND	3	9	100	0.2	0.4	22	9	83	100	0.2	ND	28	ND	ND	10	25	130
	10-11	6	ND	3	8	76	0.2	0.3	27	7	95	94	0.2	ND	31	ND	ND	9	25	240
	10-12	3.7	ND	2	7	130	0.3	0.4	23	8	99	100	0.3	ND	29	2	ND	16	29	180
	10-13	7.1	ND	3	8	130	0.4	0.6	33	9	120	140	0.3	ND	36	ND	ND	15	36	190

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
10	10-15	3.7	ND	2	16	73	0.2	1.3	23	9	130	110	0.3	ND	33	ND	ND	15	25	1300
	10-19	11	ND	3	7	100	0.2	0.6	29	8	67	130	0.3	ND	37	ND	ND	8	28	130
	10-24	5.6	ND	2	10	91	0.2	0.6	23	7	55	95	0.3	ND	32	ND	ND	11	25	350
	10-29	16	ND	3	8	85	0.2	0.5	25	8	46	120	0.4	ND	32	ND	ND	11	29	130
	10-48	6.8	ND	2	7	78	0.2	0.3	21	6	58	120	0.7	ND	27	ND	ND	9	25	120
11	11-2	11	ND	4	1	100	0.2	0.4	20	8	120	150	0.4	1	32	ND	ND	3	29	210
	11-12	5	ND	3	6	83	0.2	0.4	22	8	120	180	0.2	1	35	ND	ND	4	24	180
	11-19	7.3	ND	2	5	88	0.2	0.3	24	7	65	110	0.3	ND	28	ND	ND	ND	26	150
	11-27	5.3	ND	2	5	80	0.2	0.4	28	9	52	73	0.2	ND	37	ND	ND	4	28	110
	11-28	2.9	ND	2	6	97	0.3	0.2	42	10	40	70	0.2	ND	56	ND	ND	4	35	120
	11-30	4.7	ND	2	5	91	0.2	0.4	27	8	45	86	0.3	ND	35	ND	ND	3	27	170
	11-31	4.9	ND	3	5	120	0.3	0.6	31	9	51	100	0.3	1	50	ND	ND	3	34	140
	11-32	6.5	ND	7	12	110	0.2	0.6	32	11	120	190	0.2	6	43	ND	ND	14	26	210
	11-34	6.2	ND	3	6	97	0.3	0.3	24	8	54	290	ND	ND	38	ND	ND	3	29	120
	11-43	4.9	ND	3	6	110	0.3	0.3	35	10	46	80	0.3	1	60	ND	ND	2	37	120
14	14-6	7.4	ND	2	4	85	0.2	0.5	26	9	100	71	0.5	ND	36	ND	ND	ND	27	140
	14-19	2.6	ND	3	3	180	0.2	0.3	33	8	61	70	0.4	ND	37	ND	ND	ND	28	170
	14-20	3.9	ND	2	4	94	0.2	0.3	35	8	43	59	1.1	ND	34	ND	ND	ND	26	98
	14-21	2.7	ND	3	6	140	0.4	0.3	24	9	44	59	1.9	ND	45	1	ND	ND	27	120

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
14	14-24	2.5	0.3	2	5	69	0.2	0.3	19	8	110	57	1.1	ND	27	ND	ND	ND	23	130
	14-28	4.7	ND	2	4	75	0.2	0.3	23	7	130	67	1.2	ND	28	ND	ND	ND	24	170
	14-30	4.6	0.4	2	5	75	0.2	0.3	24	8	74	72	1.3	ND	34	ND	ND	ND	26	120
	14-37	6.6	ND	2	4	51	0.2	0.2	26	7	78	76	1.6	ND	30	ND	ND	ND	20	110
	14-39	9.4	0.3	2	4	68	0.2	0.3	20	7	94	67	0.4	ND	30	ND	ND	ND	22	140
	14-40	4.1	ND	2	5	62	0.2	0.3	22	8	81	57	1.7	ND	32	ND	ND	ND	24	170
16	16-1	8.1	ND	2	6	74	0.1	0.3	23	7	55	81	0.5	ND	27	ND	ND	ND	22	150
	16-3	3.1	ND	2	6	55	0.1	0.3	30	8	37	50	0.4	ND	38	ND	ND	ND	25	90
	16-5	6.5	ND	3	6	74	0.1	0.4	23	8	53	92	0.6	ND	28	1	ND	ND	25	130
	16-15	4.4	ND	2	8	64	0.1	0.3	17	6	77	65	0.4	ND	23	ND	ND	ND	17	110
	16-16	2.0	ND	2	5	57	0.2	0.3	25	8	95	60	1.2	ND	32	ND	ND	ND	26	120
	16-18	5.8	ND	3	6	82	0.1	0.4	25	9	58	100	0.6	ND	37	ND	ND	ND	26	130
	16-26	4.4	ND	3	5	63	0.3	0.4	21	8	86	130	1.1	ND	29	ND	ND	ND	25	160
	16-27	3.7	ND	2	4	62	0.2	0.4	21	8	73	88	2.6	ND	28	ND	ND	ND	23	130
	16-33	4.6	ND	4	9	61	ND	0.5	16	9	75	100	0.4	ND	26	ND	ND	ND	23	200
	16-42	6.1	ND	3	5	81	0.1	0.3	23	7	69	120	0.9	ND	27	ND	ND	ND	25	140
17	17-2	4.7	ND	3	10	71	0.1	0.2	33	12	85	81	0.7	ND	40	ND	ND	ND	44	130
	17-7	6.5	ND	2	6	89	0.2	0.3	28	8	78	110	0.3	ND	32	ND	ND	ND	29	170
	17-11	7.8	ND	2	5	87	0.2	0.3	29	10	65	100	0.3	ND	36	ND	ND	ND	30	140

TABLE 2

METALS ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/l or mg/kg)

Stockpile Number	Sample Number	WET Lead	TCLP Lead	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
17	17-12	8.1	ND	2	5	79	0.1	0.3	20	8	66	120	0.4	ND	28	ND	ND	ND	24	150
	17-13	7.9	ND	2	5	80	0.1	0.2	23	7	66	110	0.5	ND	28	ND	ND	ND	24	150
	17-21	5.1	ND	2	6	76	0.1	0.3	26	8	91	92	1.1	ND	32	ND	ND	ND	28	170
	17-23	4.8	0.2	2	6	58	0.1	0.2	24	8	75	72	0.7	ND	31	ND	ND	ND	23	130
	17-30	2.7	ND	3	6	72	0.2	0.6	26	8	60	90	0.7	ND	33	ND	ND	ND	25	140
	17-32	5.2	ND	2	5	75	0.1	0.3	24	8	69	110	0.9	ND	29	ND	ND	ND	25	140
	17-36	2.5	ND	3	5	64	0.1	0.4	24	7	130	65	1.8	ND	30	ND	ND	ND	24	120

Notes:

1. Samples collected by Geomatrix Consultants, Inc., and analyzed by Clayton Environmental Consultants of Pleasanton, California.
2. Analyses performed in accordance with U.S. Environmental Protection Agency (EPA) Methods 6010 and 7471 for total metals and the Waste Extraction Test (WET) and EPA Method 1311 (TCLP) followed by EPA Method 6010 for soluble lead.
3. WET - Waste Extraction Test
   TCLP - Toxic Characteristic Leaching Procedure
   Sb - Antimony As - Arsenic Ba - Barium Be - Beryllium Cd - Cadmium Cr - Chromium
   Co - Cobalt Cu - Copper Pb - Lead Hg - Mercury Mo - Molybdenum Ni - Nickel
   Se - Selenium Ag - Silver Tl - Thallium V - Vanadium Zn - Zinc ND - Not detected
4. Samples 2-2, 3-27, 4-22, 5-10, 7-18, 8-34, 9-1, 10-29, 11-2, 14-19, 16-1, and 17-11 also analyzed for reactivity, corrosivity, and ignitability. Results indicate soil is not reactive (reactive cyanide not detected and sulfide ranged from not detected to 30 ppm), corrosive (pH ranges from 8.5 to 11.1), or ignitable.
5. Samples 3-16, 3-21, and 16-27 also analyzed for soluble mercury by the WET followed by EPA Method 7471. Results indicate that soil samples do not contain soluble mercury above the detection limit of 0.01 mg/l.
6. One replicate analysis of 11-2 had a concentration of 720 mg/kg. An additional 5 replicate analyses indicated concentrations ranging from 78 to 110 mg/kg.

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES
Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
2	2-17	--		--		4,4'-DDE	0.06
						4,4'-DDD	0.16
						4,4'-DDT	0.29
	2-29	ND		ND		--	
	2-34	ND		Acenaphthene	2	--	
				Dibenzofuran	1		
				Fluorene	2		
				Phenanthrene	5		
				Anthracene	1		
				Fluoranthene	3		
				Pyrene	2		
3	3-13	Ethylbenzene	0.009	Naphthalene	8	--	
		Total Xylenes	0.018	2-methyl naphthalene	2		
		Acetone	0.03	Acenaphthene	3		
				Dibenzofuran	2		
				Fluorene	3		
				Phenanthrene	8		
				Anthracene	2		
				Fluoranthene	3		
				Pyrene	2		
	3-29	--		--		4,4'-DDE	0.07
						4,4'-DDD	0.12
						4,4'-DDT	0.22

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
3	3-36	1,2-DCA	0.008	Naphthalene	3	--	
		Ethylbenzene	0.006	Acenaphthene	2		
		Total Xylenes	0.007	Phenanthrene	3		
				Fluoranthene	2		
				Pyrene	2		
4	4-15	ND		Naphthalene	2.0	--	
				2-methyl naphthalene	0.7		
				Acenaphthene	1.4		
				Dibenzofuran	0.7		
				Fluorene	1.2		
				Phenanthrene	2.9		
				Anthracene	0.8		
				Fluoranthene	1.7		
				Pyrene	1.8		
				Benzo(a)anthracene	0.3		
				Chrysene	0.4		
				Benzo(b)fluoranthene	0.8		
				Benzo(k)fluoranthene	0.2		
				Benzo(a)pyrene	0.3		
				Indeno(1,2,3-cd)pyrene	0.2		
				Benzo(ghi)perylene	0.3		
	4-24	--		--		4,4'-DDE	0.22
						4,4'-DDD	0.17
						4,4'-DDT	0.44

