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

GEOMATRIX

14 December 1994
Project 2868

Ms. Juliet Shin
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Subject: Work Plan
National Guard Organizational Maintenance Shop No. 35
San Lorenzo, California

16501 Ashland Ave
San Lorenzo

Dear Ms. Shin:

Geomatrix Consultants, Inc., (Geomatrix), has prepared this work plan on behalf the Division of the State Architect (DSA) and the State Military Department to assess subsurface conditions near the former location of an underground gasoline storage tank at the National Guard Organizational Maintenance Shop (OMS) No. 35 in San Lorenzo, California (Figure 1). Based on the information forwarded to us by DSA, it is our understanding that an underground gasoline storage tank was removed in April 1993 by AATR Enterprise, and gasoline-containing soil and groundwater was observed in the excavation when the tank was removed. A subsequent investigation of soil and groundwater at the site, conducted by Tetra Tech, Inc., indicated that 450 milligrams per kilogram (mg/kg) of gasoline was detected in soil at a depth of 10 feet, approximately 8 feet north of the former tank location, and 4100 micrograms per liter (μg/l) of gasoline was detected in a groundwater sample collected from well MW-3, located approximately 30 feet north of the former tank location (Figure 2). Except for two soil samples with gasoline detected at less than 8 mg/kg, gasoline was not detected in any of the other soil samples collected (27 samples from 11 locations) or in groundwater samples collected from the other two monitoring wells (MW-1, located 30 feet to the southeast and MW-2, located 10 feet to the southwest of the former tank location). Based on this data, we have developed the following scope of work to evaluate the extent of gasoline in soil and groundwater at the site.

SCOPE OF WORK

The proposed scope of work includes preparation of a health and safety plan, soil coring, collecting soil samples for chemical analysis, and groundwater sampling and analysis. All field activities will be performed in accordance with Geomatrix protocols (Attachment A).

Health and Safety Plan

This task includes the preparation of a site-specific health and safety plan. The plan will include a brief description of the anticipated activities at the site and the chemicals detected there. It also will include a map to the nearest hospital.

Fieldwork

The purpose of the fieldwork will be to assess the distribution of gasoline in soil downgradient of the former tank and to determine the lateral extent of gasoline in groundwater at the site. Soil and groundwater samples will be collected using a Geoprobe 5400 Subsurface Sampling System (Geoprobe; Attachment B). The Geoprobe is a sampling system that can collect discrete samples of soil and groundwater without generating cuttings.

Soil Sampling

To assess the presence and general distribution of gasoline in soil, soil samples will be collected at two locations north of the former tank location. The proposed locations are shown on Figure 3; final locations will be selected after an underground utility survey is conducted at the site. Two samples will be collected at each location, one above the water table (at about 5 feet), and one at the water table (at about 8-10 feet). The samples will be analyzed for total petroleum hydrocarbons (TPH) as gasoline and the gasoline constituents benzene, toluene, xylenes, and ethylbenzene (BTXE).

* any chg in lithology

The extent of gasoline in groundwater downgradient of the former tank will be assessed. According to the hydrogeologic information reported by Tetra Tech. Inc., the water table has ranged from 7 to 10 feet below ground surface and shallow saturated sediments consist of silt and clay. At approximately 17 feet below ground surface, a lower zone, consisting of silty sand, is present. Samples of groundwater will be collected from the water table and the lower silty sand zone; the groundwater samples will be analyzed for TPH-gasoline and BTXE by a state-certified analytical laboratory.

As many samples of groundwater as possible will be collected in a day using the Geoprobe. Because the subsurface geology is fine-grained, we anticipate that water yield will be slow and therefore the collection of groundwater samples will be time consuming. For this reason, we estimate that only about 3 to 4 samples of groundwater from the shallow zone and 1 to 2 samples from the deeper zone can be collected in a day. If water yield from sediments within 5 feet of the water table is extremely slow, a temporary 1-inch-diameter, screened PVC pipe will be left in the ground and samples will be collected either at the end of the day or on the following day.

H_2O Sampling

Based on the existing hydraulic gradient information, we anticipate collecting samples of groundwater east, north, and west of well MW-3 (Figure 3). If access agreements can be obtained, samples of groundwater on the west side will be collected on property owned by the San Lorenzo School District. All other samples will be collected on National Guard property.

Reporting

Geomatrix will prepare a report that will describe the field activities, present results of the work, and provide recommendations for further investigation or remediation, if necessary. The report will the be submitted to the Alameda County Department of Environmental Health (ACDEH) and the Regional Water Quality Control Board, San Francisco Bay Region.

ESTIMATED SCHEDULE

Once we receive ACDEH approval for this work plan, the estimated schedule for the work is as follows:

(1) Prepare Health and Safety Plan	Week 1
(2) Perform Fieldwork	Week 2-4
(3) Obtain Analytical Results	Week 5-6
(4) Submit Report	Week 10

If you have any questions or require additional information, please contact either of the undersigned.

Sincerely yours,

GEOMATRIX CONSULTANTS, INC.

