SOIL AND GROUND WATER INVESTIGATION
at the
AC TRANSIT FACILITY
1100 SEMINARY AVENUE
OAKLAND, CALIFORNIA

For

KAISER ENGINEERS, INC.

1800 Harrison Street

Oakland, California

By

Weiss Associates
2938 McClure Street
Oakland, CA 94609

May 28, 1987

WEISS ASSOCIATES
Consulting in Geology & Geohydrology
2938 McClure Street. Oakland, CA 94609
415-465-1100

SOIL AND GROUND WATER INVESTIGATION
at the
AC TRANSIT FACILITY
1100 SEMINARY AVENUE
OAKLAND, CALIFORNIA

For

KAISER ENGINEERS, INC.
1800 Harrison Street
Oakland, California

May 28, 1987

A Division of AguaTierra Associates Incorporated

I certify that Weiss Associates' work on this project was conducted under my supervision. To the best of my knowledge, the data contained herein are true and accurate and satisfy the specified scope of work for this project.

Richard B. Weiss

Richard B. Weiss
Certified Engineering Geologist
No. EG1112
License expires June 30, 1988

CONTENTS

TABLES

FIGURES (FOLLOWING TEXT)

APPENDICES

A. Chain-of-Custody Forms
B. Unified Soil Classification System
C. Rock Color Classification System

SUMMARY

Three ground water monitoring wells were installed and four soil borings were drilled to establish the margin of a known subsurface hydrocarbon plume and assess hydrogeologic conditions in the vicinity of a proposed AC Transit building at 1100 Seminary Avenue, Oakland, California. Chemical analysis results are detailed in a separate report by Kaiser Engineers, Inc.

Three geologic units were encountered at the site: fill from the surface to about 3 ft deep, salt marsh deposits from about 3 to 5-9 ft deep, and alluvium below about 5 to 9 ft deep. Permeable channel deposits within the alluvium are the primary water-bearing zones, serving as preferred pathways for subsurface fluid flow. Preliminary data suggest that ground water flow is southeasterly toward San Francisco Bay. Free hydrocarbon was detected **in only one borehole, in soil between 14.7 and 14.8 ft at the northwestern edge of the proposed building but below the planned excavation depth.** Little or no hydrocarbon was detected within any other areas of the proposed excavation. Some organic vapors were detected in association with an organic-rich salt marsh deposit, but these are probably methane of natural origin.

1. INTRODUCTION

This report presents the results of a soil and ground water investigation at the AC Transit facility at 1100 Seminary Avenue in Oakland, California. The purpose of the investigation was to determine whether or not hydrocarbons previously identified in soil and ground water at the site extend into the foundation area of a proposed new building and to determine what effect, if any, the hydrocarbons might have on construction activities. Weiss Associates' role in the investigation was to conduct sampling and well installation and assess hydrogeologic conditions.

1.1 SITE BACKGROUND

The AC Transit facility occupies a nearly level site about 3/4 mile inland of the present San Francisco Bay shoreline. Site elevations range from about 5 to 7 feet above mean sea level. The site is bordered by industrial areas to the northwest, southwest and southeast and by a residential area on the northeast.

Soil sampling around five underground fuel storage tanks at the site was con ducted in September 1986. Four of the seven samples analyzed contained hydrocarbons, with up to 13,000 parts per million (ppm) total hydrocarbons in one sample (Baseline Environmental Consulting, 1987a). The tanks were excavated in January 1987 along with all contaminated soil containing more than 1,000 ppm total hydrocarbons. Three monitoring wells (MW-1, MW-2, and MW-3, Figure 1) were installed by Baseline Environmental Consulting in late January 1987 to determine the extent of shallow ground water contamination. Ground water from these wells showed 29 to 50 ppm total hydrocarbons and 1.5 to 13 ppm each of benzene, toluene and xylene in shallow ground water between depths of 6 to 14 ft.

To further define the extent of hydrocarbons in ground water in the direction of the proposed building, well MW-4 (Figure 1) was installed in March 1987 at the proposed building's northern corner (Baseline Environmental Consulting, 1987b). This well showed from 20 to 290 ppm total fuel hydrocarbons and benzene, toluene and xylene in the low part per million range in shallow ground water. These results indicated further need to characterize soil and ground water in the excavation areas of the proposed building. The procedures and results of this additional work are described in this report.

1.2 SCOPE OF WORK

To characterize the extent of hydrocarbons in shallow soil and ground water and hydrogeologic conditions in the proposed excavation area, the following work was conducted:

1) Installation, development and sampling of three monitoring wells: MW-5, MW-7, and MW-8 (Figure 1);

2) Overdrilling of the boreholes for wells MW-7 and MW-8 to 25 ft to collect soil samples from the deepest parts of the proposed excavation;

3) Collection of soil samples either continuously (MW-7) or every 3 ft (MW-5 and MW-8) for lithology and field organic vapor analysis (OVA);

4) Collection of samples every 3 ft to submit for laboratory analysis;

5) Review of ground water and soil analytic results;

6) Drilling of 4 additional soil borings (B-10, B-11, B-12, B-13, Figure 1) at locations and depths (11 feet) specified by AC Transit; and

7) Preparation of a final report describing procedures, results, and hydrogeologic conditions at the site.

2. SUBSURFACE INVESTIGATION

2.1 SOIL BORINGS AND SAMPLING

Boreholes for monitoring wells MW-5, MW-7 and MW-8 (Figure 1) were drilled on March 20, 1987 using a CME 75 hollow-stem auger drill rig operated by HEW Drilling Co. Soil samples were collected every 3 ft and stored at the analytic laboratory. Borehole MW-7 was logged and sampled continuously for lithology, and about every 6 inches of recovered sample was measured for hydrocarbon vapors with a Foxboro Model 128 portable organic vapor analyzer (OVA). Boreholes MW-5 and MW-8 were sampled every 3 ft (1.5-ft samples) for lithology, and every 6 inches of sample measured for hydrocarbons with the OVA. The boreholes for wells MW-7 and MW-8 were overdrilled to 25 ft to determine conditions in the deepest parts of the proposed excavation. Borehole logs for MW-5, MW-7 and MW-8 are presented in Figures 2, 3 and 4. The soil samples were submitted and held at Brown and Caldwell Analytical Laboratories of Emeryville, California.

To determine whether or not hydrocarbons identified in ground water at wells MW-4 and MW-5 would affect the proposed excavation to 8 ft at the northwest end of the proposed building, boreholes B-10, B-11, B-12 and B-13 were drilled and backfilled on April 1987 by Exploration Geoservices using a Mobile B-40L22 hollow-stem auger drill rig. Samples for chemical analysis were collected about every four feet in the B-series boreholes and separate lithologic samples were also collected. Logs for these borings are presented in Figures 5, 6, 7 and 8. The B-series samples were also analyzed on site by OVA to assist Kaiser Engineers in determining which soil samples to analyze at the laboratory.

The soil samples were collected by driving modified California, California, and standard penetration samplers with a 140 pound hammer with a 30 in. drop. Soil samples for chemical analysis were collected in two in. diameter brass tubes which were sealed with aluminum foil, plastic caps and duct tape and refrigerated. Samples were delivered the day of collection to Brown and Caldwell Laboratories. Chain-of-custody forms are presented in Appendix A.

2.2 WELL INSTALLATION, DEVELOPMENT, AND WATER SAMPLING

Four-inch diameter monitoring wells were constructed in boreholes MW-5, MW-7 and MW-8 on March 20, 1987. Each well was screened to monitor water-bearing materials where free ground water was first encountered. Since there was no evidence of free hydrocarbon on the water table, the wells were screened in the most permeable unit after first water was encountered and the screens were not extended to or above the anticipated 5-ft-deep static water level. Well construction details are presented in Figures 2, 3 and 4.

The three wells were developed on March 20 using a specially designed airlift eductor system to ensure no contact of potentially contaminated compressed air with ground water. Development water was stored in a watertight dumpster. Well development details are presented in Table 1.

TABLE 1. Well Development Details, AC Transit

Well No.	Water Evacuated (approx gal.)	Flow Rate (gpm)	OVA Reading (ppm)
MW-5	55	0.75	26
MW-7	30	<0.25	ND
MW-8	50	0.5	ND

Following development, water samples were collected from each well using steam-cleaned bailers, decanted into 40-ml glass VOA vials, labeled, refrigerated and transported to Brown and Caldwell Laboratories for analysis. The chain-of-custody form for the samples submitted is presented in

Appendix A. The samples were analyzed on a 3-day rush turnaround by gas chromatography/mass spectrometry (GC/MS) using a purge and trap extraction, EPA Method 624, for volatile organic compounds (VOCs) including benzene, toluene and xylenes (BTX), and by liquid/liquid extraction gas chromatography/flame ionization detection (GC/FID), EPA Method 8015, for total fuel hydrocarbons.

3. HYDROGEOLOGY

Hydrogeologic conditions encountered in this phase of work corroborate the earlier findings of Baseline Environmental Consultants (1987) and Geo/Resource Consultants (1983). Subsurface soils are predominantly silts and clays with occasional sandy or gravelly interbeds. Free ground water is encountered anywhere from 2.5 to 22 ft deep. Where first water is encountered below 5 ft, it rises to within 5 ft of the surface, indicating confined conditions below 5 ft deep. Unconfined ground water is occasionally found above 5 ft deep and is probably perched. The site hydrogeology is detailed in the following sections.

3.1 SUBSURFACE LITHOLOGY

Three subsurface units are consistently encountered in boreholes at the site, as shown on borehole logs (Figures 2 through 8) and in geologic cross-sections (Figures 9 and 10). Soil types are noted on the cross-sections according to the Unified Soil Classification System, outlined in Appendix B. Soil color descriptions are in accordance with the Munsell system as detailed in Appendix C. In order of increasing depth, the subsurface units are as follows:

<u>FILL</u> (0 to about 3 ft deep). This unit consists of brown silty clay of variable stiffness to brown sandy gravel of variable density. No regular patterns of coarse-grained materials could be discerned, which supports the view that the fill is of artificial orgin. Perched ground water was encountered in gravelly materials at 2 1/2 ft in the boring for well MW-8.

<u>SALT MARSH DEPOSIT</u> (from 3 to about 5 to 9 ft deep). The upper 1 to 2 ft of this unit consist of grayish-black organic-rich silty clay of low estimated permeability, which grades with depth into olive gray silty

clay. The composition of this deposit, the site's proximity to San Francisco Bay, and the coincidence of the top of the deposit with the high tide level, at about 3 ft above mean sea level, leads us to believe this deposit is Bay Mud. This unit appears to be continuous across the site and therefore serves as an aquitard separating unconfined perched ground water above and confined ground water below.

<u>ALLUVIUM</u> (below 5 to 9 ft deep). This material is composed of fine-grained sediments with more permeable lenses of coarse soil. These materials were deposited on the distal portion of alluvial fans that originate in the Oakland hills north and west of the site. The sandy and gravelly lenses represent high-energy stream-channel deposits. These stream-channel deposits tend to act as preferred pathways for ground water flow, although their effectiveness in this regard depends on the degree separate channel deposits are interconnected. The long axes of the channel deposits are generally oriented along the depositional gradient. At the 1100 Seminary Avenue site, this is about a northeast-southwest orientation. The low-permeability clays and silts were deposited in interchannel areas of the alluvial fan. These materials serve as barriers to ground water flow.

The differing depth of the contact between the alluvium and salt marsh deposits reflects the irregular surface of the alluvial fan prior to salt marsh deposition. The irregularity can be attributed partly to the original depositional surface of the fan, and partly to wind and water erosion of the fan surface.

3.2 GROUND WATER

With the exception of perched ground water present in fill in some of the boreholes, free-flowing ground water was encountered only in the more permeable lenses within the alluvium. In the seven borings drilled in this phase of work (MW-5, MW-7, MW-8, B-10, B-11, B-12, and B-13), depth of first free ground water ranged from 8 to 17 ft. In wells MW-5 and MW-7, the water level rose to about 5 ft below ground surface several days after development, similar to the pattern shown by wells MW-1 through 4, and indicating confined conditions.