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
4	4-27	ND	Naphthalene	1.0	--	
			2-methyl naphthalene	0.3		
			Acenaphthene	0.6		
			Dibenzofuran	0.3		
			Fluorene	0.6		
			Phenanthrene	1.9		
			Anthracene	0.7		
			Fluoranthene	2.0		
			Pyrene	1.7		
			Benzo(a)anthracene	0.5		
			Chrysene	0.5		
			Benzo(b)fluoranthene	0.7		
			Benzo(k)fluoranthene	0.2		
			Benzo(a)pyrene	0.3		
5	5-25	--	--		4,4'-DDE	0.19
					4,4'-DDD	0.08
					4,4'-DDT	0.11
	5-26	ND	Naphthalene	0.6	--	
			Acenaphthene	0.3		
			Fluorene	0.3		
			Phenanthrene	0.8		
			Anthracene	0.2		
			Fluoranthene	0.5		
			Pyrene	0.4		
			Benzo(b)fluoranthene	0.2		
	5-44	ND	ND		--	
7	7-6	ND	ND		--	

TABLE 3

EPA METHODS 8240, 8270, AND 8080 ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
7	7-15	ND	ND		--	
	7-39	--	--		4,4'-DDE	0.07
					4,4'-DDD	0.15
					4,4'-DDT	0.26
8	8-31	--	--		4-4'-DDE	0.02
					4,4'-DDD	0.05
					4,4'-DDT	0.08
	8-34	ND	Naphthalene	4	--	
			Acenaphthene	4		
			Dibenzofuran	2		
			Fluorene	3		
			Phenanthrene	8		
			Anthracene	2		
			Fluoranthene	3		
			Pyrene	2		
	8-47	ND	Phenanthrene	2	--	

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
9	9-2	ND	Naphthalene	0.5	--	
			Acenaphthene	0.6		
			Fluorene	0.5		
			Phenanthrene	1.5		
			Anthracene	0.3		
			Fluoranthene	0.8		
			Pyrene	0.6		
			Benzo(a)anthracene	0.2		
			Chrysene	0.2		
			Benzo(b)fluoranthene	0.4		
			Benzo(a)pyrene	0.2		
	9-12	--	--		4,4’-DDE	0.05
					4,4’-DDD	0.13
					4,4’-DDT	0.14
	9-14	ND	Naphthalene	0.4	--	
			Acenaphthene	0.2		
			Fluorene	0.2		
			Phenanthrene	0.6		
			Fluoranthene	0.5		
			Pyrene	0.4		
			Chrysene	0.2		
			Benzo(b)fluoranthene	0.4		
			Benzo(k)fluoranthene	0.2		
			Benzo(a)pyrene	0.3		
10	10-4	--	--		4-4’-DDD	0.06
					4-4’-DDT	0.08

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds
10	10-13	Ethylbenzene	0.016	Naphthalene	6	--
		Total Xylenes	0.027	2-methyl naphthalene	1	
				Acenaphthene	4	
				Dibenzofuran	2	
				Fluorene	3	
				Phenanthrene	9	
				Anthracene	2	
				Fluoranthene	3	
				Pyrene	2	
	10-19	Total Xylenes	0.006	Naphthalene	2	--
				Acenaphthene	1	
				Fluorene	1	
				Phenanthrene	3	
				Fluoranthene	1	
				Pyrene	1	

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds
11	11-12	Ethylbenzene	0.007	Naphthalene	2.1	--
		Total Xylenes	0.013	2-methyl naphthalene	0.6	
				Acenaphthene	1.5	
				Dibenzofuran	0.6	
				Fluorene	1.2	
				Phenanthrene	3.2	
				Anthracene	1.0	
				Fluoranthene	1.8	
				Pyrene	1.4	
				Benzo(a)anthracene	0.5	
				Chrysene	0.5	
				Benzo(b)fluoranthene	0.6	
				Benzo(k)fluoranthene	0.3	
				Benzo(a)pyrene	0.4	
	11-32	ND		Naphthalene	1.5	--
				2-methyl naphthalene	0.3	
				Acenaphthene	0.8	
				Dibenzofuran	0.4	
				Fluorene	0.7	
				Phenanthrene	2.4	
				Anthracene	0.6	
				Fluoranthene	1.3	
				Pyrene	1.0	
				Benzo(a)anthracene	0.4	
				Chrysene	0.4	
				Benzo(b)fluoranthene	0.4	
				Benzo(k)fluoranthene	0.2	
				Benzo(a)pyrene	0.3	

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
11	11-34	--		--		4,4'-DDE	0.031
						4,4'-DDD	0.040
						4,4'-DDT	0.19
14	14-6	Toluene	0.007	Naphthalene	3.6	--	
		Ethylbenzene	0.017	2-methyl naphthalene	1.0		
		Total Xylenes	0.035	Acenaphthene	1.2		
				Dibenzofuran	0.8		
				Fluorene	1.0		
				Phenanthrene	2.8		
				Anthracene	0.6		
				Fluoranthene	1.2		
				Pyrene	1.2		
				Benzo(a)anthracene	0.3		
				Chrysene	0.3		
				Benzo(b)fluoranthene	0.3		
				Benzo(k)fluoranthene	0.4		
	14-20	--		--		4,4'-DDE	0.020
						4,4'-DDD	0.026
						4,4'-DDT	0.072

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds		EPA Method 8270 Compounds		EPA Method 8080 Compounds	
14	14-24	Toluene	0.012	Naphthalene	9.8	--	
		Ethylbenzene	0.032	2-methyl naphthalene	3.2		
		Total Xylenes	0.065	Acenaphthene	4.0		
				Dibenzofuran	2.9		
				Fluorene	3.4		
				Phenanthrene	10		
				Anthracene	2.3		
				Fluoranthene	2.8		
				Pyrene	2.8		
				Benzo(a)anthracene	0.5		
				Chrysene	0.5		
				Benzo(b)fluoranthene	0.3		
				Benzo(k)fluoranthene	0.3		
				Benzo(a)pyrene	0.3		
16	16-15	Toluene	0.005	Naphthalene	4	--	
		Ethylbenzene	0.019	Phenanthrene	4		
		Total Xylenes	0.036				
	16-16	Ethylbenzene	0.019	Naphthalene	6	--	
		Total Xylenes	0.028	Acenaphthene	2		
				Phenanthrene	4		
	16-26	--		--		4,4'-DDE	0.05
						4,4'-DDD	0.11
						4,4'-DDT	0.36
17	17-7	Ethylbenzene	0.007	Fluoranthene	2	--	
		Total Xylenes	0.016	Naphthalene	4		
				Phenanthrene	4		

TABLE 3

EPA METHODS 8240, 8270, AND 8080
ANALYTICAL RESULTS FOR STOCKPILE SAMPLES

Concentrations in parts per million (mg/kg)

Stockpile Number	Sample Number	EPA Method 8240 Compounds	EPA Method 8270 Compounds		EPA Method 8080 Compounds	
17	17-23	ND	Naphthalene	3	--	
			Phenanthrene	2		
	17-32	--	--		4,4’-DDE	0.045
					4,4’-DDD	0.095
					4,4’-DDT	0.20

Notes:

1. Samples collected by Geomatrix Consultants, Inc., and analyzed by Clayton Environmental Consultants of Pleasanton, California in accordance with the analytical methods indicated. Two samples from each stockpile were analyzed by U.S. Environmental Protection Agency (EPA) Methods 8240 and 8270, and one sample from each stockpile was analyzed by EPA Method 8080.
2. -- = not analyzed
   ND = not detected
   1,2-DCA = 1,2-dichloroethane

TABLE 4

SUMMARY OF METALS CONCENTRATIONS, BACKGROUND CONCENTRATIONS, AND REGULATORY CRITERIA

Berth 30
Port of Oakland
Oakland, California

Concentrations in parts per million (mg/kg)

Metals	Range	Mean[1]	Background[2]	TTLC[3]	10 x STLC[3]
Antimony	1-7	2.6	<1-10	500	150
Arsenic	1-17	6.3	6.5-65	500	50
Barium	51-180	92.7	500-3000	10000	1000
Beryllium	<0.1-0.4	0.1	<1	75	7.5
Cadmium	<0.1-1.4	0.4	--	100	10
Chromium	16-62	26.5	100-1000	2500	5600
Cobalt	6-14	8.2	15-70	8000	800
Copper	24-240	63.1	30-500	2500	250
Lead	24-290	100.4	30-300	1000	50
Mercury	<0.1-2.6	0.8	0.082-1.3	20	2
Molybdenum	<1-6	0.6	<3	3500	3500
Nickel	25-100	35.6	30-300	2000	200
Selenium	<1-8	0.2	<0.1-0.5	100	10
Silver	<0.5	--	--	500	50
Thallium	<1-26	6.1	--	700	70
Vanadium	17-44	27.5	150-500	2400	240
Zinc	58-1300	146.5	120-400	5000	2500

Notes:

[1] Mean concentrations calculated using half the detection limit for samples reported as non-detect.

[2] Shacklette, H.T., and Boerngen, J.G., 1984, Element Concentrations in Soils and other Surficial Materials of the Conterminous United States, U.S. Geological Survey Professional Paper 1270.

[3] TTLC = Total Threshold Limit Concentration and STLC = Soluble Threshold Limit Concentration, California Code of Regulations, Title 22, Section 66261.24.