Lisa Rowles

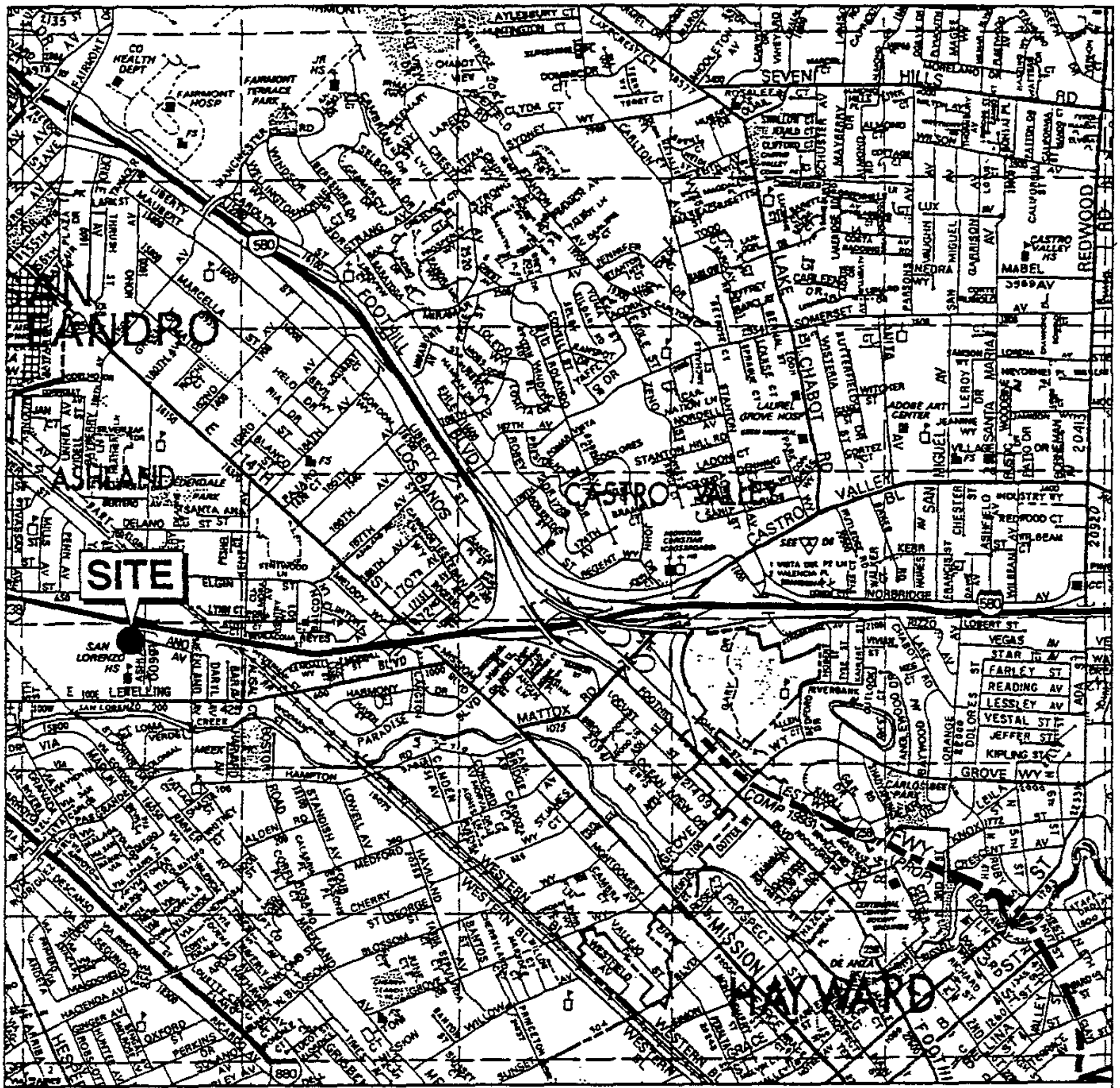
Lisa Rowles, R.G.
Senior Geologist

Sally Goodin

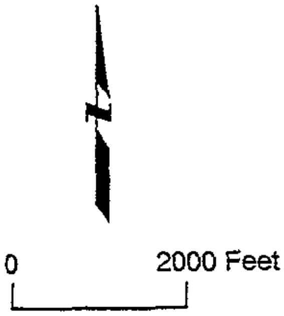
Sally Goodin, R.G.
Principal Geologist

LDR/SEG/bab
CONTR\2868-UST.WP

Attachments



Reference: Thomas Brothers Maps, Alameda County, 1993.