Water levels in MW-3, MW-5 and MW-7 indicate a potentiometric head drop from northeast to southwest. This drop parallels the hypothesized northeast/southwest orientation of permeable channel deposits in the alluvium, and suggests that ground water flows toward the southwest.

4. HYDROCARBON OCCURRENCE AND DISTRIBUTION

Chemical analysis results and patterns of hydrocarbon distribution are presented in detail in a separate report by Kaiser Engineers, Inc. Several hydrogeologic factors related to hydrocarbon distribution are discussed below.

High-Permeability Channel Deposits--These serve as preferred pathways for ground water flow and hydrocarbon migration. Under present conditions with the potentiometric surface about 3 to 5 feet below land surface and saturated conditions below that depth, free-floating hydrocarbons would float at about the 5-ft level and could not reach the high-permeability channels, which occur at depths greater than about 10 ft. Hence, at present, the channels only serve as preferred pathways for dissolved hydrocarbons. This may not have always been the case, as outlined in the next section.

Historic Water Level Fluctuations--The presence of hydrocarbons in the form of a sheen at a limited depth interval (14.7 to 14.8 ft) in borehole MW-5 is inconsistent with the present potentiometric surface, which is about 10 ft higher. One explanation is that the free hydrocarbons migrated during a time of lower water levels, such as the drought of 1977-1978. Ground water pumping for dewatering or other purposes could also have caused lowered water levels in the past.

Organic Rich Salt Marsh Deposits--A notable result of the organic vapor analysis (OVA) is the ubiquitous detection of low parts per million (ppm) concentrations of organic vapors in the grayish-black organic-rich soils from the top of the marsh deposit, between about 3 to 5 feet deep (Figures 2 through 8). In most boreholes these concentration were below 30 ppm and are probably from naturally-occuring methane generated by decay of organic matter in the soil. In the MW-7 borehole, concentrations up to 80 ppm were measured. It is uncertain whether these concentrations are entirely from naturally- occuring methane or reflect a contribution from shallow hydrocarbon occurrence.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Conclusions of this study are:

1) Three geologic units were identified beneath the site: fill from 0 to about 3 ft deep, salt marsh deposit from about 3 to 5-9 ft deep, and alluvium below about 5 to 9 ft deep;

2) Permeable channel deposits within the alluvium are the primary water-bearing zones, serving as preferred pathways for ground water flow and potential hydrocarbon migration;

3) Field evidence of significant hydrocarbon contamination was limited to detection of a hydrocarbon sheen and organic vapors in saturated soil from 14.7 to 14.8 ft deep in borehole MW-5, and detection of organic vapor in well development water from well MW-5;

4) The margin of the hydrocarbon plume in ground water lies between well MW-7 and the northwestern end of the proposed building;

5) Ground water flow is probably to the southwest, toward San Francisco Bay;

6) Historic water level fluctuations may account for the presence of free hydrocarbons 10 ft below the present potentiometric surface; and

7) Organic vapors detected in the salt marsh deposit are probably naturally-occurring methane generated by organic decay, and not from hydrocarbon contamination.

5.2 RECOMMENDATIONS

In regard to the above conclusions, the following recommendations are made:

1) Water levels should be measured at all wells on the site to provide better definition of the hydraulic gradient and direction of ground water flow;

2) The potential hydraulic influence of foundation excavation dewatering on the hydrocarbon plume should be evaluated; and

3) The results of this investigation should be discussed, with the California Regional Water Quality Control Board - San Francisco Bay Region.

REFERENCES CITED

Baseline Environmental Consulting, 1987a, Report on monitoring well installations, AC Transit Facility, 1100 Seminary, Oakland: unpublished consultant's report for Kaiser Engineers, Inc. March 9, 1987, 4 p., 3 attachments.

Baseline Environmental Consulting, 1987b, Data submitted for MW-4 installation at 1100 Seminary, Oakland: Consultant's letter report to Kaiser Engineers, Inc. April 3, 1987, 2 p., 4 attachments.

Geo/Resource Consultants, 1983, Geotechnical investigation, AC Transit facilities improvement program, Seminary Avenue, Oakland, California: unpublished consultant's report for Kaiser Engineers, Inc. July 5, 1983, 15 p., 23 figures.

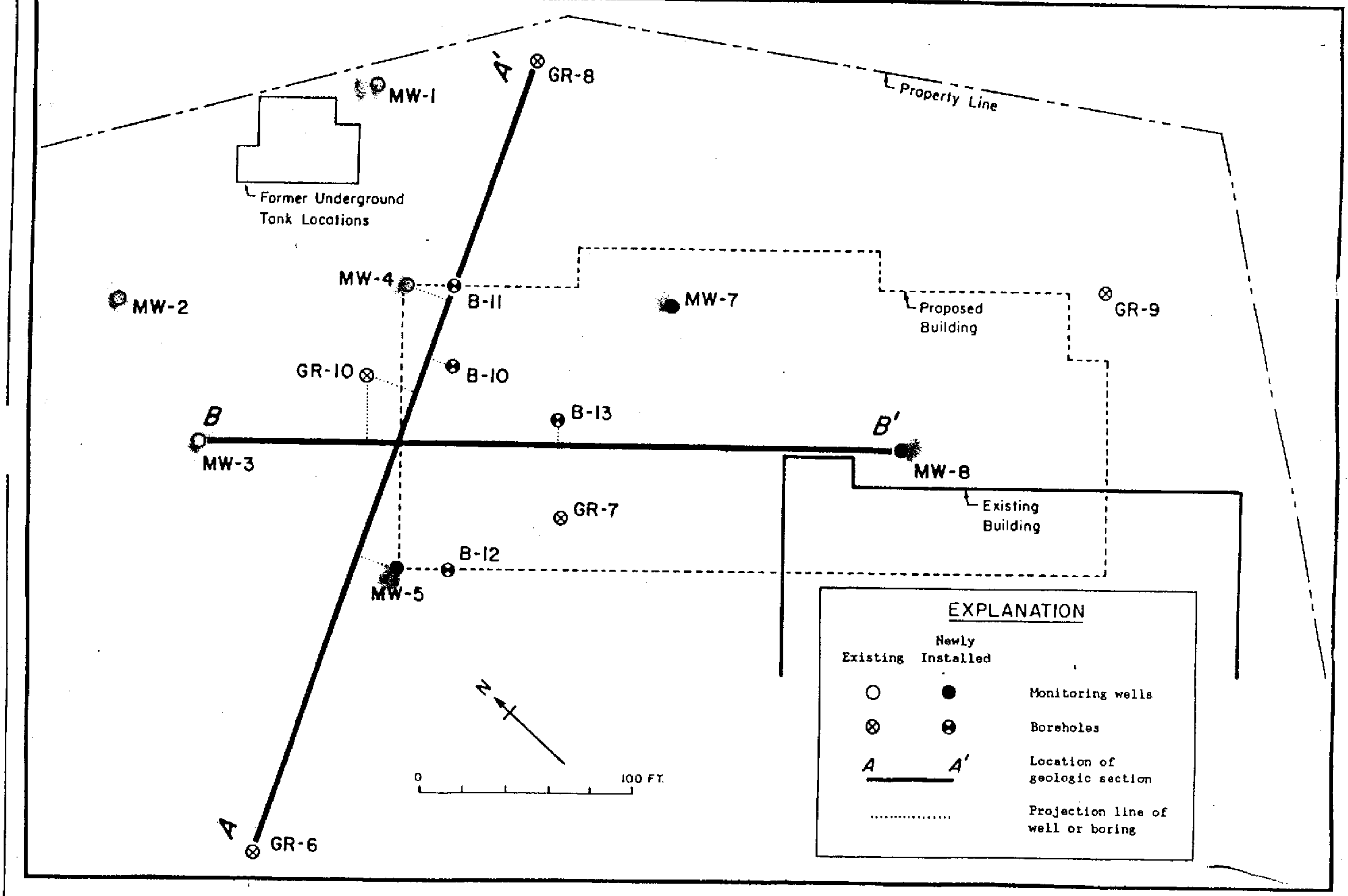
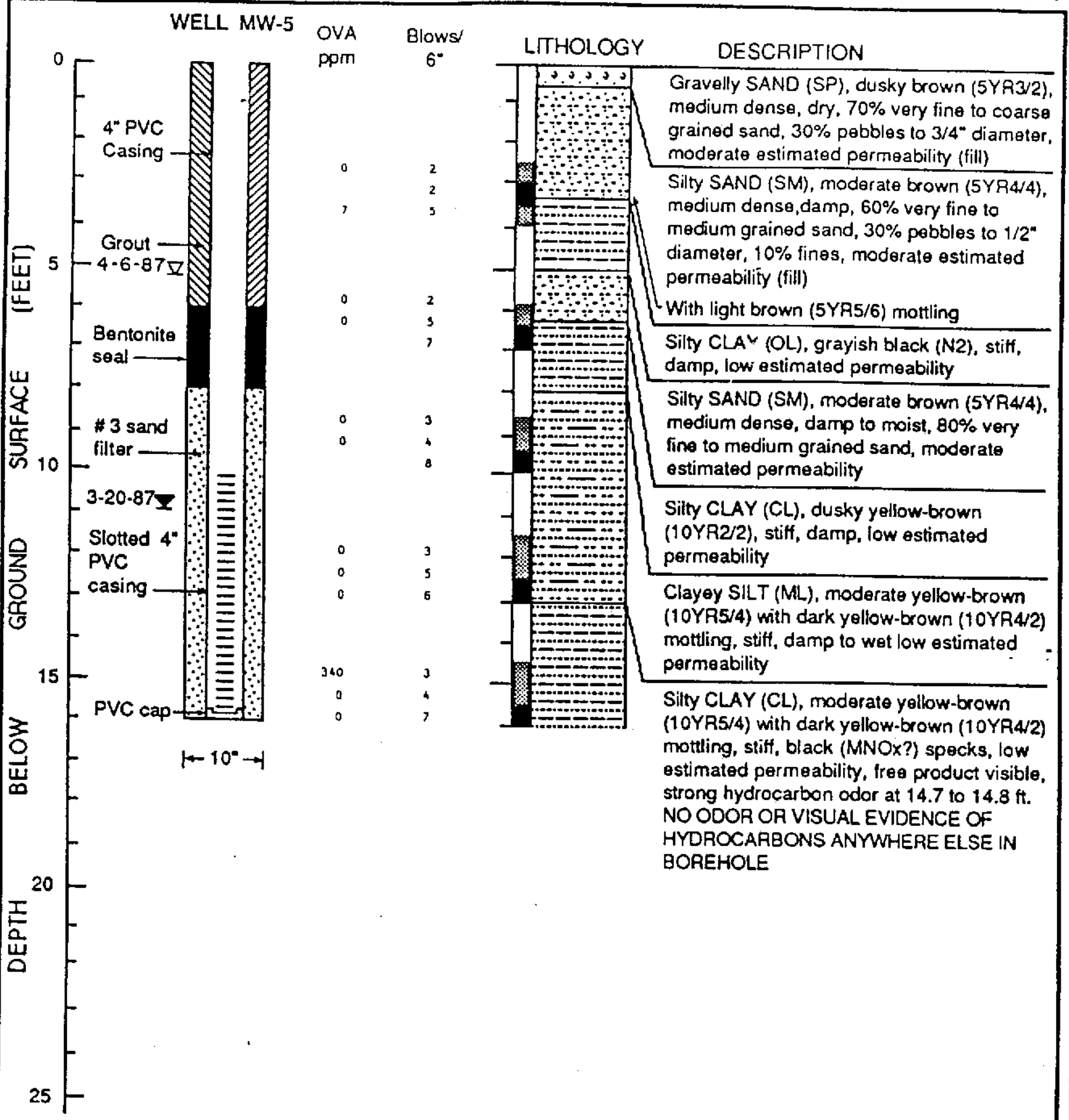


Figure 1. Location of Boreholes, Monitoring Wells, and Geologic Section - AC Transit Facility, Oakland, CA.