TABLE 5

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR COMPOUNDS DETECTED

Berth 30
Port of Oakland
Oakland, California

Compound	Mean Concentration (mg/kg)	% Mean Concentration	Oral LD50 (mg/kg)	% Mean/ Oral LD50	Dermal LD50 (mg/kg)	% Mean/ Dermal LD50
Toluene	0.0032	0.00000032	2600	1.23e-10	12220	2.62e-11
Ethylbenzene	0.0071	0.00000071	5460	1.30e-10	12220	5.81e-11
Total Xylenes	0.0135	0.00000135	4300	3.14e-10	12690	1.06e-10
Acetone	0.0108	0.00000108	8320	1.30e-10	10970	9.85e-11
1,2-dichloroethane	0.0027	0.00000027	670	4.03e-10	3400	7.94e-11
Naphthalene	2.77	0.000277	354	7.82e-07	2000	1.39e-07
2-methyl naphthalene	0.87	0.000087	354	2.46e-07	2000	4.35e-08
Acenaphthene	1.48	0.000148	354	4.18e-07	2000	7.40e-08
Fluorene	1.28	0.000128	354	3.62e-07	2000	6.40e-08
Phenanthrene	3.4	0.00034	354	9.60e-07	2000	1.70e-07
Anthracene	0.98	0.000098	354	2.77e-07	2000	4.90e-08
Fluoranthene	1.55	0.000155	354	4.38e-07	2350	6.60e-08
Pyrene	1.28	0.000128	354	3.62e-07	2000	6.40e-08
Chrysene	0.69	0.000069	354	1.95e-07	2000	3.45e-08

TABLE 5

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR COMPOUNDS DETECTED

Compound	Mean Concentration (mg/kg)	% Mean Concentration	Oral LD50 (mg/kg)	% Mean/ Oral LD50	Dermal LD50 (mg/kg)	% Mean/ Dermal LD50
Dibenzofuran	0.96	0.000096	354	2.71e-07	2000	4.80e-08
Benzo(a)anthracene	0.66	0.000066	354	1.86e-07	2000	3.30e-08
Benzo(b)fluoranthene	0.7	0.00007	354	1.98e-07	2000	3.50e-08
Benzo(k)fluoranthene	0.63	0.000063	354	1.78e-07	2000	3.15e-08
Indeno(1,2,3-cd)pyrene	0.58	0.000058	354	1.64e-07	2000	2.90e-08
Benzo(a)pyrene	0.64	0.000064	354	1.81e-07	2000	3.20e-08
Benzo(ghi)perylene	0.59	0.000059	354	1.67e-07	2000	2.95e-08
DDE	0.07	0.000007	113	6.19e-08	2510	2.79e-09
DDD	0.1	0.00001	3400	2.94e-09	10000	1.00e-09
DDT	0.2	0.00002	113	1.77e-07	2510	7.97e-09
Antimony	2.6	0.00026	7000	3.71e-08	--	--
Arsenic	6.3	0.00063	10	6.30e-05	--	--
Barium	92.7	0.00927	1980	4.68e-06	--	--
Beryllium	0.1	0.00001	18	5.56e-07	--	--
Cadmium	0.4	0.00004	40	1.00e-06	--	--
Chromium	26.5	0.00265	16.7	1.59e-04	--	--

TABLE 5

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR COMPOUNDS DETECTED

Compound	Mean Concentration (mg/kg)	% Mean Concentration	Oral LD50 (mg/kg)	% Mean/ Oral LD50	Dermal LD50 (mg/kg)	% Mean/ Dermal LD50
Cobalt	8.2	0.00082	75	1.09e-05	--	--
Copper	63.1	0.00631	100	6.31e-05	--	--
Lead	100.4	0.01004	191	5.26e-05	--	--
Mercury	0.8	0.00008	25.9	3.09e-06	--	--
Molybdenum	0.6	0.00006	114	5.26e-07	--	--
Nickel	35.6	0.00356	118	3.02e-05	--	--
Selenium	0.2	0.00002	6700	2.99e-09	--	--
Silver	NA	NA	NA	NA	--	--
Thallium	6.1	0.00061	32	1.91e-05	--	--
Vanadium	27.5	0.00275	31.2	8.81e-05	--	--
Zinc	146.5	0.01465	390	3.76e-05	--	--

SUM = 5.39e-04

SUM = 9.54e-07

Calculated Oral LD50 = 851,619 mg/kg

Calculated Dermal LD50 = 104,867,647 mg/kg

Notes:

1. Mean concentrations calculated using half the deflection limit for compounds reported as non-detect. Silver was not detected in any of the samples analyzed.
2. % Mean Concentration = (Mean Concentration in mg/kg)/10,000

TABLE 5

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR COMPOUNDS DETECTED

3. Oral and dermal LD50 values from:
   TOXNET, Hazardous Substance Database, 1993.
   TOXNET, Registry of Toxic Effects Chemical Sutstances Database, 1993.
   Smyth, Jr., H.F., Carpenter, Weil, C.S., et al, Range-finding Toxicity Data, List VI, American Industrial Hygiene Journal, 23:95-107 (1962).
   Agency for Toxic Substances and Disease Registry, U.S. Public Health Services (ATSDR), 1990 Toxicological Profile for Naphthalene and 2-methyl Naphthalene, PB91-180562, December.
   American Conference of Government Industrial Hygienist, Inc., 1991, Documentation of the Threshold Limit Values and Biological Exposure Indices, btn edition, Cincinnati, Ohio.
   ATSDR, 1988, Toxicological Profile for Beryllium, PB89-148233, December.
   ATSDR, 1989, Toxicological Profile for Chromium, PB89-236665, July.
   ATSDR, 1989, Toxicological Profile for Mercury, PB89-181256, December.
   ATSDR, 1989, Toxicological Profile for Selenium.
   ATSDR, 1992, Toxicological Profile for Thallium, TP-91/26.
   ATSDR, 1992, Toxicological Profile for Vanadium, TP-91/29.
   ATSDR, 1992, Draft Toxicological Profile for Zinc.
   ATSDR, 1988, Toxicological Profile for Nickel, PB89-160378, December.
   Lewis, Jr, R.L., 1992, Sax's Dangerous Properties of Industrial Materials, 8th edition, Volume III, Van Nostrand, Deinhold, New York.
4. Calculated LD50 = 100/SUM(% Mean Concentration/LD50)
5. If no compound specific LD50 value was available, the LD50 for similar compounds or the LDLo was used. The LD50 for DDT was ussed for DDE.
6. The metals detected are not dermally toxic, therefore the acute dermal toxicity calculation is for organic compounds only.

TABLE 6

SW-846 STATISTICAL ANALYSIS FOR SOLUBLE LEAD STOCKPILE SAMPLES

Berth 30
Port of Oakland
Oakland, California

UPPER CONFIDENCE LEVEL:

$$UCL = \bar{x} + t_{.20}s_{\bar{x}}$$

where:

$\bar{x}$ = average concentration
$t_{.20}$ = student t-test value
$s_{\bar{x}}$ = the standard error of the sample set

UCL for soluble lead = 6.90 + 1.289(0.45) = 7.48 mg/l
Regulatory Threshold (RT) for soluble lead = 5 mg/l
If UCL is greater than RT, as in this case, the waste is hazardous.

NUMBER OF SAMPLES NEEDED TO CHARACTERIZE WASTE:

$$n = \frac{t_{.20}{}^2 s^2}{(RT - \bar{x})^2}$$

where:

$t_{.20}$ = student t-test value
s = standard deviation of the sample set
RT = regulatory threshold
$\bar{x}$ = average concentration

$$n = \frac{(1.289)^2\ (4.97)^2}{(5-6.90)^2}$$

n = 11.41

Number of samples tested was 120, therefore results are statistically representative.

TABLE 7

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR PNAs AND VOCs

Berth 30
Port of Oakland
Oakland, California

Compound	Mean Concentration (mg/kg)	% Mean Concentration	Oral LD50 (mg/kg)	% Mean/Oral LD50	Dermal LD50 (mg/kg)	% Mean/ Dermal LD50
Toluene	0.0032	0.00000032	2600	1.23e-10	12220	2.62e-11
Ethylbenzene	0.0071	0.00000071	5460	1.30e-10	12220	5.81e-11
Total Xylenes	0.0135	0.00000135	4300	3.14e-10	12690	1.06e-10
Acetone	0.0108	0.00000108	8320	1.30e-10	10970	9.85e-11
1,2-dichloroethane	0.0027	0.00000027	670	4.03e-10	3400	7.94e-11
Naphthalene	2.77	0.000277	354	7.82e-07	2000	1.39e-07
2-methyl naphthalene	0.87	0.000087	354	2.46e-07	2000	4.35e-08
Acenaphthene	1.48	0.000148	354	4.18e-07	2000	7.40e-08
Fluorene	1.28	0.000128	354	3.62e-07	2000	6.40e-08
Phenanthrene	3.4	0.00034	354	9.60e-07	2000	1.70e-07
Anthracene	0.98	0.000098	354	2.77e-07	2000	4.90e-08
Fluoranthene	1.55	0.000155	354	4.38e-07	2350	6.60e-08
Pyrene	1.28	0.000128	354	3.62e-07	2000	6.40e-08
Chrysene	0.69	0.000069	354	1.95e-07	2000	3.45e-08
Dibenzofuran	0.96	0.000096	354	2.71e-07	2000	4.80e-08

TABLE 7

ACUTE ORAL AND DERMAL LD50 CALCULATIONS FOR PNAs AND VOCs

Compound	Mean Concentration (mg/kg)	% Mean Concentration	Oral LD50 (mg/kg)	% Mean/Oral LD50	Dermal LD50 (mg/kg)	% Mean/ Dermal LD50
Benzo(a)anthracene	0.66	0.000066	354	1.86e-07	2000	3.30e-08
Benzo(b)fluoranthene	0.7	0.00007	354	1.98e-07	2000	3.50e-08
Benzo(k)fluoranthene	0.63	0.000063	354	1.78e-07	2000	3.15e-08
Indeno(1,2,3-cd)pyrene	0.58	0.000058	354	1.64e-07	2000	2.90e-08
Benzo(a)pyrene	0.64	0.000064	354	1.81e-07	2000	3.20e-08
Benzo(ghi)perylene	0.59	0.000059	354	1.67e-07	2000	2.95e-08

SUM =	5.39e-05		SUM =	9.42e-06
Calculated Oral LD50 =	18,569,134 mg/kg		Calculated Dermal LD50 =	106,176,727 mg/kg

Notes:

1. Mean concentrations calculated using half the deflection limit for compounds reported as non-detect.
2. % Mean Concentration = (Mean Concentration in mg/kg)/10,000
3. Oral and dermal LD50 values from:
   TOXNET, Hazardous Substance Database, 1993.
   Smyth, Jr., H.F., Carpenter, Weil, C.S., et al, Range-finding Toxicity Data, List VI, American Industrial Hygiene Journal, 23:95-107 (1962).
   Life Systems, Inc., 1990, Toxicological Profile for Naphthalene and 2-methyl Naphthalene, prepared for Agency for Toxic Substances and Disease Registry, U.S. Public Health Services, PB91-180562, December.
4. Calculated LD50 = 100/SUM(% Mean Concentration/LD50)
5. If no compound specific LD50 value was available, the LD50 for similar compounds was used.