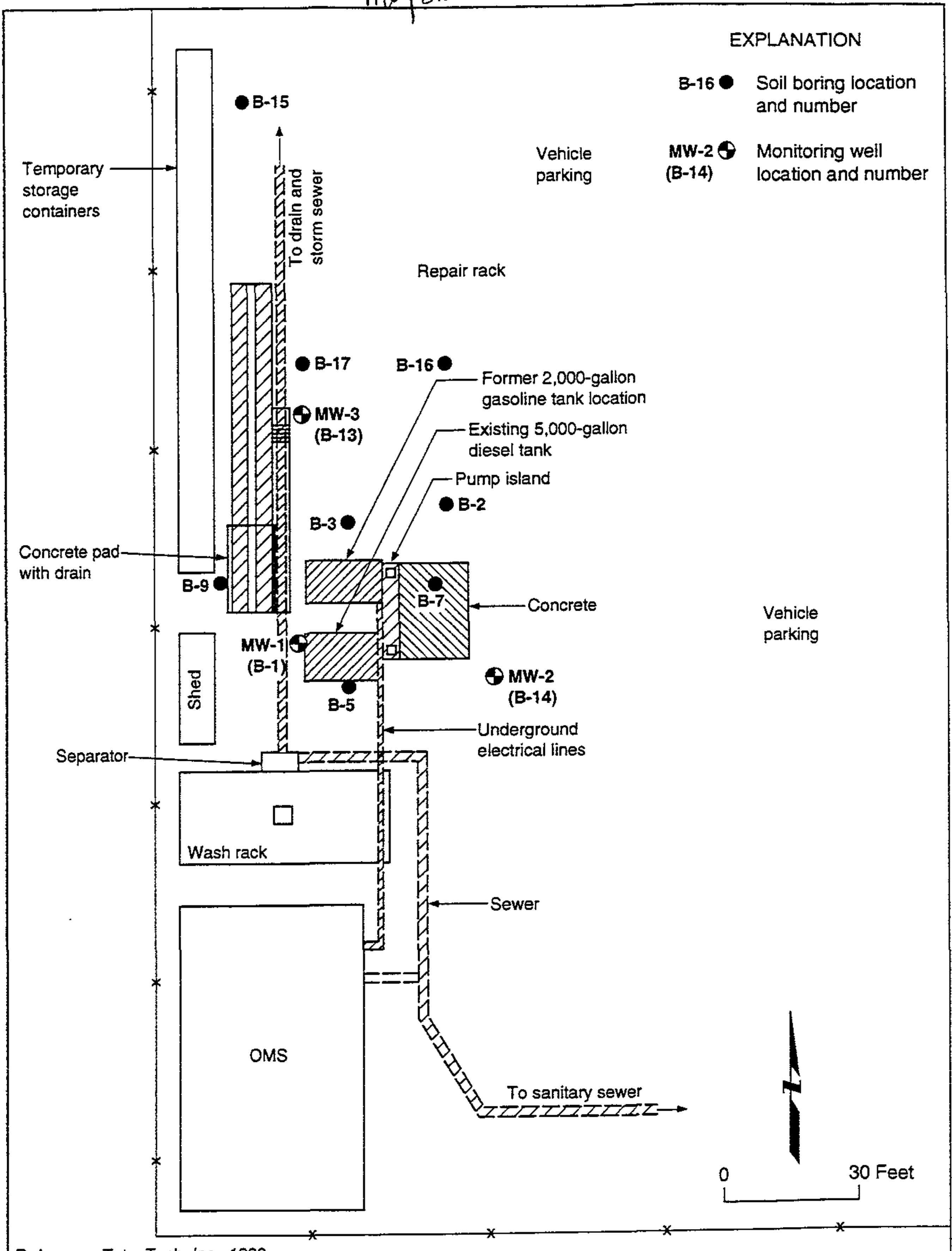


GEOMATRIX

SITE LOCATION MAP
National Guard Organizational Maintenance Shop No. 35
16501 Ashland Avenue
San Lorenzo, California

Figure	1
Project No.	2868

HWY 238

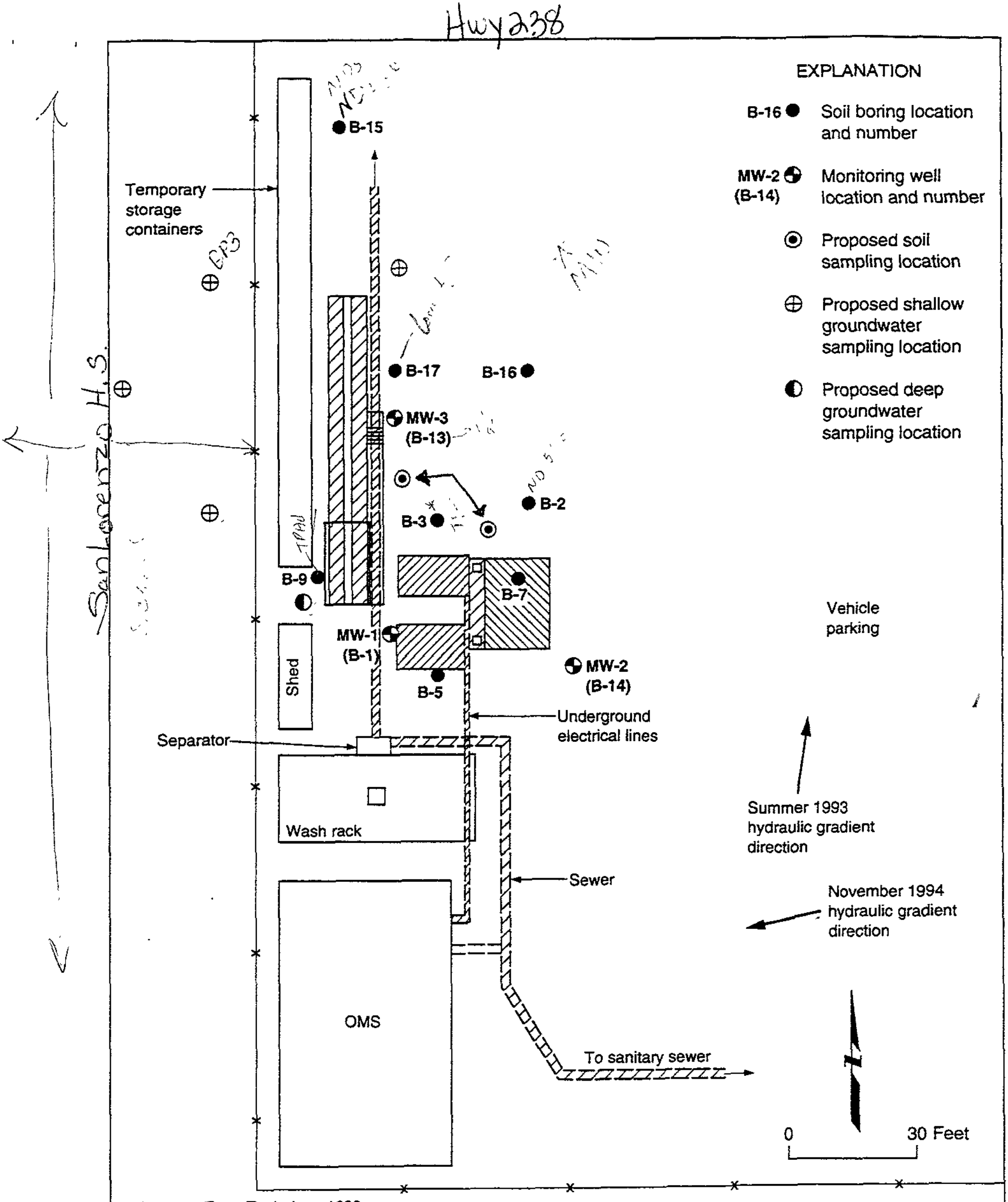


Reference: Tetra Tech, Inc., 1993

GEOMATRIX

SITE PLAN
National Guard Organizational Maintenance Shop #35
16501 Ashland Avenue
San Lorenzo, California

Figure	2
Project No.	2868



Reference: Tetra Tech, Inc., 1993

GEOMATRIX

PROPOSED SAMPLING LOCATIONS
National Guard Organizational Maintenance Shop #35
16501 Ashland Avenue
San Lorenzo, California

Figure 3

Project No. 2868

ATTACHMENT A

Analytical Results

Table 2
Analytical Results for Petroleum Hydrocarbons and Lead in Soil Samples Collected From Soil Borings Drilled July 7, 8, and 9, 1993 at San Lorenzo, OMS #35