Gravelly SAND (SP), dusky brown (5YR3/2), medium dense, dry, 70% very fine to coarse grained sand, 30% pebbles to 3/4" diameter, moderate estimated permeability (fill)

Silty SAND (SM), moderate brown (5YR4/4), medium dense,damp, 60% very fine to medium grained sand, 30% pebbles to 1/2" diameter, 10% fines, moderate estimated permeability (fill)

With light brown (5YR5/6) mottling

Silty CLAY (OL), grayish black (N2), stiff, damp, low estimated permeability

Silty SAND (SM), moderate brown (5YR4/4), medium dense, damp to moist, 80% very fine to medium grained sand, moderate estimated permeability

Silty CLAY (CL), dusky yellow-brown (10YR2/2), stiff, damp, low estimated permeability

Clayey SILT (ML), moderate yellow-brown (10YR5/4) with dark yellow-brown (10YR4/2) mottling, stiff, damp to wet low estimated permeability

Silty CLAY (CL), moderate yellow-brown (10YR5/4) with dark yellow-brown (10YR4/2) mottling, stiff, black (MNOx?) specks, low estimated permeability, free product visible, strong hydrocarbon odor at 14.7 to 14.8 ft. NO ODOR OR VISUAL EVIDENCE OF HYDROCARBONS ANYWHERE ELSE IN BOREHOLE

EXPLANATION

▼	Water level during drilling (date)	▒	Location of split tube drive sample
▽	Water level (date)	■	Location of split tube drive sample in brass tube
—— - -	Contact (dashed where approximate)	OVA	Organic Vapor Analysis

Figure 2. Well Construction Details and Subsurface Lithology - Well MW-5

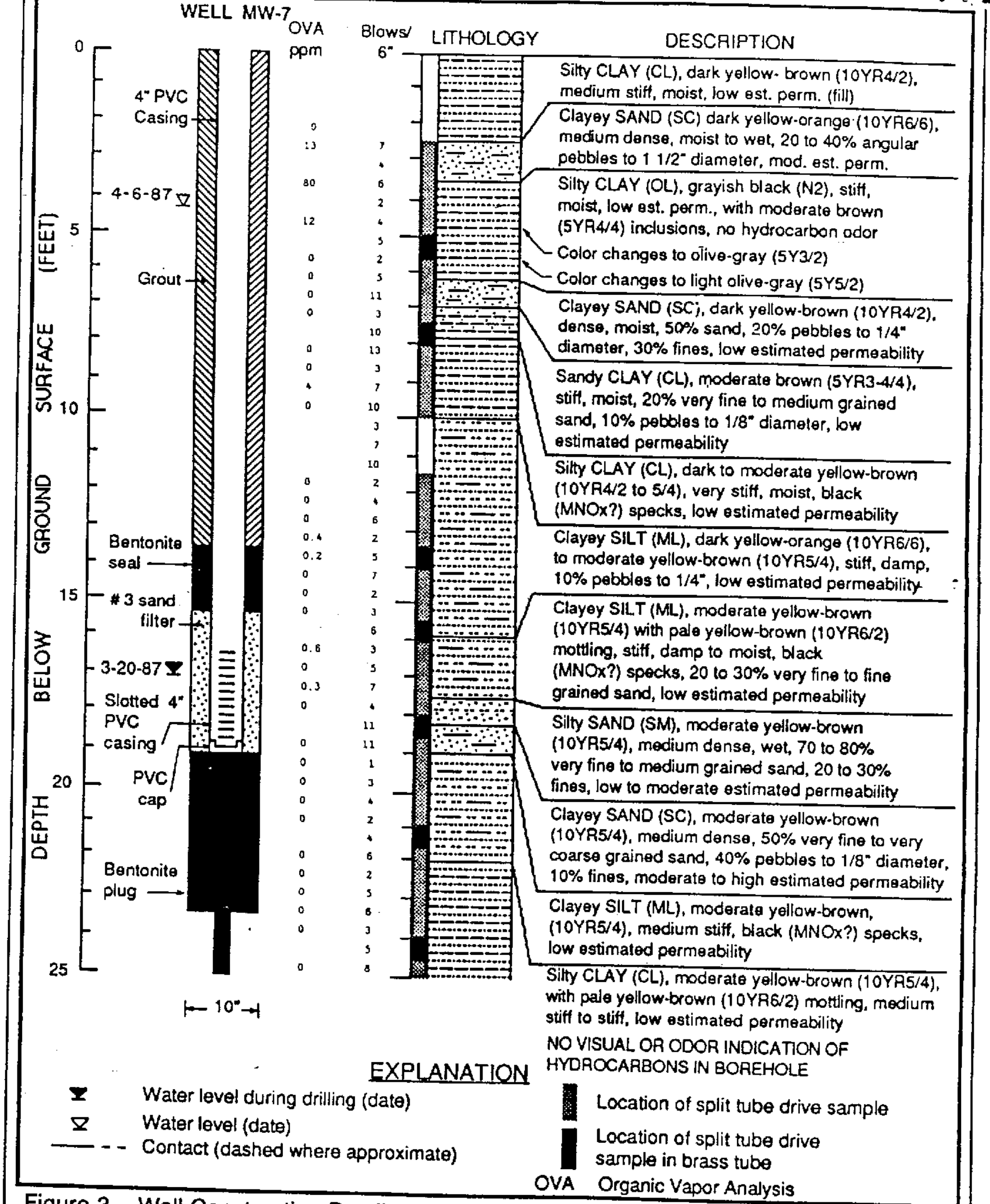


Figure 3. Well Construction Details and Subsurface Lithology - Well MW-7

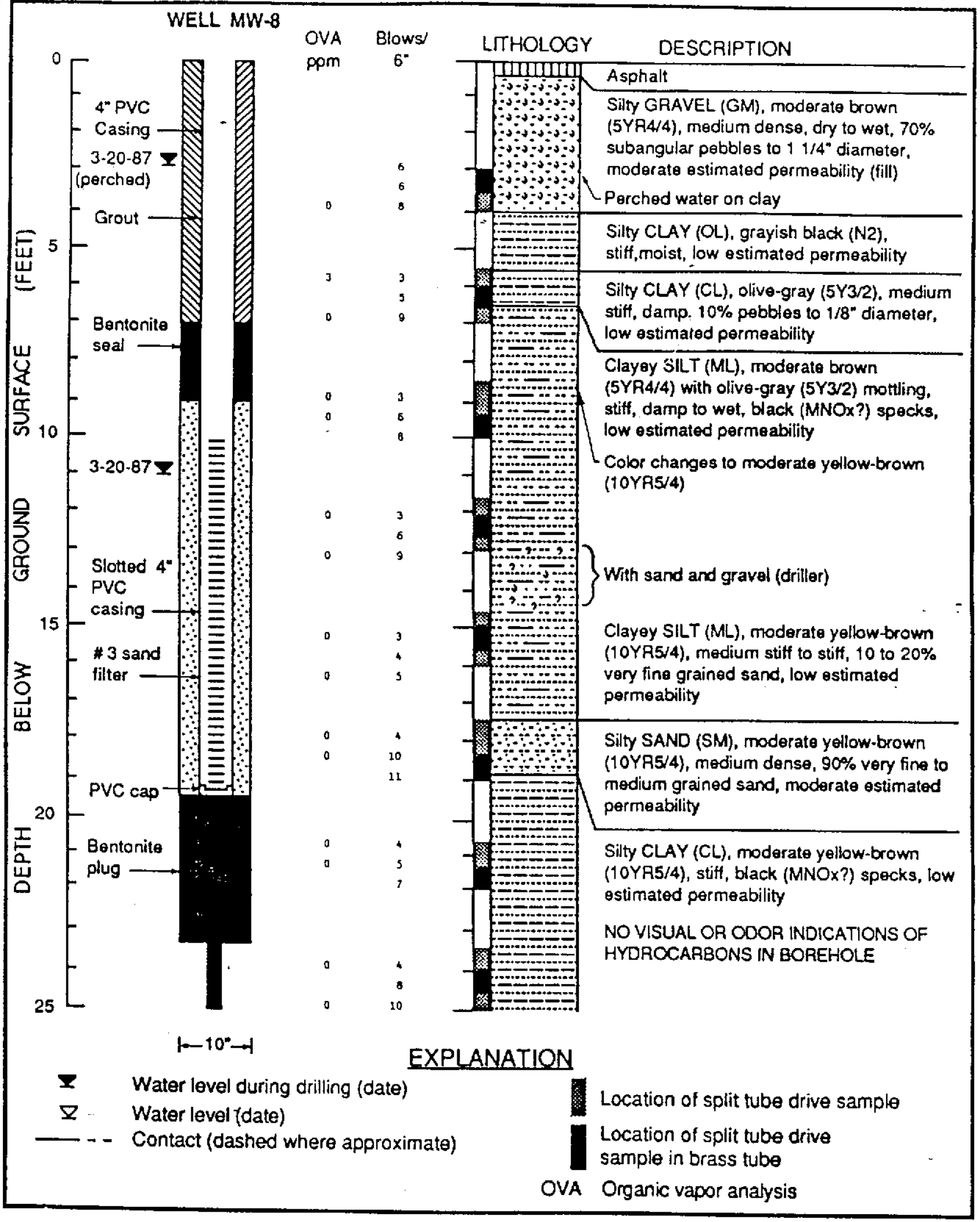
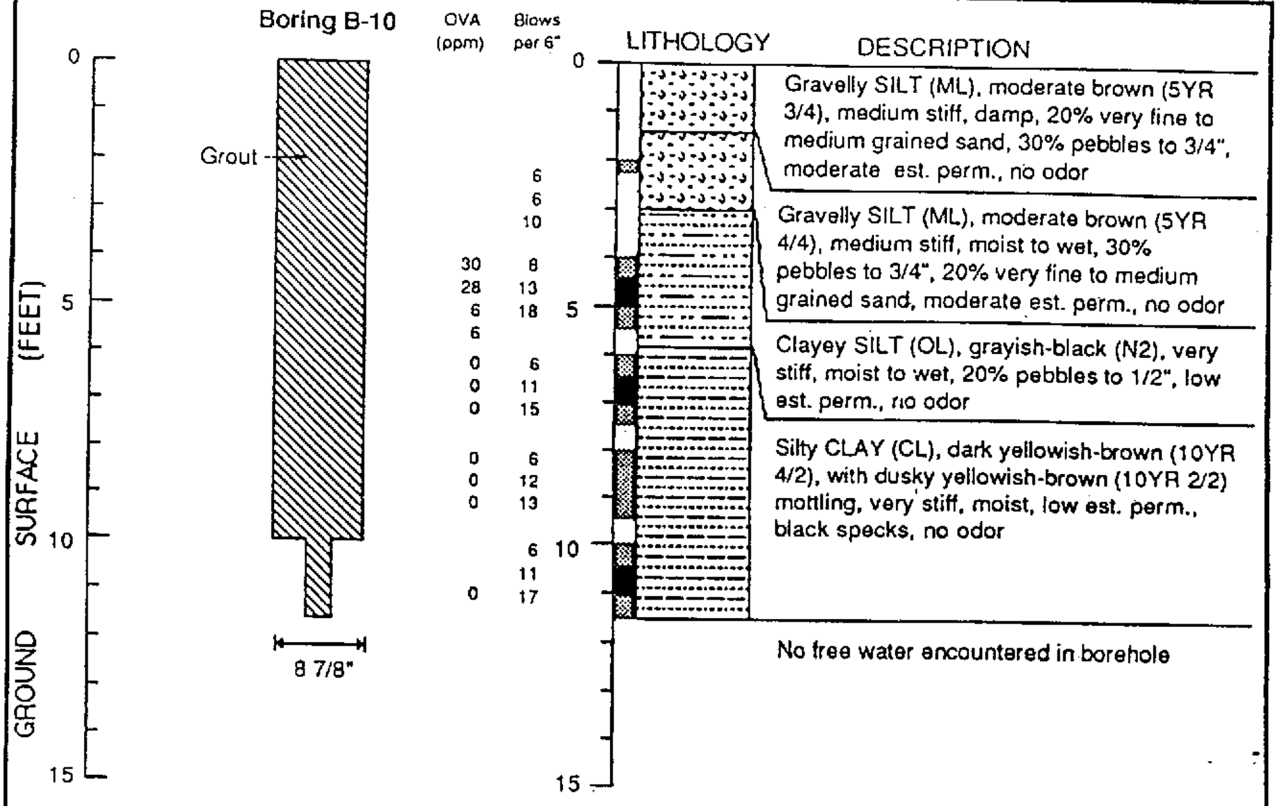