TABLE 8

CALCULATIONS OF PARTITION COEFFICIENTS

Berth 30
Port of Oakland
Oakland, California

Compound	Solubility[1] (mg/l)	Koc[2]	Kp[3]
Toluene	542	180	0.18
Ethylbenzene	165	376	0.38
Xylenes	199	335	0.33
Acetone[4]	--	--	--
1,2-Dichloroethane	8680	32.22	0.03
Naphthalene	32.1	1,037	1.04
2-methyl naphthalene	27	1,155	1.15
Acenaphthene	3.9	3,833	3.83
Dibenzofuran	10	2,138	2.14
Fluorene	1.9	5,986	5.99
Phenanthrene	1.6	6,660	6.66
Anthracene	1.29	7,611	7.61
Fluoranthene	0.265	20,304	20.30
Pyrene	0.032	75,302	75.30
Chrysene	0.006	212,592	212.59
Benzo(a)anthracene	0.01	154,882	154.88
Benzo(b)fluoranthene	0.014	125,719	125.72
Benzo(k)fluoranthene	0.00076	765,413	765.41
Benzo(a)pyrene	0.003	326,727	326.73
Benzo(ghi)perylene	0.00026	1,488,389	1,488.39
Indeno(1,2,3-cd)pyrene	0.62	49,971	49.97

[1] Solubilities taken from Roy, W.R., and Griffin, R.A., 1985, "Mobility of Organic Solvents in Water-Saturated Soil Materials," Environmental Geology Water Science, Volume 7, Number 4.

[2] Koc is octanol/water partition coefficient; log(Koc) = 3.95 - 0.62 log(S) where S is solubility (Roy and Griffin, 1985).

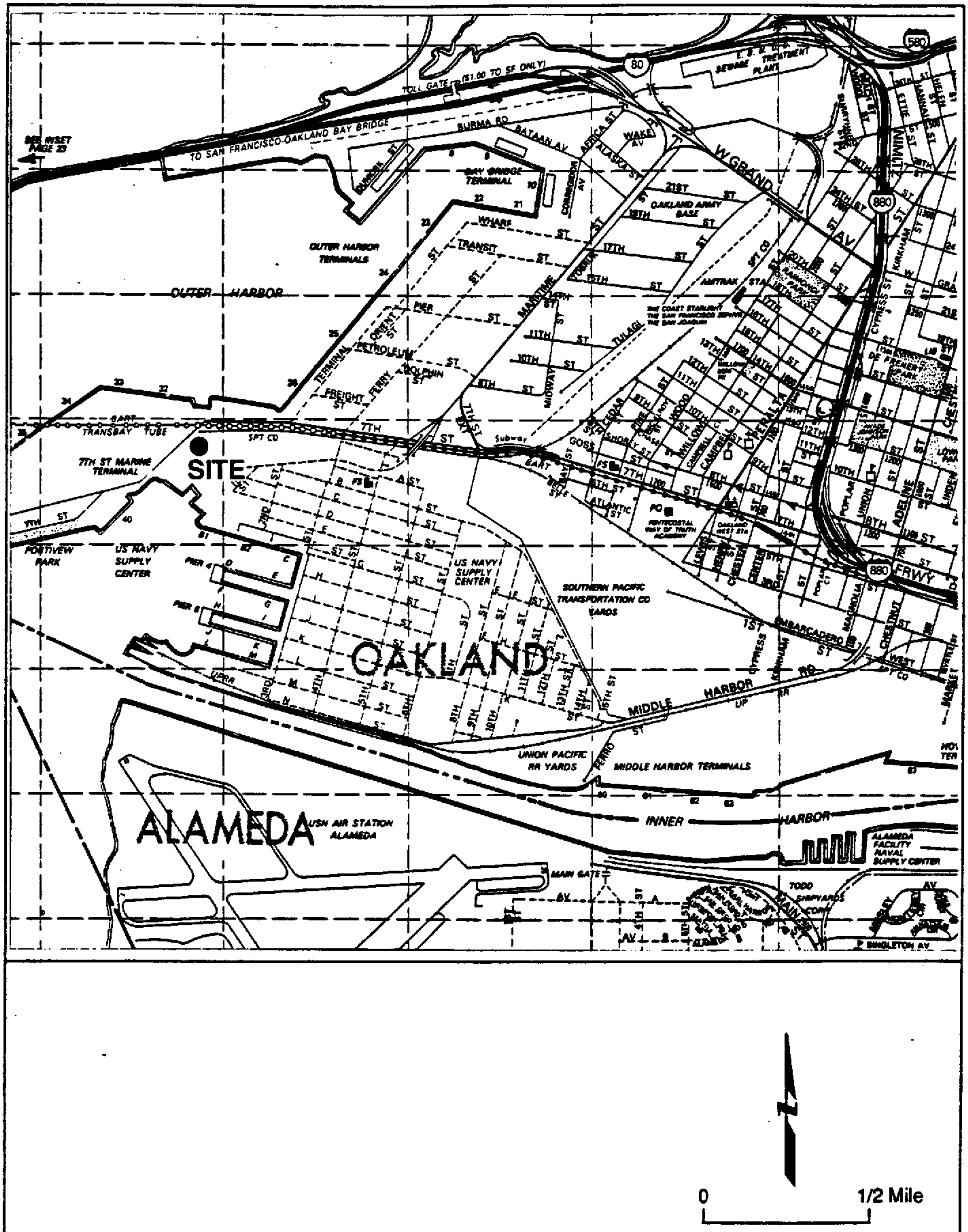
[3] Kp = soil/water partitioning coefficient (l/kg)
= (mg/kg in soil)/(mg/l in water) at equilibrium;
Kp = Koc x foc, where foc is fraction of organic carbon; in this case, assumed to be 0.001.

[4] Acetone is completely soluble in water.

TABLE 9

COMPARISON OF ESTIMATED PORE WATER CONCENTRATIONS WITH WATER QUALITY CRITERIA
Berth 30
Port of Oakland
Oakland, California

Compound	Mean Concentration[1] (mg/kg)	Kp	Estimated Pore Water Concentration[2] (mg/l)	Attenuation Factor	Attenuated Concentration (mg/l)	Basin Plan[3]	California Drinking Water[4] (mg/l)
Toluene	0.0032	0.18	0.0178	10	0.0018	--	0.1 (1.0 EPA)
Ethylbenzene	0.0071	0.38	0.0187	10	0.0019	--	0.68 (0.7 EPA)
Total Xylenes	0.0135	0.33	0.0409	10	0.0041	--	1.75 (10 EPA)
Acetone	0.0108	--	--	--	--	--	--
1,2-dichloroethane	0.0027	0.03	0.09	10	0.009	--	0.0005 (0.005 EPA)
Naphthalene	2.77	1.04	2.6642	10	0.2664	--	--
2-methyl naphthalene	0.87	1.15	0.7572	10	0.0757	--	--
Acenaphthene	1.48	3.83	0.3873	10	0.0387	--	--
Fluorene	1.28	5.99	0.2128	10	0.0213	--	--
Phenanthrene	3.4	6.66	0.5105	10	0.0510	--	--
Anthracene	0.98	7.61	0.1292	10	0.0129	--	--
Fluoranthene	1.55	20.30	0.0761	10	0.0076	--	--
Pyrene	1.28	75.30	0.0170	10	0.0017	--	--
Chrysene	0.69	212.59	0.0032	10	0.0003	--	--



SITE LOCATION MAP
Berth 30 - Port of Oakland
2801 Seventh Street
Oakland, California