Sample Number	Depth (ft)	TRPH (418.1) (mg/kg)	TPH - D (8015mod) (mg/kg)	TPH - G (8015mod) (mg/kg)	Organic Pb (22 CAC) (mg/kg)	Total Pb (7420) (mg/kg)	Benzene (8020) (mg/kg)	Toluene (8020) (mg/kg)	Ethylbenzene (8020) (mg/kg)	Xylene (8020) (mg/kg)	PID (ppm)
B1-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0.6
B1-9.5&10	9.5 - 10.5	ND	ND	ND	ND	17	ND	ND	ND	ND	0.3
B1-15	15.0 - 15.5	ND	ND	ND	na	na	ND	ND	ND	ND	0.4
B1-20	20.0 - 20.5	ND	ND	ND	na	na	ND	ND	ND	ND	0.4
B2-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0.3
B2-9.5&10	9.5 - 10.5	ND	ND	ND	ND	10	ND	ND	ND	ND	0.6
B2-15	15.0 - 15.5	ND	ND	ND	na	na	ND	ND	ND	ND	0.6
B3-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B3-9.5&10	9.5 - 10.5	82	17	450	ND	13	2.4	11	8	8	151
B3-15	15.0 - 15.5	19	ND	7	na	na	0.066	0.32	0.2	0.75	54
B3-20	20.0 - 20.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B5-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B5-10	10.0 - 10.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B5-15	15.0 - 15.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B7-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B7-10	10.0 - 10.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B7-15	15.0 - 15.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B9-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B9-10	10.0 - 10.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B13-9.5&10	9.5 - 10.5	ND	ND	5.9	ND	17	0.19	0.006	0.04	0.31	6.4
B13-15	15.0 - 15.5	ND	ND	ND	na	na	ND	ND	ND	0.008	2.8
B14-10	10.0 - 10.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B14-15	15.0 - 15.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B15-5	5.0 - 5.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
B15-10	10.0 - 10.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B15-15	15.0 - 15.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B16-5	5.0 - 5.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B16-10	10.0 - 10.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B16-15	15.0 - 15.5	ND	na	ND	na	na	ND	ND	ND	ND	0
B17-25	25.0 - 25.5	ND	ND	ND	na	na	ND	ND	ND	ND	0
Detection Limit:		10	5	1	1	1	0.005	0.005	0.005	0.005	---
Average		3.37	0.77	15.43	ND	14.25	0.09	0.38	0.27	0.30	7.20
Maximum		82	17	450	ND	17	2.4	11	8	8	151
Minimum		ND	ND	ND	ND	10	ND	ND	ND	ND	0

Note: Only soil samples which had detectable concentrations of TPHg were analyzed for lead
na = not analyzed for this analyte
ND = not detected at or above detection limit
Bold = TPH-G > 100 mg/kg
Averages are computed assuming that ND = 0 mg/kg.

Table 3
Analytical Results for Petroleum Hydrocarbons and Lead in Grab Ground Water Samples Collected From Soil Borings Drilled July 7, 8, and 9, 1993 at San Lorenzo, OMS #35

Sample Number	TRPH (418.1) (mg/L)	TPH - D (8015mod) (ug/L)	TPH - G (8015mod) (ug/L)	Organic Pb (22 CAC) (mg/L)	Dissolved Pb EPA 7421 (mg/L)	Benzene (8020) (ug/L)	Toluene (8020) (ug/L)	Ethylbenzene (8020) (ug/L)	Xylenes (8020) (ug/L)
B1-W1	ND	ND	ND	na	na	ND	ND	ND	ND
B2-W1	ND	ND	61	ND	ND	0.6	2.1	62	0.8
B2-W2*	ND	ND	ND	na	na	ND	ND	ND	ND
B3-W1	3.3	ND	110000	ND	ND	3400	7600	2600	10000
B5-W1	ND	ND	ND	na	na	ND	ND	ND	ND
B7-W1	ND	ND	ND	na	na	ND	ND	ND	ND
B9-W1	ND	56	ND	na	na	ND	ND	ND	ND
B13-W1	Free Product	na	na	ND	ND	na	na	na	na
B14-W1	ND	na	ND	na	na	ND	ND	ND	ND
B15-W1	ND	ND	ND	na	na	ND	ND	ND	ND
B16-W1	ND	na	ND	na	na	ND	ND	ND	ND
B17-W1*	ND	ND	ND	na	na	ND	ND	1.7	ND
Detection Limit	1	50	50	0.05	0.005	0.5	0.5	0.5	0.5
Average	0.33	7.00	11000.00	ND	ND	340.06	760.21	266.37	1000.1
Maximum	3.3	56	110000	ND	ND	3400	7600	2600	10000
Minimum	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Contaminant Levels (MCLs) for Drinking Water									
EPA MCL	---	---	---	---	0.05	5	1,000	700	11,000
Cal DHS MCL	---	---	---	---	0.05	1	---	680	1,750

Note: Only water samples which had detectable concentrations of TPHg were analyzed for lead.
na = not analyzed for this analyte
ND = not detected at or above detection limit
Shading = TPH > 10 mg/L, BTEX > MCLs
Averages are computed assuming ND = 0.
* Sample B17-W1 is from the lower aquifer and sample B2-W2 is predominately composed of water from the lower aquifer (Tetra Tech, 1993, p. 25). All other samples are from the upper aquifer.

Table 4
Analytical Results for Petroleum Hydrocarbons and Lead in Ground Water Samples
Collected July 14, 1993 at San Lorenzo, OMS #35

Sample Number	TRPH (418.1) (mg/L)	TPH - D (8015mod) (ug/L)	TPH - G (8015mod) (ug/L)	Benzene (8020) (ug/L)	Toluene (8020) (ug/L)	Ethylbenzene (8020) (ug/L)	Xylene (8020) (ug/L)
MW1	ND	ND	ND	ND	ND	ND	ND
MW2	ND	ND	ND	ND	ND	ND	ND
MW3	1.0	ND < 200	4100	ND < 5	ND < 5	ND < 5	640
Detection Limit	0.5	50	50	0.5	0.5	0.5	0.5
Average	0.33	ND	1366.67	ND	ND	ND	213.33
Maximum	1	ND	4100	ND	ND	ND	640
Minimum	ND	ND	ND	ND	ND	ND	ND
Maximum Contaminant Levels (MCLs) for Drinking Water							
EPA MCL	---	---	---	5	1,000	700	11,000
Cal DHS MCL	---	---	---	1	---	680	1,750

NA = not analyzed for this analyte
ND = not detected at or above detection limit
Averages are computed assuming ND = 0.