Figure 4. Well Construction Details and Subsurface Lithology - Well MW-8



Gravelly SILT (ML), moderate brown (5YR 3/4), medium stiff, damp, 20% very fine to medium grained sand, 30% pebbles to 3/4", moderate est. perm., no odor

Gravelly SILT (ML), moderate brown (5YR 4/4), medium stiff, moist to wet, 30% pebbles to 3/4", 20% very fine to medium grained sand, moderate est. perm., no odor

Clayey SILT (OL), grayish-black (N2), very stiff, moist to wet, 20% pebbles to 1/2", low est. perm., no odor

Silty CLAY (CL), dark yellowish-brown (10YR 4/2), with dusky yellowish-brown (10YR 2/2) mottling, very stiff, moist, low est. perm., black specks, no odor

No free water encountered in borehole

EXPLANATION

▼ Water level during drilling (date)

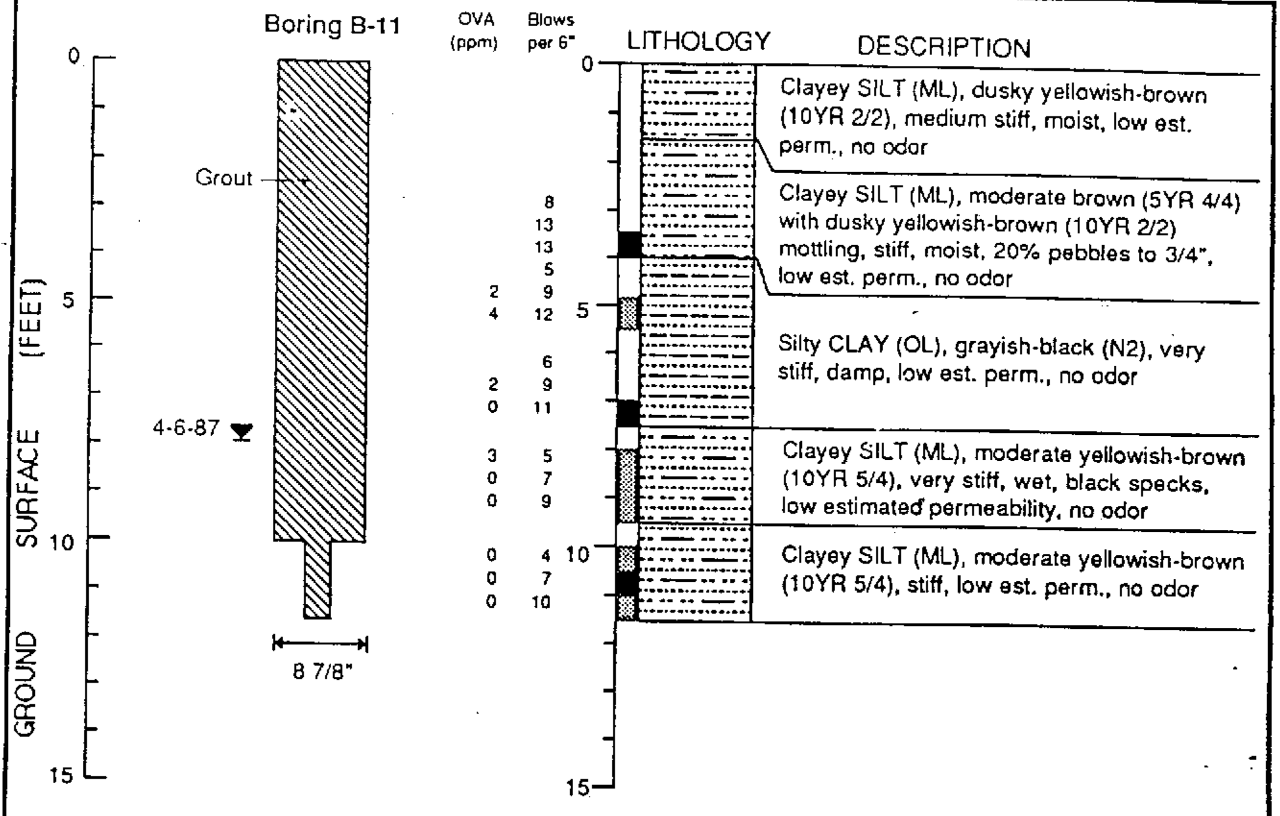
——--- Contact (dashed where approximate)

OVA Organic Vapor Analysis

▨ Location of split tube drive sample

■ Location of split tube drive sample in brass tube

Figure 5. Subsurface Lithology - Boring 10



Clayey SILT (ML), dusky yellowish-brown (10YR 2/2), medium stiff, moist, low est. perm., no odor

Clayey SILT (ML), moderate brown (5YR 4/4) with dusky yellowish-brown (10YR 2/2) mottling, stiff, moist, 20% pebbles to 3/4", low est. perm., no odor

Silty CLAY (OL), grayish-black (N2), very stiff, damp, low est. perm., no odor

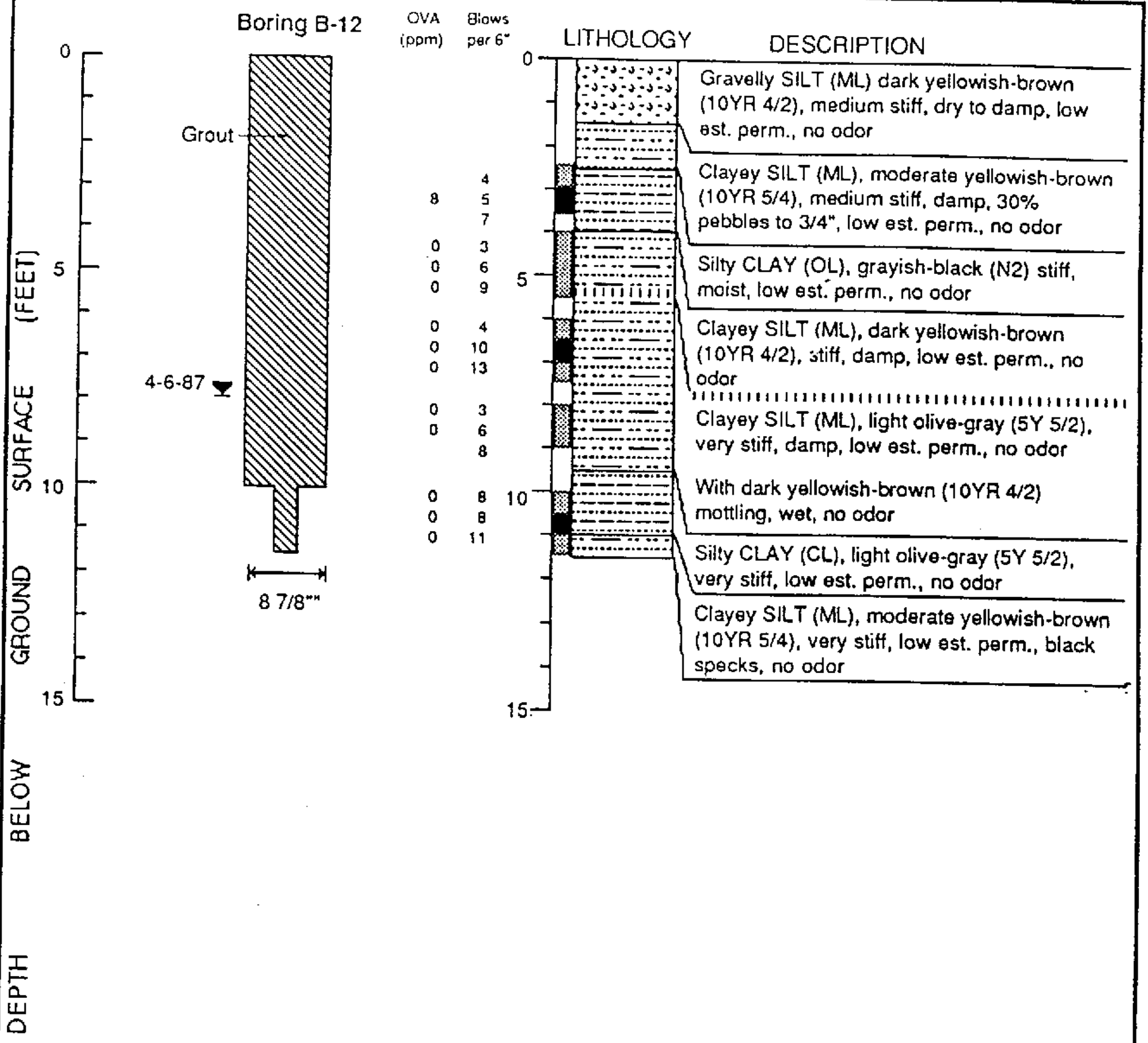
Clayey SILT (ML), moderate yellowish-brown (10YR 5/4), very stiff, wet, black specks, low estimated permeability, no odor

Clayey SILT (ML), moderate yellowish-brown (10YR 5/4), stiff, low est. perm., no odor

EXPLANATION

▼	Water level during drilling (date)
——---	Contact (dashed where approximate)
OVA	Organic Vapor Analysis
▨	Location of split tube drive sample
■	Location of split tube drive sample in brass tube

Figure 6. Subsurface Lithology - Boring 11



Gravelly SILT (ML) dark yellowish-brown (10YR 4/2), medium stiff, dry to damp, low est. perm., no odor

Clayey SILT (ML), moderate yellowish-brown (10YR 5/4), medium stiff, damp, 30% pebbles to 3/4", low est. perm., no odor

Silty CLAY (OL), grayish-black (N2) stiff, moist, low est. perm., no odor

Clayey SILT (ML), dark yellowish-brown (10YR 4/2), stiff, damp, low est. perm., no odor

Clayey SILT (ML), light olive-gray (5Y 5/2), very stiff, damp, low est. perm., no odor