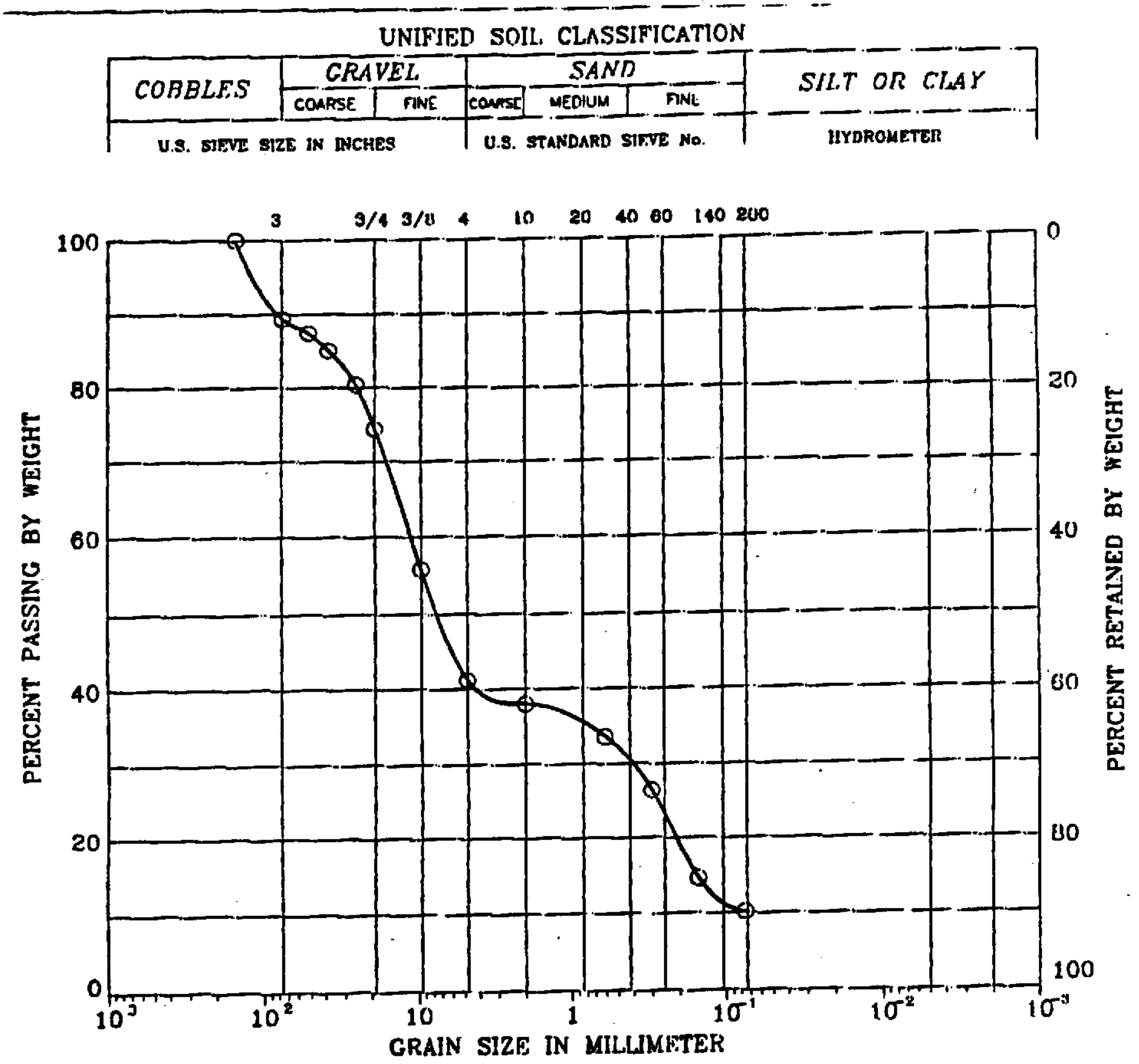
GEOMATRIX

Figure 1

Project No. 2026.06

APPENDIX A

GRAIN SIZE DISTRIBUTION CURVE



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
O	1				Brown gravel w/silt (GM-GP)

Remark :

Project No.109.024	Geomatrix 2026.061
Cooper Testing Labs Mountain View CA	GRAIN SIZE DISTRIBUTION Figure No.

Cooper Testing Laboratories

Project No.109.024

Geomatrix 2026.06I

Figure No.

BORING	DEPTH	% COBBLES	% GRAVEL	% SAND	% FINE	% SILT	% CLAY	Cu	Cc
1		12.65	46.14	31.09	10.12				

1

Grain Size (mm)	% Finer	Grain Size (mm)	% Finer	Grain Size (mm)	% Finer	Grain Size (mm)	% Finer
0.0750	10.12						
0.1500	14.55						
0.3000	26.37						
0.6000	33.67						
2.0000	38.10						
4.7500	41.21						
9.5250	55.72						
19.0500	74.49						
25.4000	80.49						
38.1000	85.05						
50.8000	87.35						
76.2000	89.40						
152.4000	100.00						

APPENDIX B

CHAIN-OF-CUSTODY RECORDS, REQUEST FOR ANALYSIS FORMS, AND ANALYTICAL LABORATORY REPORTS

(SEE VOLUME 2)

APPENDIX C

ANALYTICAL LABORATORY PERSONNEL RESUMES

Name: Ronald Marvin Block

Present Position: Principal and Environmental Toxicologist

Education:
B.A. 1967, University of Alaska, Major: Zoology
M.S. 1972, University of North Dakota, Major: Physiology
Ph.D. 1974, University of North Dakota, Major: Biochemistry

Professional Societies:
American Association for the Advancement of Science
Society for Risk Analysis
Air Pollution Control Association
New York Academy of Sciences
Society of Environmental Toxicology and Chemistry
Sigma XI

Registrations: California Registered Environmental Assessor, REA-00870

Awards and Honors:
MacIntosch Scholarship (1966-67)
AEC Fellowship (1972-73)
Adjunct Research Associate, Dept. of Pathology, University of Maryland Medical School, Baltimore, MD (1977 - Present)
Marquis's Who's Who in the East (17th ed., 1982-84)
Marquis's Who's Who in the West (18th ed., to 23nd ed., 1984-92)

Committees:
Chairman, Air Pollution Control Association Committee on Regulating Air Toxics - 1989
HazMat Certificate Advisory Board, UC Berkley-Present
National Advisory Board, Findlay College - Present
National Editorial Board, HAZMAT WORLD - Present
Advisory Board, HAZMAT WEST
Member, Working Group on Toxic Substances Bi-State Conference on the Chesapeake Bay, 1977.
Member, ASTM Committee F-20, Hazardous Material Spill Control Systems.
Association, Northern Division, Fire Prevention Officer's Section, 1984 - present.
Appointed Member, Sonoma County Hazardous Material Management Council, 1984-1986.
Expert witness: Pennsylvania Superior Court; Alameda Superior, Los Angeles Superior Court - Environmental Toxicologist, and Hazardous Waste Management Specialist.

Current Teaching Responsibilities:

1. Instructor, "Principles of Hazardous Materials Management", "Site Assessments", Health and Environmental Effects of Hazardous Materials, Risk Assessment, Storm Water Compliance at University of California, Berkeley, CA (1990 - present).
2. Instructor, "Principles of Hazardous Material Management", "Proposition 65 Compliance", "Site Assessments", Complying with AB 2588, at University of California, Santa Cruz, CA (1987 - 1990).

3. Instructor for National Groundwater Association Course, "Risk Assessment for The Environmental Professional (1986 - present).

Experience:

May 1984 - Present. Principal and Technical Advisor. Aqua Terra Technologies, Inc., Walnut Creek, CA.

Development of human health and environmental risk assessment for contaminated waste sites, conduct environmental toxicology studies for air, groundwater and surface water contamination on human health and the environment. Project management experience includes providing supervision for projects involving environmental site assessments; risk assessments (Endangerment Assessments and Public Health and Environmental Evaluations); remedial investigation/ feasibility studies; evaluation of indoor air quality including new and sick building syndrome and development of acceptable levels of toxics in ambient air; proper management and disposal of infectious and radioactive wastes; interpretation of federal, state and local environmental regulatory requirements to ensure client compliance; preparation and implementation of health and safety plans; and provide liaison between regulatory agencies and clients in the development of compliance programs with regards to hazardous wastes and toxic materials. Experience also includes providing expert witness testimony in the area of toxicology and hazardous waste management.

1979 - 1984. Project Manager. Kennedy/Jenks Engineers, San Francisco, CA.

Regulatory analysis with emphasis on TSCA, CWA, and RCRA policy and regulations for industrial compliance.

Specific experience included development of hazardous waste management plans, assessments, remedial action, closure and post closure of hazardous waste sites, permit preparation, delisting of hazardous wastes under RCRA, and the performance of industrial environmental audits.

Other experience has included toxicological development and evaluation of pollutant criteria and action levels for groundwater, streams, estuaries and marine environments, new product toxicity evaluation, innovative toxicity design studies, toxicity acceptance studies for drinking water polymers, and expert witness in toxicology and hazardous waste.

Specific industrial experience has included mining, petroleum, electronics, chemical, automobile manufacturer, steam electric stations, railroad, military, hospitals and municipal agencies.

1978 - 1979. Senior Scientist. Tetra Tech, Inc., Lafayette, CA.

Developed environmental toxicology and physiology programs. Responsibilities included paper studies on oil/oil dispersant effects, pesticide evaluation, acid rain impact, sewage treatment plant impact on aquatic environments, impact of organics in drinking water on human health, and dredged material effects to marine biota.

1977 - 1978. Project Scientist. Potomac Research, Inc., Panama City, FL.

Toxicological evaluation of drilling mud components on a variety of species found in the Gulf of Mexico using acute bioassays and community diversity studies.

Responsibilities included direction of continuous flow laboratory 14 miles at sea, experimental design, and data interpretation (funded by EPA).

1975 - 1977. Research Associate. University of Maryland, Chesapeake Biological Lab, Solomons, MD.

Principal Investigator on environmental toxicological programs which included chlorine, ozone, phthlates, metals, chaff material, and other organics. Test species included oyster larvae, fish, phytoplankton and other invertebrate species.

Principal Investigator of the Chlorination Workshop. Responsibilities included organization, preparation and publication of the workshop and its proceedings (funded by EPA).

Director of NSF Summer Student Program (1977).

Chairman of Controlled Environmental Laboratory (1976 - 1977).

1973 - 1975. Research Associate. University of Maryland, Chesapeake Biological Laboratory, Hallowing Point Field Station, MD.

Program Manager for ichthyoplankton investigations on the Potomac River. Studies were concerned with horizontal and vertical distribution of fish eggs and larvae.

1972 - 1973. AEC Graduate Fellow. Battelle Northwest, Richland, WA.

Completed doctoral research on temperature and salinity effects on osmoregulatory functions in rainbow trout and channel catfish.

1969 - 1972. Research Assistant. University of North Dakota, Grand Forks, ND.

Developed water chemistry programs to investigate the pollution of rivers and lakes in North Dakota.

1967 - 1969. Analytical Chemist. Alaska Water Laboratory (FWPCA), Fairbanks, AK.

Conducted chemical analyses of water from lakes and rivers in Alaska to determine effects of cold climate on water quality and nutrient cycling.

Publications:

Block, R.M. April 1992. Conducting an Ecological Risk Assessment for Sites Contaminated with Petroleum Hydrocarbons. Hydrocarbon Symposium, Abstract, Long Beach, CA

Block, R.M., K.D. Jennings, November, 1990. A Simplified Approach to Environmental Risk Assessments at Superfund Sites. Society for Environmental Toxicological and Chemical, Abstract, pp. 24, SETAC 90, Washington, D.C.

Block, R.M. 1990. Air Toxics, Regulatory Implications, HAZMAT WEST, Long Beach, CA. November 6-8, 1990.

Block, R.M. 1989. Complying with AB 2588, A Consultant's Perspective. HAZMAT WEST, 1989. November 3-7, 1989.

Sheehan, P.J., R.W. Schneiter, T.K.G. Mohr and R.M. Block, 1987. Bioreclamation of Gasoline Contaminated Groundwater: Step by Step. Eighth Annual Meeting, Society of Environmental Toxicology and Chemistry, Pensacola, Florida. November 1987.

Block, R.M., Levin, Hale J., October, 1987. The 3rd Annual Hazardous Material Management Conference West. Solid Waste Assessment Testing: Where Is It and Where Is It Going?.