ATTACHMENT B

Geomatrix Protocols

PROTOCOL

DRILLING AND DESTRUCTION OF SOIL BORINGS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during the drilling and logging of soil borings. The information gathered from the exploratory borings will provide information about geologic conditions, soil engineering properties and/or soil quality. If the soil boring is utilized for well installation, the well will be installed in accordance with the protocol INSTALLATION OF WELLS.

The procedures presented herein are intended to be of a general use. As the work progresses and, if warranted, appropriate revisions will be made by the project manager. Detailed procedures in this protocol may be superceded by applicable regulatory requirements.

2.0 DRILLING

If required, permits for the drilling of soil borings will be acquired from the appropriate agency before drilling is initiated and an underground utility check will be conducted. The soil borings will be drilled using a rotary, hollow stem auger, or other appropriate method. In mud rotary borings, appropriate drilling fluid additives, such as bentonite, will be used to maintain an open hole and to carry cuttings to the surface. However, no organic drilling fluid additives will be used. The drilling mud will be circulated into a settling tank or basin located near the boring. Viscosity of the drilling fluid will be assessed periodically by the driller and will be controlled throughout the drilling operation to achieve the required results (hole stability, sample return, and minimum mud cake along boring wall). Only potable water will be used as makeup water for drilling fluid. Exploratory borings drilled using the hollow stem auger generally do not require the use of drilling fluid. If required, potable water from a municipal supply will be used to maintain boring stability.

The specific depth of each soil boring will be determined by the Geomatrix project manager before drilling. The Geomatrix field geologist/engineer will specify to the drill rig operator the depth of soil sample collection, method of sample retrieval, and other matters pertaining to the satisfactory completion of the borings. Drill cuttings, unused soil samples, and drilling fluids generated during drilling of soil borings will be stored for future disposal by the client in accordance with legal requirements.

The drill rods, augers, hoses, drive samplers, bits, and other components which fluids and cuttings contact will be thoroughly steam cleaned on-site before drilling each boring, including at the beginning of each project and at the completion of field activities. Only potable water from a municipal supply will be used for decontamination of drilling equipment. All decontamination rinsate will be collected and stored for future disposal by the client in accordance with legal requirements.

3.0 SAMPLING AND LOGGING

3.1 OBTAINING SAMPLES

Borings will be continuously cored, or sampled at depth intervals specified by the project manager based on the intended use of the boring. Samples and/or cuttings will be obtained for logging purposes at least every five feet for all borings. Drive samples will be used to log hollow stem borings, if continuous core is not collected. The samples and/or drill cuttings will be collected and described. A lithologic log of these samples will be made. Grain-size (sieve) analyses may be performed on selected samples in potential well completion zones and in other zones. These analyses will be summarized on standard grain-size analysis sheets. Other physical testing may also be performed on soil samples to evaluate additional physical properties. Samples for chemical analysis will be collected in accordance with the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

3.1.1 Coring and/or Discrete Sampling

Continuous cores from mud rotary borings will be collected, with a split-barrel sampler using a wire-line method of sampler operation. Continuous cores from the auger borings will be collected with a split-barrel sampler. The core diameter will be a minimum of 1.5 inches. In general, the split-barrel sampler will be opened for observation and logging of the retrieved core.

For discrete sampling of mud rotary or auger borings, sampling will be accomplished by driving or pushing a split-barrel sampler. The field geologist/engineer will record information pertaining to the sampling, such as rate of penetration, hydraulic ram pressure or drive-hammer blow count, coring smoothness and sample recovery on the BORING LOG.

At selected depth intervals, the split-barrel sampler may be fitted with brass or stainless steel liners for collection of soil samples for possible subsequent chemical or physical testing. Samples may be retained for future review and/or preserved for chemical or physical testing, as specified by the project manager. The samples will be stored and labeled to show project number, boring number, and cored interval denoted either by depth or sequential numbering system. Procedures for the preservation and transport of soil samples retained for chemical analysis are presented in the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

3.1.2 Collecting Drill Cuttings

The field geologist/engineer will observe drill cuttings from the drilling return for every 5-foot increment of the rotary borings that are not continuously cored. Sampling and logging will be done by adherence to the following procedures:

A. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods should be taken into account in calculating the depth of penetration.

B. In mud rotary drilling, a small diameter, fine mesh, hand screen will be used to obtain a sample of the cuttings from the borings by holding the screen directly in the flow of the drill fluid return line. In air rotary drilling, cuttings will be collected after discharge from the cyclone.

C. In rotary drilling, a composite sample may be obtained from the return line by leaving the screen in place during the time it takes the driller to advance the boring to any preselected depth.

D. In rotary drilling, the travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after circulation is resumed. This travel time will be used along with the depth of penetration to estimate the start and finish of each 5-foot sampling interval.

3.2 LOGGING OF EXPLORATORY BORINGS

The observations of the field geologist/engineer will be recorded on a BORING LOG OR WELL LOG at the time of drilling. The drill rig operator and the field geologist/engineer will discuss significant changes in material penetrated by the drill, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The field geologist/engineer will be present during drilling of soil borings and will observe and record such changes by time and depth.

Drill cuttings and core samples will be observed in the field. A lithologic description will be recorded on the log using the Unified Soil Classification System (USCS) as described in ASTM D 2488-90. This description will include the USCS soil type, grain sizes and estimated percentages of each, moisture content, color according to the Munsell color charts (Kollmorgen Instruments Corp.), plasticity for fine-grained materials, consistency or density, and any other pertinent information, such as degree of induration, calcareous content, presence of fossils and other distinctive materials.

The original field logs will be sent or delivered to the Geomatrix office for review by the Registered Geologist or Engineer and the project manager and for storage in the project files.