With dark yellowish-brown (10YR 4/2) mottling, wet, no odor

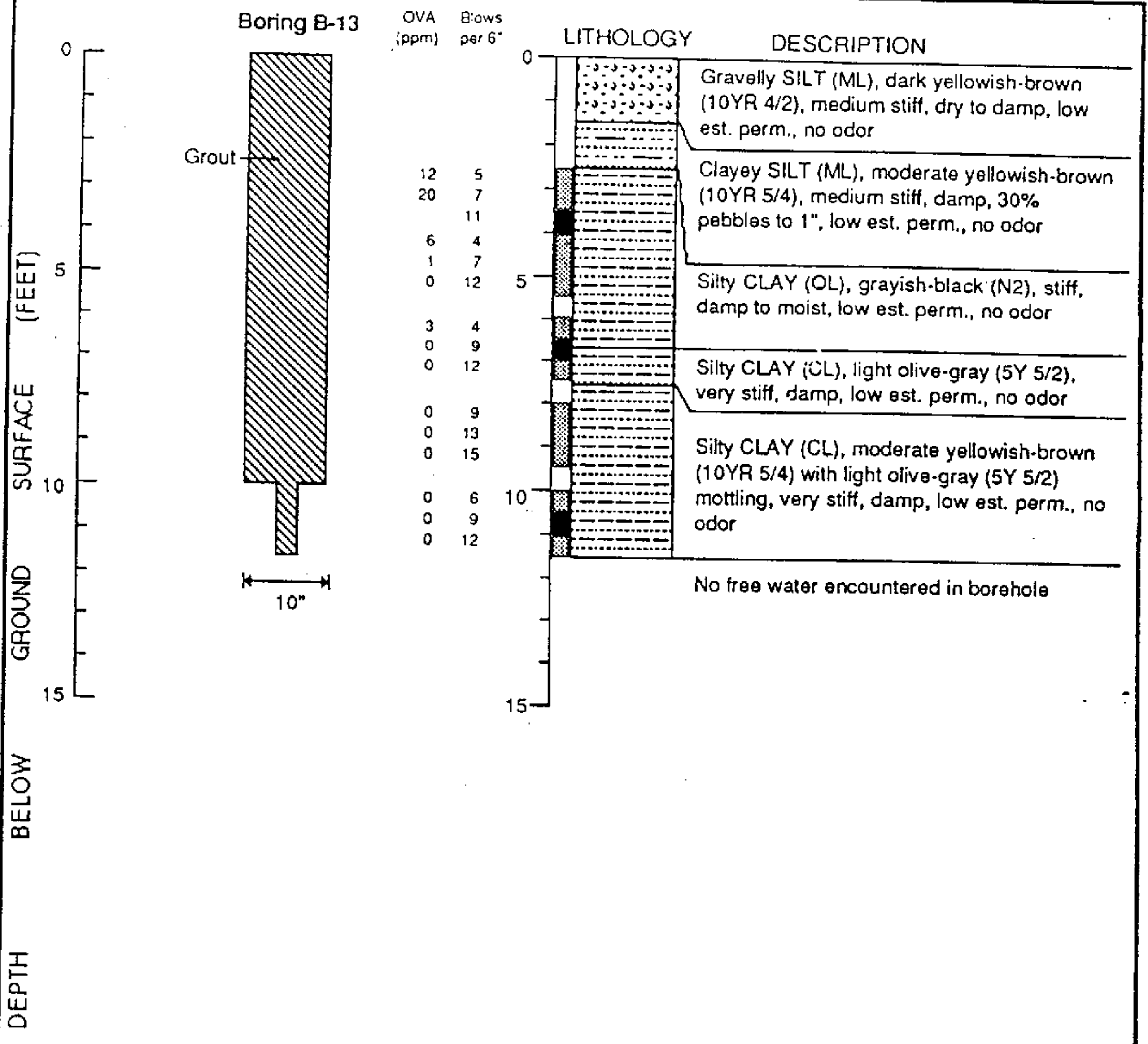
Silty CLAY (CL), light olive-gray (5Y 5/2), very stiff, low est. perm., no odor

Clayey SILT (ML), moderate yellowish-brown (10YR 5/4), very stiff, low est. perm., black specks, no odor

EXPLANATION

▼	Water level during drilling (date)	▨	Location of split tube drive sample
— - -	Contact (dashed where approximate)	■	Location of split tube drive sample in brass tube
ııııııı	Gradational Contact		
OVA	Organic Vapor Analysis		

Figure 7. Subsurface Lithology - Boring 12



OVA (ppm)	Blows per 6"
12	5
20	7
	11
6	4
1	7
0	12
3	4
0	9
0	12
0	9
0	13
0	15
0	6
0	9
0	12

Gravelly SILT (ML), dark yellowish-brown (10YR 4/2), medium stiff, dry to damp, low est. perm., no odor

Clayey SILT (ML), moderate yellowish-brown (10YR 5/4), medium stiff, damp, 30% pebbles to 1", low est. perm., no odor

Silty CLAY (OL), grayish-black (N2), stiff, damp to moist, low est. perm., no odor

Silty CLAY (CL), light olive-gray (5Y 5/2), very stiff, damp, low est. perm., no odor

Silty CLAY (CL), moderate yellowish-brown (10YR 5/4) with light olive-gray (5Y 5/2) mottling, very stiff, damp, low est. perm., no odor

No free water encountered in borehole

EXPLANATION

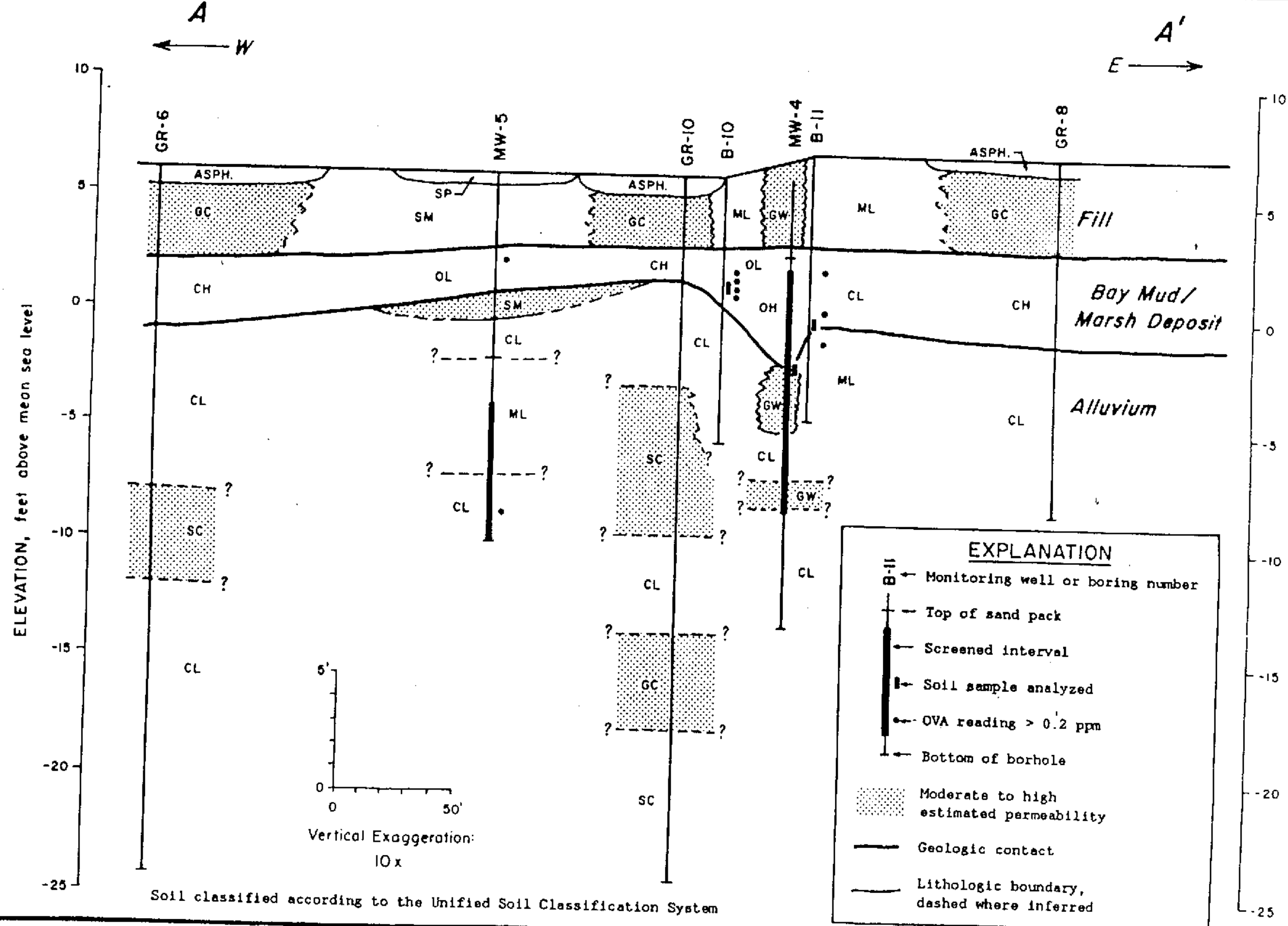
——— - - - Contact (dashed where approximate)

OVA Organic Vapor Analysis

▨ Location of split tube drive sample

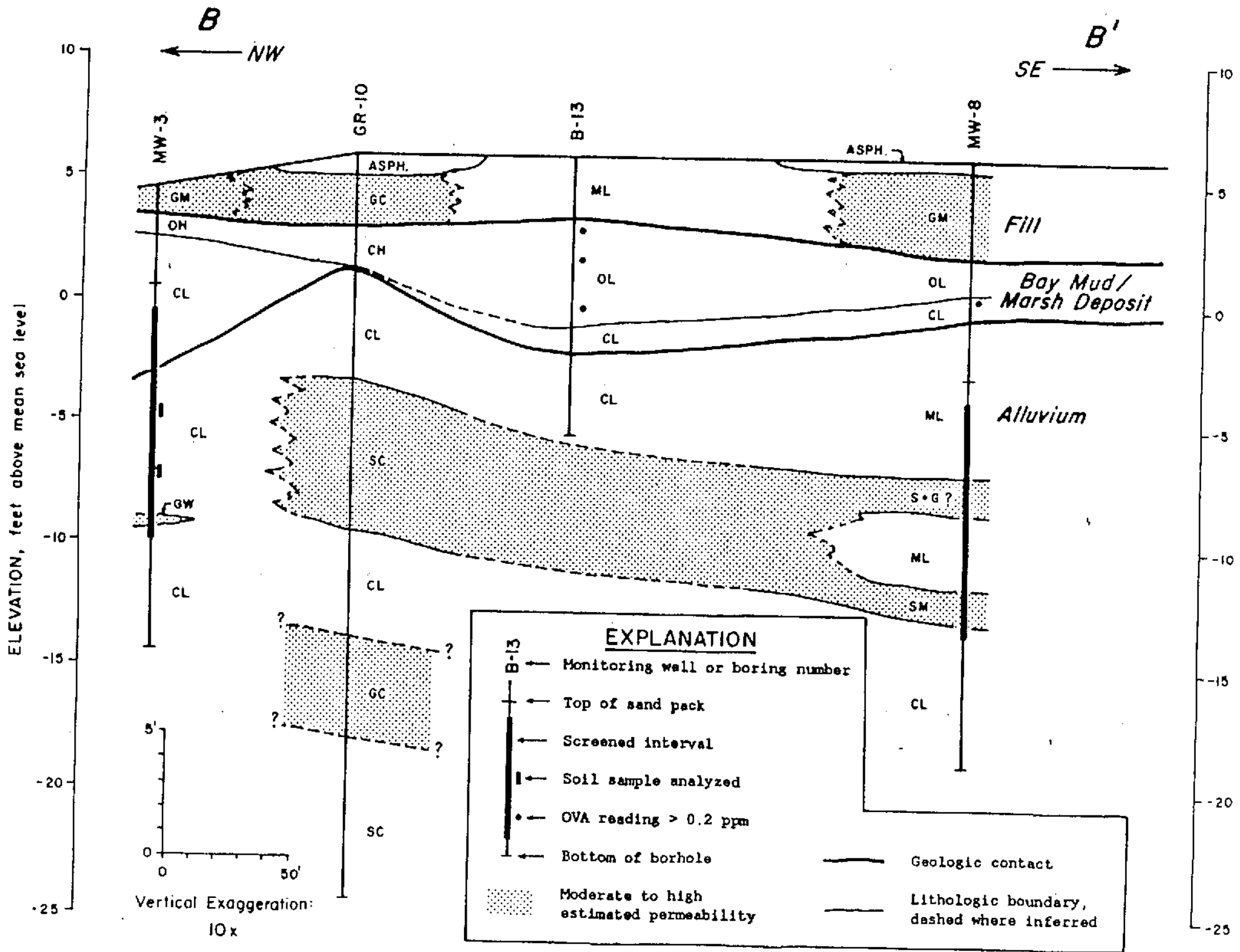
■ Location of split tube drive sample in brass tube

Figure 8. Subsurface Lithology - Boring 13



Soil classified according to the Unified Soil Classification System

Figure 9. Geologic Section A - A'



Soil classified according to the Unified Soil Classification System

Figure 10. Geologic Section B - B'

Attn Bill McIlvride

Page 1 of 2

WEISS ASSOCIATES
2054 University Ave., Suite 301/Berkeley, CA 94704/415-644-3281

WA Personnel: Be sure to include copy of this form in job billing and field sampling files

Project ID 49-253

CHAIN OF CUSTODY RECORD AND ANALYTIC INSTRUCTIONS

NOTES TO LAB:
1) Specify analytic method and detection limit in report
2) Notify us if there are any anomalous peaks on GC or other scans.
3) Duplicates listed in parentheses.
4) Questions/clarifications–CALL US.