Block, R.M. 1986. Risk Analysis. National Water Well Association Symposium on Anatomy of Superfund. Kansas City, MO. September 24-27, 1986.

Block, R.M. 1986. Risk Assessment - A Consultants Guideline. Proceedings of the Hazardous Materials Management Conference/86. pp. 273-278. Tower Management Conference.

Block, R.M. 1985. Development of Clean-Up Criteria - A Consultants Perspective. Proceedings of the Hazardous Materials Management Conference/West 85', pp. 501-513.

Smith, L.R., R.M. Block, and T.M. Holsen. 1985. Studies on the Acute Toxicity of Fluoride to Several Species of Fish. Chemosphere, 14(9):1383-1389.

Block, R.M. and R.W. Schneiter. 1985. Development of Toxicological Criteria for the Protection of Human Health. Proceedings of Environmental and Public Health Effects of Soils with Petroleum Products. University of Massachusetts, Amherst, MA.

Block, R.M., J. Dragun, and T.W. Kalinowski. 1984. Chemical Engineering Aspects of Groundwater Contamination: II. Health and Environmental Aspects of Setting Cleanup Criteria. Chemical Engineering, 19(24):70-73.

Block, R.M., R.M. Kennedy. 1983. California and EPA Hazardous Waste Regulations. J. Professional Issues in Engineering, 109(1):10-17.

Block, R.M. and T.W. Kalinowski, 1983. Disposing of Old Drums under the RCRA Regulations II. Chemical Engineering, 90(8):103-105.

Block, R.M., D.T. Burton, S.R. Gullans and L.B. Richardson. 1978. Respiratory and Osmoregulatory Responses of White Perch (*Morone americana*) Exposed to Chlorine and Ozone in Estuarine Waters. In: Water Chlorination: Environmental Impact and Health Effects, edited by R.L. Jolley, Ann Arbor Science Publishers, Inc., pp. 351-360.

Helz, G.R., R.Y. Hsu and R.M. Block. 1978. Bromoform Production by Oxidative Biocides in Marine Waters. In: Ozone-Chlorine Dioxide Oxidation Production of Organic Materials, edited by R.G. Rice, J.A. Cotruro and M.E. Browning, pp. 68-76.

Roosenburg, W.H., R.M. Block, and J.C. Rhoderick. 1977. The Influence of Chlorine Produced Oxidants on Larval Stages of the Soft Shell Clam, *Mya arenaria*. Assoc. So. East/Biol. Bulletin, 24(2):82.

Rhoderick, J.C., R.M. Block, W.H. Roosenburg and K. Drobeck. 1977. Effects of Chlorination to the American Oyster, *Crassostrea virginica*, at Two Temperatures. Assoc. So. East. Biol. Bulletin, 24(2):80.

Vreenegoor, S.M., R.M. Block, J.C. Rhoderick, and S.R. Gullans. 1977. The Effects of Chlorination on the Osmoregulatory Ability of the Blue Crab, Callinectes *sapidus*. Assoc. So. East. Biol. Bulletin, 24(2):93.

Block, R.M., S.R. Gullans and J.C. Rhoderick. 1977. Physiological Response of White Perch, *Morone Americana*, to Chlorine. Published in Assoc. So. East. Biol. Bulletin, 24(2):37.

Block, R.M. 1977. Physiological Responses of Estuarine Organisms to Chlorine. Chlorination Workshop Proceedings, Ches. Sci., 18(1):156-160.

Block, R.M., G.R. Helz and W.P. Davis. 1977. The Fate and Effect of Chlorine in Coastal Waters, Chlorination Workshop Proceedings. Ches. Sci., 18(1):97-101, 1977.

Block, R.M. and G.R. Helz (Eds) 1977. Proceedings of the Chlorination Workshop. Ches. Sci., 18(1):97-160.

Gullans, S.R., R.M. Block and J.C. Rhoderick. 1977. Effects of Continuous Chlorination on White Perch (*Morone americana*) and Atlantic Menhaden (Brevoortia tyrannus) at Two Temperatures. Assoc. So. East Biol. Bulletin, 24(2):55.

Liden, J.H., D.T. Burton, S.L. Margrey, R.M. Block, and J.C. Rhoderick. 1977. Effects of Chlorinated and Bromochlorinated Power Plant Condenser Cooling Waters on Survival and Blood pH of Atlantic Menhaden (Brevoortia tyrannus) and Spot (Leiostromus xanthurus). Assoc. So. East Biol. Bulletin, 24(2):66.

Block, R.M. 1975. Effects of Temperature and Salinity on the Osmotic Adjustment in the Euryhaline Rainbow Trout, Salmo gairdneri Richardson and the Stenohaline Channel Catfish, Ictalurus punctatus (Rafinesque). Dissertation Abstracts, 35(10).

Block, R.M. 1974. Effects of Temperature and Salinity on the Osmotic Adjustment in the Euryhaline Rainbow Trout, Salmo gairdneri Richardson and the Stenohaline Channel Catfish, Ictalurus punctatus (Rafinesque). Doctoral Dissertation, University of North Dakota, 161 pp.

Block, R.M. 1974. Effects of Acute Cold Shock on the Channel Catfish, Ictalurus punctatus in: Thermal Ecology. J.W. Gibbons and R.R. Sharitz (Eds.), AEC Symposium Series, (CONF-730505), pp. 109-118.

Block, R.M. 1972. Free Amino Acids and Salts as an Osmoregulatory Substance in Three Species of Fish. Master's Thesis, University of North Dakota, Grand Forks, North Dakota. pp. 59.

Block, R.M. 1969. Methods for the Chemical Analysis of Fresh Water. 59 pp. Alaska Water Laboratory, College, Alaska.

Name: **Julianne Christine Fegley**

Present Position: Biologist

Education:

B.S. 1973. Biology with a Chemistry minor, Western Washington State College, Bellingham, WA.
Graduate work in Fisheries, 1976-1981, University of Washington, Seattle, WA.
Education Certification Program, 1985-1986, Secondary Biology, Chemistry, and General Science University of Alaska, Anchorage, AK.

Experience:

1989 - Present. Biologist. Aqua Terra Technologies, Inc., Walnut Creek, CA.

Ms. Fegley serves as a field biologist and data analyst for programs involving biomonitoring of treated effluent prior to discharge into marine waters. Ms. Fegley is involved in biological resource assessments of estuarine intertidal habitats; she is also involved in the preparation of environmental sampling plans as part of remedial investigations. Ms. Fegley is involved in ecological risk assessment projects using bioaccumulation studies and toxicity testing to assess potential exposure of non-human receptors to chemicals of concern in aquatic systems. She is responsible for review of aquatic toxicity data and evaluation of laboratory reports.

Ms. Fegley is involved in permitting matters which require use of aquatic toxicity tests. These include State of California Title 22 Hazardous Waste Certification, NPDES point source and stormwater discharge permits, and EPA/Corps of Engineers dredge and disposal permits.

Ms. Fegley serves as a liaison between ATT's Environmental Consulting sector and ATT's bioassay laboratory. She provides technical review of the laboratory quality assurance/quality control program (QA/QC) and procedures and reports to the laboratory director. Ms. Fegley also serves as the laboratory safety officer; her duties include maintenance of laboratory MSDS and periodic review for revision of the laboratory's injury and illness prevention program.

1988. Assistant Environmental Scientist. Dames & Moore, San Francisco, CA.

Ms. Fegley was involved in preparation of environmental documents pursuant to guidelines presented in the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). She performed field reconnaissance to assess habitat and species potentially affected by proposed projects. Ms. Fegley utilized procedures for identification of wetlands pursuant to U.S. Fish and Wildlife Service, EPA, and the U.S. Army Corps of Engineers determination procedures. Ms. Fegley performed site assessments which involved site examination and examination of available maps, aerial photographs, and records in order to evaluate site history and hazardous materials onsite. She also provided assistance in project management.

1979-1981. Fisheries Biologist. National Marine Fisheries Service Seattle, WA.

Ms. Fegley served as a fisheries biologist during the Marine Ecosystems Survey and Assessment of Puget Sound. She participated in the field collection of target marine invertebrate species; processed specimens for histological examination; and performed pathological examinations of specimens, utilizing photomicrography to document conditions. Ms. Fegley devised a computerized recording system and format for data storage. She was involved in all aspects of the preparation and presentation of laboratory reports and publications. Ms. Fegley has been formally trained in both fish and invertebrate pathology.

1976-1979. Fisheries Biologist. Fisheries Research Institute University of Washington, Seattle, WA.

Ms. Fegley served as a fisheries biologist during the Puget Sound Nearshore Fish and Microinvertebrate Assemblages Study. She supervised and trained laboratory technicians in the identification of predatory fish and invertebrate prey species encountered in food web studies. Ms. Fegley served as an epibenthic and benthic fish and invertebrate taxonomist for Seattle Metropolitan Sewage Outfall Baseline Study and the Kodiak Nearshore Fish Assemblages Study, Alaska Department of Fish and Game.

Name: Glen Richard Daggett

Present Position: Aquatic Biologist

Education: B.A., Biology, 1972. Sonoma State University.
1978-1979, University of California Davis at Sonoma State:
Biochemistry, Advanced Organic Chemistry, Calculus I, II and III.

Professional Societies: Bodega Marine Science Association

Experience:

July 1, 1992 - Present. Marine Criticle Life-Stage Testing Specialist/Senior Culturist. Western Bioassay Laboratory, Walnut Creek, CA

Mr. Daggett is in charge of all criticle life-stage bioassays performed on marine organisms. His duties include supervision of test set-up, generation and statistical analysis of data, report preparation, and training and supervision of all technicians assisting in marine criticle lifestage bioassays. Mr. Daggett also serves as senior culturist. His duties include set-up and maintenance of fish and invertebrate cultures and holding tanks, determination and maintenance of the health of test organisms, maintaining marine shellfish in spawning condition for criticle lifestage testing, and inspection of temperature control, aeration and water filtration equipment for proper function. Mr. Daggett is responsible for monitoring the culture and equipment logs for the laboratory; he advises when cultured organisms are suitable for use in bioassays, and oversees service and maintenance of culture equipment.

1988 - June 30, 1992. Bioassay Scientist. Aqua Terra Technologies, Inc., Walnut Creek, CA.