4.0 GEOPHYSICAL LOGS

Following completion of drilling, downhole geophysical logs may be performed immediately after the drilling fluid has been circulated to remove all of the cuttings. Geophysical methods and equipment will be selected to provide stratigraphic or hydrogeologic data appropriate for the project. Geophysical logging will be done as quickly and efficiently as possible, while the boring side wall is still in stable condition, to minimize the possibility of interference with the down-hole probes. Instruments on the logging unit will be adjusted to give the maximum definition of strata boundaries. All down-hole geophysical equipment will be cleaned before and after entering each borehole.

5.0 FIELD SCREENING

Soil samples at the boring locations may be screened using a portable meter such as a photoionization detector (PID), a flame ionization detector (FID), or a lower explosion limit (LEL) meter, or other organic vapor meter. The meter may be used to assess the presence of VOCs or other gases in soil samples. Additional field screening techniques for chemical characterization of soils may include x-ray fluorescence (XRF) and thin layer chromatography (TLC). Procedures for field screening are described in the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

6.0 DESTROYING SOIL BORINGS

Soil borings that are not completed as monitoring wells will be destroyed by filling the holes with a neat cement grout, cement/sand grout, or cement/bentonite grout. A high-solids bentonite grout may be used in the saturated zone. Geomatrix field staff will calculate borehole volume and compare it to the volume of grout used to evaluate whether bridging has occurred. These calculations and the actual volume emplaced will be noted on the boring log. The grout will be placed in one continuous pour before its initial set from the bottom of the boring to ground surface. The grout will be emplaced by pumping through a tremie pipe or flexible hose initially lowered to the bottom of the borings and raised incrementally as placement proceeds. If hollow stem augers were used for drilling, the augers should be raised in incrementally as emplacement proceeds. Augers will not be raised in increments greater than 20 feet or as greater than allowed by borehole stability. Borings that are terminated above the water table and not greater than 20-feet deep may be abandoned by a continuous grout pour originating at the ground surface. The grout will be pumped until a return of fresh grout is visible at the surface.

PROJECT:	**Log of Boring No.**
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR:	DATE STARTED: / DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH: / MEASURING POINT:
DRILLING EQUIPMENT:	DEPTH TO WATER / FIRST / COMPL. / 24 HRS.
SAMPLING METHOD:	LOGGED BY:
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES			OVM Reading	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
	Sample No.	Sample	Blows/ Foot		Surface Elevation:	

B-1 (11/92)

Geomatrix Consultants	Project No. #	Figure ---

PROTOCOL

SOIL SAMPLING FOR CHEMICAL ANALYSIS

1.0 INTRODUCTION

This protocol describes procedures to be followed for collecting soil samples and conducting soil field screening in conjunction with the drilling of soil borings. Selected soil samples will be submitted to a designated laboratory for chemical analysis. The laboratory must be certified by the California Department of Health Service (DHS) or other appropriate agency for the analyses to be performed. The procedures presented herein are intended to be of general use. As the work progresses and if warranted, appropriate revisions will be made and approved by the Geomatrix project manager.

2.0 DRILLING

The drilling of soil borings will be in accordance with the protocol DRILLING AND DESTRUCTION OF SOIL BORINGS.

3.0 SAMPLE COLLECTION AND PRESERVATION

Soil samples will be collected in clean brass or stainless steel liners that have been washed with detergent-water solution and rinsed with potable water. The liners will generally be set in a 2-inch or 2.5-inch diameter split-spoon sampler and then driven or pushed into soil at the selected sampling depth. Alternatively, a subsample for chemical analyses may also be collected by driving a liner of smaller diameter into the center of the larger core sample, taking care to minimize sample disturbance and air space within the liner. If the soil sample is collected in a hand auger, a subsample should be collected from the core of the auger, again taking care to minimize sample disturbance and air space within the liner. If the sample is to be analyzed for metals only, a disturbed sample may be placed in a glass jar. Samples to be analyzed for metals will be homogenized before analysis either in the field or by the lab to provide results more representative of the entire sampling interval.

The sampler will be washed with laboratory grade detergent-water solution to remove any soil present and then it will be rinsed with potable water prior to and between sampling. Upon disassembly of the soil sampler, the Geomatrix field geologist/engineer will take charge of the sample. Clean latex or solvex gloves will be worn by the sampler before touching the sample. The sample will be parted at the joints between the brass liners using a clean, sharp, stainless steel knife or spatula. The sample will be quickly observed for color, appearance, and composition and then capped. The ends of the liners will be covered with teflon sheeting and/or aluminum foil and then capped by plastic end caps. Capped samples will be sealed with tape and will be labeled and stored in a chest, which contains ice or blue ice if cooling is required, until delivered to the laboratory. Table 1 lists common analyses performed and the appropriate storage and handling requirements.

Sample containers will be labeled using waterproof ink and having the following information written on them.

- Geomatrix
- Project number
- Sample I.D. number
- Date and time sample was collected
- Initials of Sampler

4.0 SOIL FIELD SCREENING

A portable photoionization detector (PID), flame ionization detector (FID), lower explosive limit meter (LEL) or other type of organic vapor meter, may be used to screen selected soil samples collected from the soil borings. The purpose for the field screening of selected soil samples is to assess the presence of volatile organic compounds in the soil samples. The meter measures total volatile organics in the air in parts per million (ppm) by volume in reference to a selected standard. Calibration of the meter will be performed each day prior to the soil sampling. The meter cannot specifically identify each volatile compound, but can be adjusted to be sensitive to selected volatile organics.

The organic vapor meter screening method for selected soil samples consists of transferring a soil sample into a clean glass jar or plastic resealable bag. After some time has elapsed, the headspace will be quickly screened for the presence of volatile organics, and the meter will be allowed to return to a zero measurement before the next reading is taken. No soil sample used for field screening will be submitted to the laboratory for chemical analysis. The meter may also be used in auger borings to periodically screen for volatile organics in the air space at the top opening of the hollow stem auger. All meter readings for soil samples and ambient air at the top of the auger will be recorded on the BORING LOG or WELL LOG. Positive readings from the meter screening may be used to assist with selection of soil samples for chemical analysis.

Other soil screening techniques may also be used, including thin layer chromatography (TLC) which is discussed in the protocol SOIL EXCAVATION MONITORING AND SAMPLING, or x-ray fluorescence (XRF).