Field Record

Sampled by RAStolzman

Laboratory Record

Laboratory Name Brown + Caldwell

Sample ID	Sample/ Container Type[1]	Sampling Date	Analyze/ Hold[2]	Analyze for:	Analytic Method/Detection Limit	Received by	Date	Condition
MW-7 5'	S-T	3-20-87	HOLD					
MW-7 7.5'		↓	↓					
MW-7 13.5'		↓	↓					
MW-7 15.5'		↓	↓					
MW-7 18.0'		↓	↓					
MW-7 21.0'		↓	↓					
MW-7 24.0'		↓	↓					
MW-8 3'		↓	↓					
MW-8 6'		↓	↓					
MW-8 9.5'		↓	↓					
MW-8 12.0'		↓	↓					
MW-8 15.0'		↓	↓					
MW-8 18.5'		↓	↓					
MW-8 21.5'		↓	↓					
MW-5 3.0'		↓	↓					
MW-5 6.5'		↓	↓					
MW-8-24.0		↓	↓					

x RAS 3-20-87
Released by Field Personnel, Date

x
Released by Courier, Date

x Elliott F. Eaton
Received by Lab Personnel, Date
Telephone

1. Sample Type Codes: W=water, S=soil, O=other(specify)
   Container Codes: V=VOA bottle, P=Plastic bottle, G=Glass bottle, T=brass tube, O=other(specify)

2. Analyze/Hold:

ATTN: Bill McIlvride

WA
WEISS ASSOCIATES
2054 University Ave., Suite 301/Berkeley, CA 94704/415-644-3281

Page 2 of 2

WA Personnel: Be sure to include copy of this form in job billing and field sampling files

Project ID 49-253

CHAIN OF CUSTODY RECORD AND ANALYTIC INSTRUCTIONS

NOTES TO LAB:
1) Specify analytic method and detection limit in report
2) Notify us if there are any anomalous peaks on GC or other scans.
3) Duplicates listed in parentheses.
4) Questions/clarifications–CALL US.

Field Record

Sampled by RA STOLZMAN

Laboratory Record

Laboratory Name B+C

Sample ID	Sample/ Container Type[1]	Sampling Date	Analyze/ Hold[2]	Analyze for:	Analytic Method/Detection Limit	Received by	Date	Condition
MW-5 9.5'	S-T	3-20-87	HOLD					
MW-5 12.5	↓	↓	↓					
MW-5 15.5								
MW-7 A	VOA	3-20-87	ANALYZE	VOC's total fuel hydrocarbons	EPA 624			
MW-7 B	"	"	HOLD	"	"			
MW-8 A	"	"	ANALYZE	"	"			
MW8 B	"	"	HOLD	"	"			
MW5 A	"	"	ANALYZE	"	"			
MW5 B	"	"	HOLD	"	"			

Water samples [illegible]
TOTAL HYDROCARBONS by MONDAY AM
EPA 624 MONDA PM

x RAS 3-20-87
Released by Field Personnel, Date

x
Released by Courier, Date

x Elliott J Eaton
Received by Lab Personnel, Date
Telephone

1. Sample Type Codes: W=water, S=soil, O=other(specify)
Container Codes: V=VOA bottle, P=Plastic bottle, G=Glass bottle, T=brass tube, O=other(specify)

4-095-1-12

WA WEISS ASSOCIATES
2054 University Ave., Suite 301/Berkeley, CA 94704/415-644-3281

Page 1 of 1

WA Personnel: Be sure to include copy of this form in job billing and field sampling files

Project ID 49-253

CHAIN OF CUSTODY RECORD AND ANALYTIC INSTRUCTIONS

NOTES TO LAB:
1) Specify analytic method and detection limit in report
2) Notify us if there are any anomalous peaks on GC or other scans.
3) Duplicates listed in parentheses.
4) Questions/clarifications–CALL US.

Field Record

Sampled by R. STULZMAN

Laboratory Record

Laboratory Name B+C

Sample ID	Sample/Container Type[1]	Sampling Date	Analyze/Hold[2]	Analyze for:	Analytic Method/Detection Limit	Received by	Date	Condition
B-10-4.5	S/T	4-6-87	A	VOCs	EPA 602 w/xylene			
B-11-7.0			A					
B-12-6.5			A					
B-10-6.5			HOLD					
B-10-10.5			HOLD					
B-11-3.5			HOLD					
B-11-10.5			HOLD					
B-12-3.0			HOLD					
B-12-10.5			HOLD					
B-13-3.5			HOLD					
B-13-6.5			HOLD					
B-13-10.5			HOLD					

OVERNIGHT RUSH!!!

x Robert A. Stulzman 4-6-87
Released by Field Personnel, Date

x
Released by Courier, Date

x E. Kwong 4/6/87
Received by Lab Personnel, Date
Telephone

1. Sample Type Codes: W=water, S=soil, O=other(specify)
Container Codes: V=VOA bottle, P=Plastic bottle, G=Glass bottle, T=brass tube, O=other(specify)

APPENDIX B

UNIFIED SOIL CLASSIFICATION SYSTEM

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels gravel-sand mixtures little or no fines
			GP	Poorly graded gravels or gravel-sand mixtures little or no fines
		GRAVEL WITH FINES	GM	Silty gravels gravel-sand-silt mixtures non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

U.S. STANDARD SERIES SIEVE 200 40 10 4

CLEAR SQUARE SIEVE OPENINGS 3/4" 3" 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

SANDS AND GRAVELS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

SILTS AND CLAYS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
mid stiff ~~FIRM~~	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

† Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D (1-3/8 inch I.D.) split spoon (ASTM D-1586)

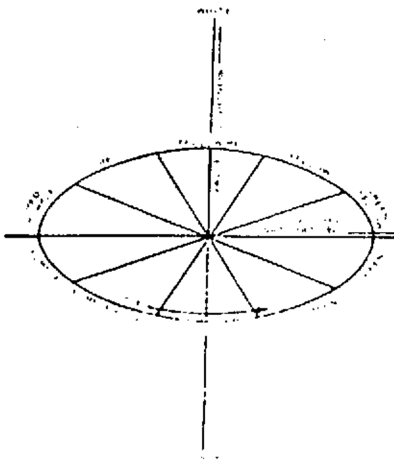
‡ Unconfined compressive strength in tons/sq ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer torvane, or visual observation.

Unified Soil Classification System

APPENDIX C

ROCK COLOR CLASSIFICATION SYSTEM

ROCK-COLOR CHART



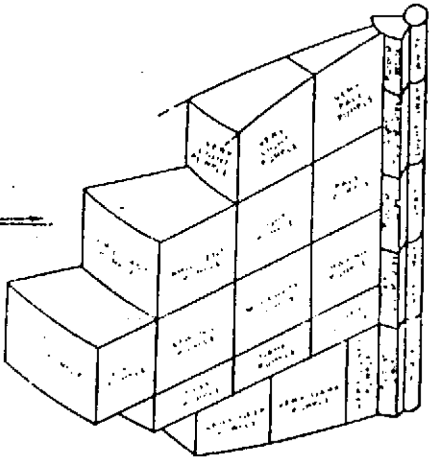


Figure 1. Dimensions of the color solid. Figure 2. The purple section of the color solid.
After Judd and Kelly, Jour. Am. Pharm. Assoc., vol. 27, no. 3, March 1938,
with modifications.

Prepared by
THE ROCK-COLOR CHART COMMITTEE
representing the following organizations

F. N. GODDARD, Chairman
U. S. Geological Survey

PARKER D. TRASK
The Geological Society of America

RONALD K. DE FORD
American Association of Petroleum Geologists

OLAF N. ROVE
Society of Economic Geologists

JOSEPH T. SINGEWALD, JR. and R. M. OVERBECK
Association of American State Geologists

Distributed by
GEOLOGICAL SOCIETY OF AMERICA
P.O. Box 9140
Boulder, CO 80401

Chart Printed in the Netherlands by Huyskes-Enschede
Envelope Printed in U.S.A.

EXPLANATION OF THE ROCK-COLOR CHART

This chart is designed primarily for field use, but nevertheless it indicates the range of rock colors for all purposes. The mineralogist and the geologist working in the laboratory no doubt will feel the need of more colors and perhaps a different style of mounting. For their purpose, similar color chips or large colored sheets that may be cut into any desired size can be purchased from the Munsell Color Company, 2441 N. Calvert St., Baltimore 21218, Maryland. Additional color names for colors outside the range of rock colors can be found in U.S. National Bureau of Standards Special Publication SP 440, "Color, universal language and dictionary of names," 184 p, (1976) available from the Superintendent of Documents, Washington D.C. 20402.

The form and arrangement of the chart are based on the Munsell system, the most widely accepted system of color identification in use in the United States. This system is based on a color solid or approximately a color sphere, which has a neutral gray axis grading from white at the top to black at the bottom (see fig. 1). This property of lightness is called *value*. Around the circumference or equator of the solid are the 10 major hues shown in fig. 1, each of which is divided into 10 numbered divisions, so that 5 marks the middle of a hue and 10 marks the boundary between one hue and the next. Thus any particular hue can be designated by a number and a letter such as *5R* or *10YR*. Any single vertical section through the neutral gray axis and a particular hue constitutes a color chart on which the colors grade in *value* from light at the top to dark at the bottom and in *chroma* (degree of saturation) from gray at the left to the most vivid colors at the right. Both *value* and *chroma* are numbered so any particular color can be given a numerical designation representing *hue*, *value*, and *chroma* such as *5R 6/4* and *10YR 8/2*. The rock colors have been placed on the charts in approximately their correct relative position according to the Munsell system, and the Munsell numerical designations have been placed under the color names for the use of those who wish to make fine color

(Continued on back of last chart)

distinctions. Numerical designations of colors lying between the color chips on the chart can be interpolated, as for example, if the color of a rock lies half way between *light red (5R 6/6)* and *moderate red (5R 4/6)* it can be designated as *5R 5/6*, or if it is nearer to *light red*, it can be designated as *5R 5.5/6*. In the same way *hue* and *chroma* can be interpolated. The spacing of the color chips according to *chroma* has been slightly modified in order that, if the geologist desires, he can cut each chart into two strips along the center black line and thus have most of the color chips along the margins of the strips so that they can be closely compared with the rock specimen. However, the chart is simpler to use when not cut into strips and some geologists will prefer to leave it uncut. All the grays or one chroma colors have been grouped together on the last page of the chart in order that they can be readily compared with one another.

The color names have been taken from the ISCC-NBS[1] system as described in U.S. National Bureau of Standards Special Publication SP440 as this system has been accepted by a large number of scientific organizations. According to this system each color name, such as *pale purple*, occupies a field or portion of space in the color solid (fig. 2), whereas a Munsell designation, such as *5 P 6/2* is represented by a point. Consequently a single color name may be represented by two or more differently colored chips, each having a different Munsell designation. The use of the Munsell system is recommended to geologists who find need for closer discrimination than is provided by the color names on the chart.

The Rock-color Chart Committee decided to adhere as closely as possible to the ISCC-NBS system of names, inasmuch as the system is already widely used by organizations interested in color. However, the ISCC-NBS Subcommittee on Color Names has tentatively adopted certain modifications in their system which will be incorporated in a new edition of the Bureau of Standards Research Paper RP 1239. These modifications consist chiefly in substituting the adjective *grayish* for *weak*, the term *dark grayish* for *dusky*, and the term *light grayish* for *pale*. With respect to the last two terms, however, the ISCC-NBS Subcommittee provides for the use of the terms *dusky* and *pale* as alternatives. The Rock-color Chart Committee, therefore, decided to substitute *grayish* for *weak*, but to retain the terms *dusky* and *pale* as these tend to shorten several of the color names and to avoid the use of 4-word color names. The Rock-color Chart Committee has also made a few other minor changes from the ISCC-NBS revised names, in order to eliminate as many duplications of names on the chart as possible, and in order to avoid awkward combinations such as *grayish reddish brown* and *grayish greenish yellow*. However, the Committee has attempted to make these changes entirely consistent with the ISCC-NBS system.