Mr. Daggett served as a bioassay scientist with ATT's Aquatic Bioassay Laboratory. He was responsible for the day-to-day operations of the bioassay services program. He planned, conducted, and interpreted bioassays performed in accordance with Title 22 and NPDES requirements. He maintained cultures of bioassay organisms. He prepared and maintained records of samples, organisms and testing procedures to document quality assurance in bioassay testing.

1986 - 1988. Manager Bioassay Services. NET Pacific, Inc. (formerly ANATEC). Mr. Daggett designed and maintained bioassay test and culture systems including flow-through delivery, recirculating holding tanks, treatment center and general plumbing. He also designed and built specialized systems for on-site testing. Mr. Daggett assisted in routine and specialized bioassay functions including test set-ups, water quality control monitoring, test termination and culturing techniques.

REV: 09/22/92

He trained and supervised NET Pacific staff in on-site monitoring procedures, and coordinated interdepartmental activities with client's personnel.

1981 - 1983. Assistant Manager. Petaluma Wholesale Fish and Lobster Company.

Mr. Daggett constructed and maintained a 3,500 gallon refrigerated recirculating seawater system for holding live seafoods, primarily Atlantic lobsters. He performed maintenance, quality control, and delivery of seafood.

1973 - 1983. Staff Research, Associate II. University of California, Crustacean Aquaculture Project, Bodega Marine Laboratory, Bodega Bay, CA.

Mr. Daggett designed and constructed experimental crustacean rearing system, collected and analyzed water quality data, prepared progress and monitoring reports for the University and California Water Quality Control Board, and trained and supervised laboratory assistants. He was responsible for maintenance of laboratory equipment. Mr. Daggett advised staff members, students, state agencies and private aquaculture enterprises on water quality problems in aquaculture and provided analytical services for interdepartmental aquaculture groups (i.e., nutrition, genetics, etc).

Mr. Daggett operated a variety of laboratory equipment including: Techicon Auto Analyzer II (automated spectrophotometer), total organic carbon analyzer, infrared spectrophotometer, particle counter, H.P. gas chromatographs, ultracentrifuge, pH meters, dissolved oxygen meters, turbidity meters, salinity meters, and moisture analyzers.

1973. Graduate student assistant. California Regional Water Quality Control Board. Santa Rosa, CA.

Mr. Daggett's duties included: water analysis (i.e., total phosphorus, nitrates, chlorine, dissolved oxygen, suspended solids, settleable solids, pH, alkalinity, electroconductivity, BOD, and trace elements), algae growth potential, and particle size analysis. He participated in a variety of studies which involved identification of aquatic organisms, non-point source discharges, biological monitoring, field and aerial surveillance, and photography.

Publications: Co-author, "Development of Aquaculture Systems," 1977. Sea Grant Publication 58.

REV: 09/22/92

Co-author, "Density Dependent Growth Inhibition in Juvenile Lobsters," 1980. Journal of Experimental Marine Biology and Ecology.

Co-author, "Relationships Among Dietary Lipids, Tissue Lipids, and Growth in Juvenile Lobsters", 1980. World Mariculture Society Journal.

Name: Linda S. Mortensen

Present Position: Laboratory Scientist

Education: B.S. 1989, Biochemistry. University of Vermont, Burlington, Vermont

Experience: July 1, 1992 - Present. Laboratory Scientist, Specialist-Hazardous Waste Bioassays. Western Bioassay Laboratory, Walnut Creek, CA.

Ms. Mortensen manages the hazardous waste bioassay program. Her duties include scheduling hazardous waste bioassays, preparation and periodic revision of Standard Operating Procedures for conducting hazardous waste bioassays, supervision of test set-up and monitoring, statistical analysis of data, report preparation, client and test records maintenance, and laboratory QA/QC of hazardous waste testing.

Ms. Mortensen serves as the laboratory health and safety officer. She also provides support in data management and test monitoring for a variety of bioassays performed at Western Bioassay Laboratory.

1991 - June 30, 1992. Laboratory Scientist. Aqua Terra Technologies, Inc., Walnut Creek, CA.

Ms. Mortensen assisted in the operation of the bioassay laboratory. Her duties included the performance of bioassays on effluent, sediment and hazardous waste samples using both freshwater and marine algal, invertebrate, and fish species. She was responsible for revisions to Standard Operating Procedures for conducting Title 22 Hazardous Waste testing. Ms. Mortensen also assisted in data analysis using a variety of statistical software.

October, 1989 to October, 1991, Roy F. Weston, Inc., Burlington, MA. Ms. Mortensen performed EPA approved bioassay tests for Superfund sites using marine, freshwater, and benthic indicator organisms as part of the Environmental Services Assistance Team (ESAT) to the U.S. EPA Region I, Environmental Services Division.

Within the chemistry laboratory, Ms. Mortensen assisted on the Boston Lead Free Kids Program performing X-Ray Fluorescence (XRF) spectroscopy on soil and dust samples, Inductively Coupled Plasma (ICP) analysis on selected QA/AC samples and report formulation. Ms. Mortensen also assisted the Superfund Environmental Assistant Team (SEAT) through the review of site documents (RI/FS), Work Plans and FSP pertaining to the potential ecological risk at hand. Document review was supplemented with site visits and monthly meetings to present comments to Remedial Project Managers.

Ms. Mortensen's extensive involvement with a marine Superfund site through two consecutive (1989, 1990) summer sampling events, sample analysis and report formulation, enabled her to give a slide presentation of the analytical results before the SEAT and reformat presentation at the 1991 annual NEAEB meeting.

Name: Phyllis Fassini Riboni

Present Position: Laboratory Scientist

Education: Undergraduate Research in Zoology,
Reproductive and Animal Behavior, 1979-1986,
University of New Mexico

B.S. 1991, Chemistry and Zoology,
University of California Berkeley

Professional Societies: Society for Environmental Toxicology and Chemistry, Northern California.

Experience: July 1, 1992 to Present. Laboratory Scientist, Specialist - Chronic Toxicity and Critical Life-Stage Bioassays, Western Bioassay Laboratory, Walnut Creek, CA.

Ms. Riboni manages the chronic toxicity testing program. Her duties include determination of NPDES toxicity testing requirements, scheduling bioassays, preparation and periodic revision of Standard Operating Procedures for chronic bioassays, maintenance of Ceriodaphnia dubia and Selenastrum capricornutum cultures, supervision of test set-up and monitoring, statistical analysis of data, report preparation, client and test records maintenance, and laboratory QA/QC of chronic and critical life stage testing (including maintenance of reference toxicant test data).

Ms. Riboni is responsible for compliance reporting of chronic toxicity testing. She is also responsible for the preparation of Variability Phase Study Plans for Effluent Toxicity Characterization Program clients.

Ms. Riboni also serves as a laboratory project manager for the Corps of Engineers sediment bioassays and special projects utilizing greenbook protocols for ecological assessment. She serves as laboratory QA/QC supervisor for sediment testing.

1990 - June 30, 1992. Laboratory Scientist
Aqua Terra Technologies, Inc., Walnut Creek, California

Ms. Riboni performed aquatic bioassays for estimating the chronic and acute toxicity of effluent and receiving water to freshwater, marine, and estuarine organisms. She regularly performed a wide variety of bioassays on effluent, sediment, and hazardous waste samples, using both freshwater and marine algal, invertebrate and fish species.

Ms. Riboni was responsible for data input and analysis as part of report production. She routinely used a variety of statistical software, as well as methods using a handheld calculator.

Ms. Riboni was responsible for test organism culture maintenance and in-house QA/QC for freshwater effluent testing. Her activities included the maintenance of neonatal fathead minnows obtained from commercial suppliers, and the cultures of algae (Skeletonema costatum) and invertebrates (Ceriodaphnia dubia); Ms. Riboni was also responsible for QA/QC of dilution water used in freshwater effluent testing.

Ms. Riboni served as laboratory project manager for marine sediment testing projects. Her duties included scheduling of testing, determination of staffing needs, determination of test supply and organism needs, reference toxicant testing, and report preparation.

1988-1990. Technician II, EA Engineering Science and Technology, Inc.

Ms. Riboni's responsibilities consisted of performance of acute and chronic aquatic bioassays, performance of water quality and water chemistry measurements, preparation of weekly reference toxicant tests, and computer input of test results. Ms. Riboni was also responsible for logging in and disposition of incoming test samples.

1984 - 1987. Research Assistant, The University of California at Berkeley, Berkeley, CA, under the direction of Dr. Stephen M. Schuster, Zoology Department.

Ms. Riboni assisted in the research on the life history of sperm storage, mating behavior, and reproductive biology on the Parcusas sculpta. Field studies were performed in Porto Penasco, Mexico at the CEDO marine station (of the University of Arizona at Tucson). The findings of these research studies were published in Animal Behavior, 1987, and Crustaceana, 1988.

1983-1984. Research Assistant, The University of Albuquerque, Albuquerque, New Mexico.

Ms. Riboni performed research on the life history and sperm storage in the Sphaeromatid isopod, Thermosphaeroma. Under the direction of Stephen M. Shuster, she conducted embryological studies on T. thermophilum (Crustacea: Peracaripa). The research has not yet been published.

1980-1983. Research Assistant, The University of New Mexico.

Ms. Riboni performed research in the history and reproductive biology of the Socorro Isopod, Thermosphaeroma thermophilum, (Crustacea: Peracarripa) (Crustacea:Peracarida).

1979-1980. Research Assistant, Under the Direction of Dr. Randy Thornhill.

Ms. Riboni assisted in the research of adaptive female mimicking behavior of Hyibitacus Scorpionflies.

Emmanuel Akanyirige-Karibo
Senior Environmental Chemist
Laboratory Services
Western Operations

AREA OF EXPERTISE

Experienced with Liquid and Gas Chromatography. HPLC analyses for formaldehyde, polynuclear aromatic hydrocarbons, carbamate pesticides and phenols using reverse and normal phase HPLC techniques. GC analyses include quantitative determinations of PCBs, halocarbons, petroleum hydrocarbons using EPA Methods 608/8080, 601/8010, 602/8020, 8015, and 8040.