5.0 DOCUMENTATION

5.1 BORING LOG

Soil samples collected from soil borings will be recorded on the BORING LOG. These logs provide a means of uniquely identifying and tracking the samples. When sampling is completed, the original field log sheets will be placed in the project file.

5.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory.

A CHAIN-OF-CUSTODY RECORD will be filled out for each sample sent to the laboratory for analysis. Information contained on the triplicate carbonless form will include:

- Name of sampler.
- Date and time sampled.
- Sample I.D.
- Number of sample bottles.
- Sample Matrix (soil, water, or other).
- Analyses required.
- Remarks, including any preservatives, special conditions, or specific quality control measures.
- Turnaround time and person to receive lab report.
- Project number.
- Signatures of all people assuming custody.
- Signatures of field sampler at top of chain-of-custody.
- Condition of samples when received by lab.

Blank spaces on the chain-of-custody record will be crossed out between last sample number listed and signatures at the bottom of the sheet.

The field sampler will sign the chain-of-custody record and will record the time and the date at the time of transfer to the laboratory or an intermediate person. A set of signatures is required for each relinquished/received transfer, including transfer within Geomatrix. The original imprint of the chain-of-custody record will accompany the sample containers. A duplicate copy will be placed in the Geomatrix project file.

6.0 EQUIPMENT CLEANING

The sampler, brass or stainless steel liners, spatula, and any tools used in the assembly and disassembly of the sampler will be thoroughly cleaned before and after each use. All soil will be removed from the tools and parts and the tools will be steam-cleaned or washed in laboratory-grade detergent water with a brush followed by rinsing in potable water. Decontamination rinsate will be contained and stored for future disposal by the client in accordance with legal requirements.

PROJECT:		**Log of Boring No.**			
BORING LOCATION:		ELEVATION AND DATUM:			
DRILLING CONTRACTOR:		DATE STARTED:		DATE FINISHED:	
DRILLING METHOD:		TOTAL DEPTH:		MEASURING POINT:	
DRILLING EQUIPMENT:		DEPTH TO WATER	FIRST	COMPL.	24 HRS.
SAMPLING METHOD:		LOGGED BY:			
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO	

DEPTH (feet)	SAMPLES			OVM Reading	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo. inter.	REMARKS
	Sample No.	Sample	Blows/ Foot		Surface Elevation:	

B-1 (11/92)

Geomatrix Consultants	Project No. #	Figure ---

Chain-of-Custody Record

No

Date:

Page of

Project No.:

Samplers (Signatures):

			ANALYSES																			REMARKS				
Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX													Cooled	Soil (S) or water (W)	Acidified	Number of containers	Additional comments

Turnaround time:

Results to:

Total No. of containers:

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:
Signature:		Signature:		Signature:	
Printed name:		Printed name:		Printed name:	
Company:		Company:		Company:	
Received by:	Time:	Received by:	Time:	Received by:	Time:
Signature:		Signature:		Signature:	
Printed name.		Printed name.		Printed name	
Company:		Company:		Company:	

Method of shipment:

Laboratory comments and Log No :

Geomatrix Consultants
100 Pine St 10th Floor
San Francisco, CA 94111
(415) 434-9400

TABLE 1

WATER AND SOIL ANALYTICAL METHODS AND SAMPLE HANDLING

Parameter	Method	Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool on ice	14 days
as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH2: cool on ice	14 days
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020 (soil) EPA 602 (water)	2 - 40 ml VOA glass	HCL to pH2: cool on ice	14 days
Oil and Grease	5520 D & E (soil) 5520 A & E (water)	2 - 1 liter amber glass	H_2SO_4 to pH<2: cool on ice	28 days
Volatile Organics	EPA 8010	2 - 40 ml VOA glass	cool on ice[3]	14 days
	EPA 8240[4]	2 - 40 ml VOA glass	HCL to pH 2: cool on ice	14 days
Semi-volatile Organics	EPA 8270	2 - 1 liter amber glass	cool on ice	7 days for extraction 40 days for analysis
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Field filtration (0.45 micron filter): field acidify to pH 2 with HNO_3 except: Cr^{+6} - Cool on ice	6 months, except: Hg - 28 day Cr^{+6} - 24 hrs

Notes:

[1] All soil should be collected in full, clean brass liners, capped with foil and plastic caps, and sealed with tape. If soil samples are to be analyzed for metals they may be placed in clean glass jars. Soil should be cooled as indicated under "preservation" and maximum holding times apply to both soil and water.

[2] DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector.

[3] If EPA methods 8010 and 8020 are to be run in sequence, HCL may be added. Check with the project manager before adding acid.

[4] Chloroethylvinylether may be detected at concentrations below 50 parts per billion due to degradation of HCL.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July, and final amendments.
State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.
Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1990, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 10 August.

PROTOCOL

WATER LEVEL, WELL DEPTH, AND FREE PRODUCT MEASUREMENTS

1.0 INTRODUCTION

This protocol describes procedures to be followed during water level, well depth, and free product measurements. The procedures presented herein are intended to be of a general nature and, as the investigation progresses and when warranted, appropriate revisions may be made by the project manager.

2.0 WATER LEVEL AND WELL DEPTH MEASUREMENTS

Water level measurements at a site will be taken as quickly as possible, to best represent the potentiometric surface across the site at a single time. If pressure is suspected or has developed inside the well casing, the well will be allowed to stand without a cap for a few minutes before taking the water-level measurement. Water-level measurements will be recorded to the nearest hundredth foot, and well depth measurements will be noted to the nearest half foot. Equipment placed in the wells for water level and well depth measurements will be cleaned prior to reuse, as discussed in Section 5. Care will be taken to not drop any foreign objects into the wells and to not allow the tape or sounding device to touch the ground around the well during monitoring.

2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be performed by one of the following methods:

A. Wetted-tape Method

A steel surveyor's tape will be prepared by coating several feet of the lower end of the tape with chalk or water-finding paste. A lead weight is attached to the lower end of the steel tape to keep it taut. The tape is lowered into the well until a foot or two of the chalked portion is submerged.