It is hoped that these color names will eventually become familiar to all geologists, but it is realized that some geologists may prefer to use a different system of names. To them it is suggested that in published reports, they follow each color name with the Munsell notation so that other geologists can readily refer to the right color on the chart. For a comparison of the Munsell and ISCC-NBS systems with other systems of color identification and color names, geologists are referred to NBS Special Publication SP 440.

The color chips are as permanent as it is possible to make them. However, it is considered advisable to protect the Rock-Color from bright sunlight and dampness as much as possible.

The chart is chiefly of value in describing the colors of medium-to fine-grained rocks but is also helpful in working with coarse-grained rocks. In describing very coarse-grained rocks, such as porphyritic granites, it is necessary to give the color of each mineral, and the chart is designed to cover the range of the chief rock-forming minerals such as feldspar, quartz, mica, and hornblende. If the rock is not too coarse-grained, a blending of the individual colors can be secured by spinning the specimen like a color disc or by looking at the rock from a short distance and thus getting a monotone which can be matched with the chips on the chart.

The number and range of colors on the Rock-color Chart are based on studies made by the Committee of more than 1300 selected rock specimens collected from the United States and Alaska. The colors of these rocks were plotted on Munsell charts and these charts served as a basis for selecting the colors. The committee believes that the full range of rock colors is covered by the chart, except possibly for very rare rocks of high chroma. For most rock colors, the chart will serve for both wet and dry specimens. It was found by experiment that wetting the rock specimen merely decreases the *value*, that is, makes the specimen darker, but does not change the *chroma*. Accordingly, the Rock-color Chart Committee selected colors for the chart as far as possible into the dark range in order to cover wet specimens as well as dry.

The Committee wishes to thank the many geologists throughout the country who contributed rock specimens and also those who contributed comments and suggestions. It also wishes to express its appreciation to Miss Dorothy Nickerson, of the United States Department of Agriculture, Mrs. B.R. Bellamy of the Munsell Color Co., and Dr. Deane B. Judd of the National Bureau of Standards for their wholehearted help and cooperation. The Committee hopes that the chart will attain wide usage among geologists and also that it will be useful to mineralogists,

KAISER
ENGINEERS

KAISER ENGINEERS CALIFORNIA CORPORATION
1800 HARRISON STREET
POST OFFICE BOX 23210
OAKLAND CALIFORNIA 94623
415 268 6000

April 13, 1987

Kaiser Engineers (California) Corporation
AC Transit Project Office
508 16th Street
Oakland, CA 94612

Attention: Mr. Steve Whitehead

Subject: Results of hydrological and geo-chemical activities performed in January - April 1987 at the AC Transit Maintenance Facility site, 1100 Seminary Avenue

During the period 1/26/87 through 4/10/87 field and laboratory activities were carried on to meet the needs of the following tasks:

1. Estimate whether previously documented hydrocarbon releases have migrated in the general direction of the newly planned construction site.

2. Provide data needed to support recommendations concerning construction siting, waste disposal and safe operation during contruction activities, in compliance with pertinent regulatory requirements.

Preliminary Data

Data provided by Georesource Consultants (7/05/83) indicate that the site is covered characteristically by a silty clay soil of considerable stiffness below a depth of several feet; this feature renders the site its low permeability and consequently retards migration of dissolved hydrocarbon species away from the point of release.

Data provided by Anatec Laboratories, Inc. (1/21/87) indicate that 7 out of 16 soil samples, collected in the vicinity of previously existing tanks, show a level of total petroleum hydrocarbons (TPH) in excess of 100 $mg.kg^{-1}$ which confirmed the presence of hydrocarbons in the soil environment. One of these 7 data showed a TPH value well off the scale and equal to 2275 $mg.kg^{-1}$. This single value may qualify the site as a "Fuel Case Site" according to the State Guidelines*. The finding required removal of contaminated earth to levels below 1,000 $mg.kg^{-1}$ and investigation of water quality, i.e. well(s) development and water chemistry investigations.

---

*Guidelines for Addressing Fuel Leaks
Sept. 1985, CRWQCB, San Francisco.

Recently Acquired Data

This part of the report introduces data pertaining to the first set of 4 monitoring wells*, the second set of 3 monitoring wells**, and the third set of 4 boreholes** for which only preliminary data are available. The location of all 7 monitoring wells (MW) and 4 boreholes (B) are indicated on Figure 1. Significant data collected during field work and developed in chemical laboratories*** are presented in Table 1.

Figure 1 shows that all monitoring wells and boreholes can be classified, for interpretative purposes, in three groups:

1. Those included by the perimeter of the new construction: MW-7, MW-8 and B-13.
2. Those placed on the perimeter of the new construction: B-10, B-11 and B-12.
3. Those excluded by the perimeter of the new construction: MW-1, MW-2, MW-3, MW-4 and MW-5.

Group 1 - Most Important Assessment Points

Table 1 shows that MW-7 and MW-8 had the free water surface at or below 11 feet immediately following drilling and that in two weeks the water level has risen to 4-5 feet below ground surface. The table shows also that in the case of these two wells, in only one instance a significant OVA reading was detected (80 ppm close to surface and thus likely to have been unrelated to the removed tanks); the water samples were clean of TPH and BTX. Table 1 also shows that B-13 showed no water at or above the drilling depth (11.5') and indicated no OVA reading during the field operation.

Group 2

Table 1 shows that the water level at the NW construction boundary is at around 10 feet. B-12, the most distant borehole vis-a-vis the position of the removed tanks, indicated a zero OVA reading throughout the borehole profile. B-10 indicated a maximum reading of 30 ppm, while B-11, the closest to the tank position, indicated a reading spike of 600 ppm at 7.5 feet. The three soil samples collected from the three boreholes at depths between 4.5 and 7 feet indicated no contamination as BTX; the sample of B-12 at 6.5 feet showed a toluene concentration at the detection limit of 0.01 $mg.kg^{-1}$.

---

* Data originally presented in two reports submitted by Baseline Environmental Consultants on 3/9/87 and 4/3/87.

** Data originally presented by Weiss Associates in a preliminary bore-log transmittal letter on 4/8/87.

***All chemical data presented in this report were generated at Brown and Caldwell Laboratories, Emeryville, CA.

TABLE II-I
SIGNIFICANT FIELD DATA AND LABORATORY ANALYSES

Monitoring Well (MW), or Borehole (B)	Date Field Operation	Depth to Well Base (feet)	Depth to Water Level (feet)		Presence of Free Product Deeper than 0.25"	Observations During Field Work SPO = Slight Petr.Odor PO = Petr. Odor STPO = Strong Petr. Odor	Soil Chemistry Data (mg/kg)		Water Chemistry Data (mg/L)		
			During Drilling	Depth days			Sampling Depth (feet)	TPH/BTX	TPH	B/T/X	
MW-1	1/26/87	22	9.7	5/7	Negative	SPO at 6', 13', 16' & 19'	6 - 6.5 8 - 8.5	<10/ <10/	32	1.5/4.0/6.4	
MW-2	1/26/87	26	13.5	5.5/7	Negative	SPO at 3', 9', & 12'	8 - 8.5 13.5 - 14	2200/ 100/	50	13.0/6.0/2.9	
MW-3	1/26/87	19	11.5	4/7	Negative	SPO at 10' and 12' PO at 13'	9 - 9.5 11.5 - 12	13/ 110/	29	5.3/6.8/5.4	
MW-4	3/10/87	19.5	8	6/3	Negative	SPO at 13'/PO at 4'/ STPO at 8'	8 - 8.5	<10/	290 20	6.2/9.4/20.0 4.6/6.8/14.0	20 = xylene isomers .9 of 4.6 = ethyl benzene
MW-5	3/20/87	16	11	5.1/14	Negative	STPO at 14.7' OVA = 340 ppm			64	0.7/4.8/6.5 C5H12 = 3 C6H12 = 2	6.5 = xylene isomers
MW-7	3/20/87	25	17	4.3/14	Negative	OVA = 80 ppm at 3.5'			<1	<0.001	
MW-8	3/20/87	25	11	ND*	Negative	Highest OVA = 3 ppm at 6'			<1	<0.001	
B-10	4/06/87	11.5	Dry	Dry	NA**	Highest OVA = 30 ppm at 4.5'	4.5	/<0.01			
B-11	4/06/87	11.5	8	8/0.1	Negative	Spiky OVA of 600 ppm at 7.5'	7	/<0.01			
B-12	4/06/87	11.5	8	7/0.1	Negative	OVA = 0 throughout	6.5	/TOL = 0.01			
B-13	4/06/87	11.5	Dry	Dry	NA**	OVA = 0 throughout					

*ND = Not determined
**NA = Not applicable

APPENDIX III

DESCRIPTION OF SITE SENSITIVITY AND CONTAMINATION SEVERITY FACTORS ACCORDING TO SANTA CLARA MODEL

Site Sensitivity Factors

The following 15 factors contribute, according to the Santa Clara model, to the definition of the site sensitivity:

A. Distance to point of water use
   1. Distance to the nearest public well downgradient
   2. Distance to the nearest public well not downgradient
   3. Distance to the nearest private well downgradient

B. Intensity of present water use
   4. Well production by section
   5. Number of public wells less than 1500 feet downgradient
   6. Number of private wells within one square mile downgradient
   7. Number of public wells greater than 1500 feet but less than one square mile downgradient

C. Depth to groundwater
   8. Depth to shallow groundwater
   9. Depth to shallowest currently-used potable groundwater
   10. Depth to shallowest usable groundwater

D. Permeability of soils

11. Permeability of soil 0 to 50' depth
12. Permeability of soil 50' to 150' depth
13. Permeability of soil 150' to 300' depth

E. Groundwater gradient and conduit scales

14. Groundwater gradient
15. Conduits for potential contaminant migration within one square mile downgradient.

For each one of the above 15 factors, the possible point grade is between 0 and 10, with 10 meaning the highest degree of sensitivity. The only exceptions are factors 12 and 13 for which the highest point value is equal to 5. Thus, theoretically a value equal to zero means a completely safe environment totally insensitive to contamination; conversely, a value equal (or close) to 140 means an acutely vulnerable environment sensitive even to otherwise minute quantities of contaminant releases.

Contamination Severity Factors

The following 9 factors contribute, according to the Santa Clara model to the definition of the contamination severity:

F. Toxicity Scales

15. Acute toxicity with Oral LD50, Dermal LD50 and Aquatic LC50; five discrete values possible
16. Carcinogenicity; four discrete values possible
17. Mutagenicity; five discrete values possible

G. Physical/Chemical Properties of Contaminants

18. Soil sorption characteristics. A low log Ksc value associated with a high point value
19. Octanol/Water partition coefficient. A high Kow value associated with a high point value

H. Magnitude of Contamination

20. Concentration of the most abundant contaminant in groundwater
21. Concentration of the most abundant contaminant in soil
22. Contaminant spreading pattern
23. Number of identified contaminants at the site.

For factors 15, 16, and 17 the maximum discrete value assigned is equal to 10. For factors 18, 19, 22 and 23, the maximum point value that can be assigned is equal to 10. For factors 20 and 21, the maximum point value is equal to 20. Thus a total of 110 points is theoretically possible and would reflect an extremely severe contamination.

In terms of both site sensitivity and contamination severity, a maximum value equal to 250 is theoretically possible according to the Santa Clara model.