EDUCATION

B.S., Chemistry/Math
Ball State University
Muncie, Indiana

M.S., Math/Chemistry
Ball State University
Muncie, Indiana

CERTIFICATION, LICENSE, REGISTRATION

Perkin Elmer introductory certificate course in HPLC techniques and troubleshooting.

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1988 to Present

- GC - Method development and validation of EPA 502 Method using photo ionization and hall electrolytic conductivity detectors in series.
- HPLC - Method development and instrument configuration for method validation study of EPA 531.2 (Carbamate Pesticides).

International Technology Corporation
Martinez, California
1985 to 1988

Analytical Chemist

- Performed extensive gas chromatographic analyses of hazardous waste and industrial solvents to determine conformity with EPA physical and chemical standards for appropriate disposal and treatment.

- Emphasized qualitative and quantitative determinations of PCB's, pesticides, halocarbons, aromatics, phenols, and petroleum hydrocarbons using EPA Methods 608/8080, 601/8010, 602/8020, 8015 and 8040.

GC Supervising Chemist

- Planned and organized daily GC analysis requests using EPA Methods 608/8080, 601/8010, 602/8020, 8015 and 604/8040.
- Delegated various tasks to other GC chemists.
- Supervised and reviewed analyses to ensure conformity with EPA guidelines as well as with customer specifications.

PROFESSIONAL AFFILIATIONS

American Chemical Society

American Mathematical Society

Toastmasters International Club

Stefanie Bulilan
Associate Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional experience in extraction of various analytes from water and soil.

EDUCATION

B.S., Biological Sciences
California State University, Hayward

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1992 to Present

- Performs sample extractions on water, soil, and waste by EPA Methods for TPH, 418.1, Oil and Grease, 625/8270, 608/8080, and 3550/8015.
- Performs sample preparation of soils and waste for CAM Waste Extraction Test and EP Toxicity Tests.

Engineering Science
1991 to 1992

- Performed extractions on water and soil in accordance with CLP and client protocols.

Pathology Service Inc.
1987 to 1988

- Stained microscopic slides
- Data entry

Amy Chen
Senior Environmental Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional experience in instrumental analysis of environmental samples. Special experience in gas chromatography (GC) and in gas-chromatography-mass spectrometry (GC/MS).

EDUCATION

B.S., Chemistry
Ginn-Yee University
Taiwan

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1986 to Present

- Analyses of volatile and semi-volatile organics in water, soil, and hazardous waste by GC/MS using EPA Methods 524.2, 624/8240, and 625/8270.
- Analysis of toxic contaminants by GC/MS using EPA Methods TO1/TO2 and NIOSH Methods.
- Analysis of Agricultural Chemicals (Chlorinated Pesticides and PCB's, Organophosphorus Pesticides, Herbicides, and Fumigants) in water, soil, and waste by gas chromatography using EPA Methods 608/8080, 614/8140, 504, 508.
- Project chemist for EPA Method 505, (Organochlorine Pesticides) Method validation study under EPA laboratory contract.
- Analysis of air sample media for organic contaminants using gas chromatography by NIOSH and OSHA approved methodologies.

Chung Shan Science and Institute Center
Taiwan
Research Engineer
1980 to 1985

- Synthesis and analyses of high temperature resistant materials by using GC, IR, HPLC, DSC, TMA and RDS-7700.

Research Assistant
1970 to 1980

- Analyses of propellants and explosives

Lei Chen
Senior Environmental Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional experience in instrumental analysis of environmental and industrial hygiene samples. Special experience in gas chromatography (GC) and in gas-chromatography/mass spectrometry (GC/MS).

EDUCATION

M.S., Physical Chemistry
San Jose State University

B.S., Chemistry
Fujian Normal University, China

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1992 to Present

- Analysis of Agricultural Chemicals (Chlorinated Pesticides and PCB's, Organophosphorus Pesticides, Herbicides, and Fumigants) in water, soil, and waste by gas chromatography using EPA Methods 608/8080, 614/8140, 504, and 508.

California Advanced Environmental Technology Corporation
1990 to 1992

- Analytical method development (GC EPA 601/8010 and 602/8020, 608/8080, GC/MS EPA 624/8240 and 625/8270).
- Performed sample analysis for analytical method development for EPA Methods 601/8010, 602/8020, 608/8080, 624/8240, and 625/8270.
- Data validation and QA/QC support
- Instrument troubleshooting and maintenance

Bay Area Environmental Inc.
1990

- Supervised state certified environmental lab including, assessment of chemical waste and waste water in varied matrices.
- Performed air, waste water and waste solid analyses.
- Data validation and QA/QC support

Romic Chemical Corporation
1987 to 1990

- Environmental Sample analyses by GC, GC/MS, ICP and wet chemistry.
- Instrument troubleshooting and maintenance

Margaret S. Foster
Associate Chemist III
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Experienced in analysis of environmental samples by gas chromatography and mass spectrometry.

EDUCATION

B.S., Environmental Toxicology
University of California, Davis - 1989

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1991 to Present

- Perform EPA Methods 601/602, 624, 8240, 524.2, 502.2 and BTX Gas
- Prepare standards

Med-Tox & Associates, Inc.
1989 to 1991

- Prepared standards
- Performed EPA Methods 601/602, 624, 8240, 8010/8020 and 608/8080
- Performed polychlorinated biphenyls and total petroleum hydrocarbons by gas chromatography

Michael Lynch
Technical Supervisor
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Expert in the analysis of environmental samples including soil, water, air and hazardous wastes. Hands-on experience with inorganic and organics analyses, with special emphasis on GC/MS Extensive knowledge of current and emerging technologies for the analysis of environmental samples.

EDUCATION

Graduate Studies in Chemistry
California Polytechnic State University
San Luis Obispo, California

B.S., Fisheries
University of Washington
Seattle, Washington

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1991 to Present

- Provides technical support to staff and clients regarding analytical methodologies.
- Supervise staff chemists, in all analytical sections of the laboratory including hiring and performance evaluation of laboratory personnel.
- Oversees personnel and instrumental resources to meet project data quality and turnaround requirements.
- Performs data review for completeness and acceptability of results.
- Research and implementation of new methodologies.

Med-Tox Associates
Technical Director
Manager, Organic Laboratory
Senior Chemist
1987 to 1991

- Managed and supervised department for organics analysis of environmental samples by EPA protocol.

- Developed sampling programs, provided written reports, and consulted with clients in regards to their analytical problems.

- Maintained laboratory instruments

- Supervised chemists and technicians

- Developed and implemented new methodologies
- Responsible for laboratory quality control

Central Coast Analytical Services
Mass Spectrometer Operator
1985 to 1986 (Part time position)

- Operated two Hewlett-Packard mass spectrometers, analyzing environmental and air samples

Environmental Research Group
Project Chemist, ICP Operator
1985 (Part time position)

- Established ICP operating parameters

- Begun production mode for routine metals analysis

Technical Director: Manager, Organics Department
1982 to 1984

- Managed and supervised department for organics analysis of environmental samples by EPA protocol.

- Developed sampling programs, provided written reports, and consulted with clients in regards to their analytical problems.

- Maintained laboratory instruments

- Supervised technicians

- Developed new methodologies
- Responsible for laboratory quality control

Ultrachem Corporation
Analyst to Manager, Water Testing Services
1978 to 1982

- Performed wet bench chemistry on water samples in inorganics department
- Analysis of anions by wet bench methods and ion chromatography
- Analysis of metals by flame, hydride and cold vapor atomic absorption spectroscopy.

Hui-Yao Tsai
Senior Environmental Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional and academic experience in chemical fermentation process operation and control, various inorganic and chemical analytical techniques, and quality assurance and control. Special emphasis on sample preparation and extraction techniques, and standard inorganic analytical methods.

CERTIFICATION, LICENSE REGISTRATION

NIOSH 582 Equivalent
Sampling and Evaluating Airborne Asbestos Dust

McCrone Research Institute
Bulk Asbestos Identification by Polarized Light Microscopy

EDUCATION

Ph.D. (Honorary), Chemistry
May Kong University
Hong Kong 1977

B.S. Agriculture chemistry
National Taiway University
Taipei, Taiwan 1953

RELEVANT WORK EXPERIENCE

Clayton Environmental Consultants, Inc.
Senior Chemist, Extraction Laboratory and Asbestos Analysis
1982 to Present

- Direct technical aspects of extraction and asbestos laboratory.
- Supervise extraction and asbestos lab personnel.
- Manage QA/QC program requirements as specified by the program manager.
- Coordinate and execute sample preparation activities in Extraction Lab, including soil, tissue, and water sample matrices.
- Perform standard wet chemical analysis on water and waste water.

Richard A. Hale
Environmental Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional experience in performing metal analysis in digestions of soil, water and air samples. Experienced with AA and ICP instrumentation, Ion Chromatography, wet and TCLP extractions.

EDUCATION

B.S., Chemistry, 1990
University of California
Davis, California

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1991 to Present

- Performs trace metals and general inorganic analysis for environmental samples.
- Performs inorganic tests for characterization of hazardous wastes.

Med-Tox Associates, Inc.
Pleasant Hill, California
Chemist
1990-1991

- Performed soil, water and air sample digestion.
- Ran Atomic Absorbtion (Flame, Nitrous and Furnace) and ICP instrumentation.
- Troubleshot, repaired and maintained instruments.

Tinni Kar
Chemist
Laboratory Services
Western Operations
Pleasanton, California Office

AREA OF EXPERTISE

Professional experience in analysis of hazardous waste using graphite furnace atomic absorption spectrophotometry (GFAA), flame atomic absorption (AA) and wet chemistry techniques.

EDUCATION

B.S., Environmental Toxicology
University of California, Davis

PROJECT EXPERIENCE

Clayton Environmental Consultants, Inc.
1992 to Present

- Analysis of environmental samples using wet chemistry techniques

Chemical Waste Management
1992

- Chemical analysis of hazardous waste using GFAA and Flame AA

FGL Environmental
1990 to 1992

- Waste water analysis for metals using flame AA

- Sampling for waste streams, underground storage tank removal and wet chemistry

- Wet chemistry analyses

Eureka Labs
1990

- Inorganic analysis of soil and water samples, extractions for AA and ICP

- Wet chemistry analyses

Enesco Labs
1988

- Analysis of soil, water and air for dioxins and furans by GC/MS