Tape without weight can be used if the well opening or pump casing clearance is too small and restricts the passage of weight. The proper length to lower the tape may have to be determined experimentally. Measurement will be done as follows:

1. Lower and hold the tape at an even foot mark at the Measuring Point (MP) and note this tape reading.

2. Remove the steel tape from the well. Add or subtract the wetted length from the even foot mark noted in Step 1 as appropriate for your tape, and record this as water level below MP on the WATER LEVEL MONITORING RECORD.

B. Electric Sounder Method

An electric sounder consists of a contact electrode that is suspended by an insulated electric cable from a reel that has an ammeter, a buzzer, a light, or other closed circuit indicator attached. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. Electric sounders will be calibrated by measuring each interval and remarking them where necessary.

The procedure for measuring water levels with an electric sounder is as follows:

1. Switch on.

2. Lower the electric sounder cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.

3. With the cable in this fixed position, note the length of cable at the MP.

4. Since the electric cable is graduated in intervals, use a pocket steel tape measure (graduated in hundredths of a foot) to interpolate between consecutive marks. Care must be taken that the tape measurements are subtracted from graduated mark footage value when the water level hold point (determined in Step 3) is below the graduated mark and added when above the mark. Record the resulting value as water level below MP on the WATER LEVEL MONITORING RECORD.

2.2 WELL DEPTH MEASUREMENT

Depth of a well will be measured by sounding with a weighted steel surveying tape or an electric sounding line, weighted when possible. Procedures to be followed are described below.

A. Measure the distance between the zero mark on the end of the measuring line and the bottom of the weight.

B. Lower the weighted measuring line into the well until the line becomes slack or there is noticeable decrease in weight, which indicates the bottom of the well. Raise the line slowly until it becomes taut (this may have to be done several times to determine that taut point) and, with the line in this fixed position, note the reading at the MP. Add the distance described in Step A to this reading, and record the resulting value as well depth. This procedure will be performed before and after initial well development or as necessary to determine well casing depth.

C. Record the well depth value on a MONITORING WELL SAMPLING RECORD.

4.0 FLOATING FREE PRODUCT MEASUREMENT

Floating free product level/thickness measurements will be measured using a Flexidip interface probe (or other similar interface probe) or using an electric sounder and a bailer. The electric sounder and bailer method is limited to measuring product thickness less than the length of the bailer. Alternatively, if the free product is to be measured is hydrocarbon product, the thickness is greater than the length of the bailer, and a Flexidip is not available, a steel surveyor's tape and gasoline or oil finding paste in combination with water finding paste may be used. All floating free product level measurements shall be recorded to the nearest hundredth foot. All equipment placed in the wells for free product level measurement will be cleaned prior to reuse, as discussed in Section 5.0. Care will be taken to not drop any foreign objects into the wells and to not allow the measuring device to touch the ground around the well during monitoring.

4.1 FLEXIDIP INTERFACE PROBE METHOD

The Flexidip free product-water interface probe consists of a contract electrode that is suspended by a graduated tape from a reel that has a light and two-toned audible signals. Audible and visual signals occur when the electrode touches the free product surface and then the water surface.

The procedure for measuring free product levels using the Flexidip is as follows:

1. Turn the probe on. A short chirp every 5 seconds signals that the probe is on.
2. Lower the steel probe cover into the well until the cover sits on well casing near the measuring point. Make sure the WIPER switch is off.
3. Unlock the reel using the lock screw and lower tape and probe down into well using reel.
4. When the probe reaches the free product level, the audible signal will be a continuous tone, and the yellow OIL light will be illuminated.
5. Lock reel using lock screw, lift up, and read the level from the tape-viewing window on the side of the steel probe cover.
6. Unlock the reel and slowly lower probe to find the interface level.
7. When the probe reaches the interface, the audible signal changes from a continuous tone to an interrupted tone, and the red INTERFACE light flashes.
8. Lock reel and read level.
9. Turn on WIPER switch and reel up. Always thoroughly clean off any free product before reeling the tape and probe in.
10. Turn probe off and store in case after cleaning.
11. Replace battery when a continuous chirping sound is heard after turning on power with the probe in air. Always replace battery in a gas-free atmosphere.

4.2 ELECTRIC SOUNDER AND BAILER METHOD

The procedure for measuring free product using an electric sounder and an acrylic bailer are as follows:

A. Measure the water level with the electric sounder as described in Section 2.1

B. Suspend a clean acrylic bailer on a line and slowly lower the bailer into the well until it partially intersects the groundwater surface

C. Slowly pull the bailer to the surface

D. Let the bailer stand for several minutes

E. Measure the thickness of the product in the bailer to the nearest 0.01 foot and record the value on the sampling record. If the product is less than 0.01 foot thick the amount should be recorded as less than 0.01 foot. If only a shean is observed, or no free product is seen, these observations should be recorded.

4.3 STEEL TAPE AND PASTE METHOD

A. Measure the water level with an electric sounder as described in Section 2.1.

B. Spread a thin layer of gasoline or oil finding paste on one side of a steel surveyor's tape beginning at the zero foot mark and extending up the tape about one-foot more than the anticipated thickness of the free product.

C. Spread a thin film of water finding paste on the opposite side of the tape beginning at the zero foot mark and extending up the tape about one-foot.

D. Slowly lower the tape into the well until the zero foot mark is located about six inches below the water level (the tape reading at the measuring point should be six inches greater than the actual depth to water). Take care not touch the sides of the well with the tape.

E. Slowly remove the tape from the well. The pastes will have changed color upon contact with the water or the free product. The product thickness is the difference between the tape reading at the point where water finding paste indicates the water level to be and the point where the gasoline or oil finding paste indicates the top of the free product to be.

5.0 EQUIPMENT CLEANING

Steel tapes, electric well sounders, and acrylic bailers will be cleaned after measurements in each well. Cleaning procedures will be as follows:

A. Wipe free product off with disposable towels. Rinse probe or portion of instrument that was immersed in well water with a solution of laboratory-grade detergent and potable water.

B. Rinse with potable water.

C. Dry with a clean paper towel.

D. The Flexidip may also be cleaned with acetone at this stage.

Solutions resulting from cleaning procedures will be collected and stored for future disposal by the client in accordance with legal requirements.