BROWN AND CALDWELL
ANALYTICAL LABORATORIES

LOG NO: E87-01-473

Received: 26 JAN 87
Reported: 05 FEB 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Purchase Order: S-593A

REPORT OF ANALYTICAL RESULTS

Page 1

OG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
1-473-1	MW-1 6.0-6.5'	26 JAN 87
1-473-2	MW-1 8.0-8.5'	26 JAN 87
1-473-3	MW-2 8.0-8.5'	26 JAN 87
1-473-4	MW-2 13.5-14.0'	26 JAN 87

ARAMETER	01-473-1	01-473-2	01-473-3	01-473-4
otal Fuel Hydrocarbons, mg/kg	<10	<10	2200	100

A. McLean, Laboratory Director

BROWN AND CALDWELL LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-01-486

Received: 27 JAN 87
Reported: 11 FEB 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Project: S-593A

REPORT OF ANALYTICAL RESULTS

Page 1

OG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
1-486-1	MW-3 9.0-9.5'	27 JAN 87
1-486-2	MW-3 11.5-12.0'	27 JAN 87

ARAMETER	01-486-1	01-486-2
otal Fuel Hydrocarbons, mg/kg	13	110

. A. McLean, Laboratory Director

BROWN AND CALDWELL LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-02-037

Received: 03 FEB 87
Reported: 18 FEB 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Project: AC Transit

REPORT OF ANALYTICAL RESULTS

Page 1

OG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
2-037-1	MW1	03 FEB 87
2-037-2	MW2	03 FEB 87
2-037-3	MW3	03 FEB 87

ARAMETER	02-037-1	02-037-2	02-037-3
otal Fuel Hydrocarbons, mg/L	32	50	29

. A. McLean, Laboratory Director

BC BROWN AND CALDWELL LABORATORIES

ANALYTICAL REPORT

1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

LOG NO: E87-02-474

Received: 23 FEB 87
Reported: 24 FEB 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Purchase Order: AC Transit

REPORT OF ANALYTICAL RESULTS

Page 1

G NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
2-474-1	MW1	03 FEB 87
2-474-2	MW2	03 FEB 87
2-474-3	MW3	03 FEB 87

RAMETER	02-474-1	02-474-2	02-474-3
enzene,Toluene,Xylene Isomers			
enzene, mg/L	1.5	13	5.3
oluene, mg/L	4.0	6.0	6.8
otal Xylene Isomers, mg/L	6.4	2.9	5.4

Linda Brack Fox
. A. McLean, Laboratory Director

BROWN AND CALDWELL LABORATORIES

1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-218

Received: 11 MAR 87
Reported: 16 MAR 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Project: S-593 A

REPORT OF ANALYTICAL RESULTS

Page 1

OG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
03-218-1	MW-4 8-8.5'	10 MAR 87

ARAMETER	03-218-1
otal Fuel Hydrocarbons, mg/kg	<10

BROWN AND CALDWELL LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-218

Received: 11 MAR 87
Reported: 16 MAR 87

Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Project: S-593 A

REPORT OF ANALYTICAL RESULTS

Page 2

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
03-218-2	MW-4	11 MAR 87

ARAMETER	03-218-2
Total Fuel Hydrocarbons, mg/L	290
EPA Method 602	
Date Extracted	03.12.87
1,2-Dichlorobenzene, ug/L	<100
1,3-Dichlorobenzene, ug/L	<100
1,4-Dichlorobenzene, ug/L	<100
Benzene, ug/L	6200
Chlorobenzene, ug/L	<100
Ethylbenzene, ug/L	<100
Toluene, ug/L	9400
Total Xylene Isomers, ug/L	20000

D. A. McLean, Laboratory Director

BC BROWN AND CALDWELL LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-284

Received: 13 MAR 87
Reported: 18 MAR 87

Ms. Yane Nordhav
Baseline
315 Washington St.
Oakland, CA 94607

Project: S-593 A

REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
03-284-1	MW4 Seminary	MAR 87

PARAMETER	03-284-1
Total Fuel Hydrocarbons, mg/L	20
EPA Method 602	
Date Extracted	03.15.87
1,2-Dichlorobenzene, ug/L	<50
1,3-Dichlorobenzene, ug/L	<50
1,4-Dichlorobenzene, ug/L	<50
Benzene, ug/L	4600
Chlorobenzene, ug/L	<50
Ethylbenzene, ug/L	<50
Toluene, ug/L	900
Total Xylene Isomers, ug/L	6800
	14000

D. A. McLean, Laboratory Director

1 23

BROWN AND CALDWELL LABORATORIES

1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-423

Received: 23 MAR 87
Reported: 01 APR 87

Beverly Ousmus
Raymond Kaiser Engineers Inc.
1800 Harrison St. P.O. Box 23210
Oakland, California 94623-2321

Purchase Order: 80097-109

CC: Bill McIlvride

REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
03-423-1	MW-5 A	20 MAR 87
03-423-2	MW-7 A	20 MAR 87
03-423-3	MW-8 A	20 MAR 87

PARAMETER	03-423-1	03-423-2	03-423-3
Total Fuel Hydrocarbons, mg/L	64	<1	<1

BROWN AND CALDWELL LABORATORIES

1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-423

Received: 23 MAR 87
Reported: 01 APR 87

Beverly Ousmus
Raymond Kaiser Engineers Inc.
1800 Harrison St. P.O. Box 23210
Oakland, California 94623-2321

Purchase Order: 80097-109

CC: Bill McIlvride

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
03-423-1	MW-5 A	20 MAR 87
03-423-2	MW-7 A	20 MAR 87
03-423-3	MW-8 A	20 MAR 87

PARAMETER	03-423-1	03-423-2	03-423-3
Purgeable Priority Pollutants			
Extraction	03.23.87	03.23.87	03.23.87
1,1,1-Trichloroethane, ug/L	<250	<1	<1
1,1,2,2-Tetrachloroethane, ug/L	<250	<1	<1
1,1,2-Trichloroethane, ug/L	<250	<1	<1
1,1-Dichloroethane, ug/L	<250	<1	<1
1,1-Dichloroethylene, ug/L	<250	<1	<1
1,2-Dichloroethane, ug/L	<250	<1	<1
1,2-Dichloropropane, ug/L	<250	<1	<1
1,3-Dichloropropene, ug/L	<250	<1	<1
2-Chloroethylvinylether, ug/L	<250	<1	<1
Acrolein, ug/L	<2500	<10	<10
Acrylonitrile, ug/L	<2500	<10	<10
Bromodichloromethane, ug/L	<250	<1	<1
Bromomethane, ug/L	<250	<1	<1
Benzene, ug/L	700	<1	<1
Chlorobenzene, ug/L	<250	<1	<1
Carbon Tetrachloride, ug/L	<250	<1	<1
Chloroethane, ug/L	<250	<1	<1
Bromoform, ug/L	<250	<1	<1
Chloroform, ug/L	<250	<1	<1
Chloromethane, ug/L	<250	<1	<1
Dibromochloromethane, ug/L	<250	<1	<1

BROWN AND CALDWELL LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-03-423

Received: 23 MAR 87
Reported: 01 APR 87

Beverly Ousmus
Raymond Kaiser Engineers Inc.
1800 Harrison St. P.O. Box 23210
Oakland, California 94623-2321

Purchase Order: 80097-109

CC: Bill McIlvride

REPORT OF ANALYTICAL RESULTS

LOG NO	SAMPLE DESCRIPTION, GROUND WATER SAMPLES	DATE SAMPLED
03-423-1	MW-5 A	20 MAR 87
03-423-2	MW-7 A	20 MAR 87
03-423-3	MW-8 A	20 MAR 87

PARAMETER	03-423-1	03-423-2	03-423-3
Ethylbenzene, ug/L	2000	<1	<1
Methylene Chloride, ug/L	<250	<1	<1
Tetrachloroethylene, ug/L	<250	<1	<1
Trichloroethylene, ug/L	<250	<1	<1
Trichlorofluoromethane, ug/L	<250	<1	<1
Toluene, ug/L	4800	<1	1 (<1?)
Vinyl Chloride, ug/L	<250	<1	<1
trans-1,2-Dichloroethylene, ug/L	<250	<1	<1
trans-1,3-Dichloropropene, ug/L	<250	<1	<1
Semi-Quantified Results **			
C5H12, ug/L	3000	10	---
C6H12, ug/L	2000	---	---
Xylene Isomers, ug/L	6500	1	4

** Quantification based upon comparison of total ion count of the compound with that of the nearest internal standard.

Linda Brack FOR
A. McLean, Laboratory Director

BC **BROWN AND CALDWELL** LABORATORIES
1255 POWELL STREET EMERYVILLE, CA 94608 • (415) 428-2300

ANALYTICAL REPORT

LOG NO: E87-04-095

Received: 06 APR 87
Reported: 10 APR 87

Ms. Laura Hoffman
Raymond Kaiser Engineers Inc.
1800 Harrison St. P.O. Box 23210
Oakland, California 94623-2321
CC: Weiss Associates

Project: AC Trainsit

REPORT OF ANALYTICAL RESULTS

Page 1

LOG NO	SAMPLE DESCRIPTION, SOIL SAMPLES	DATE SAMPLED
04-095-1	B-10-4.5'	06 APR 87
04-095-2	B-11-7.0'	06 APR 87
04-095-3	B-12-6.5	06 APR 87
04-095-4	B-10-6.5'	06 APR 87
04-095-5	B-10-10.5'	06 APR 87

PARAMETER	04-095-1	04-095-2	04-095-3	04-095-4	04-095-5
Sample Held, Not Analyzed	---	---	---	HELD	HELD
EPA Method 8020					
Date Extracted	04.06.87	04.06.87	04.06.87	---	---
1,2-Dichlorobenzene, mg/kg	<0.01	<0.01	<0.01	---	---
1,3-Dichlorobenzene, mg/kg	<0.01	<0.01	<0.01	---	---
1,4-Dichlorobenzene, mg/kg	<0.01	<0.01	<0.01	---	---
Chlorobenzene, mg/kg	<0.01	<0.01	<0.01	---	---
Benzene, mg/kg	<0.01	<0.01	<0.01	---	---
Ethylbenzene, mg/kg	<0.01	<0.01	<0.01	---	---
Toluene, mg/kg	<0.01	<0.01	0.01	---	---
Total Xylene Isomers, mg/kg	<0.01	<0.01	<0.01	---	---

ASSESSMENT OF TOTAL PETROLEUM HYDROCARBON (TPH) RELEASE AT THE AC TRANSIT SITE, 1100 SEMINARY AVENUE, OAKLAND - RISK ANALYSIS

Report No. 87-010-R

KAISER ENGINEERS (CALIFORNIA) CORPORATION

June 1, 1987

ASSESSMENT OF TOTAL PETROLEUM HYDROCARBON (TPH) RELEASE AT THE AC TRANSIT SITE, 1100 SEMINARY AVE., OAKLAND RISK ANALYSIS

Introduction

Recent developments and approaches toward investigating environmental pollution emphasize the quantification of the risk involved caused by a particular release based on relevant geohydrologic characteristics and contaminant parameters (1, 3, 4). Risk analysis associates a certain risk with site characteristics (site sensitivity) and environmental stress (contamination severity). Such analysis is particularly useful when a priority among several sites is being sought. Risk analysis has a relative rather than an absolute accuracy since the model is relatively qualitative and contains several uncertainties. This approach was used to rank more than 100 contaminated sites in the Santa Clara Groundwater Basin in a study commissioned by the U.S. EPA (1, 2). It resulted in dividing the sites into two groups: those that required ongoing (OG) action, i.e., further investigation and remediation; and those sites (22) for which no action (NA) was considered necessary. This report follows the same analytical methodology in assessing the risk associated with TPH release(s) at the Seminary Ave. site. The location of the site is presented in Figure 1.

Background Information

Construction of a new building at the AC Transit location required removal of five underground tanks present on the property that contained diesel fuel and gasoline. In September 1986, soil samples collected next to the tanks were analyzed for TPH; four out of seven samples were contaminated, with the highest value of 13,000 ppm located inside the vault. This led to the conclusion that the tanks or the associated piping systems were leaking and that the vault was not preventing TPH dispersion away from the tanks. Removal of the tanks in January 1987 confirmed the presence of leak(s). This prompted a geohydrologic investigative program with the immediate purpose of locating a construction site on the property free of contaminants. Construction over a clean site will achieve a dual goal: safe working conditions for the construction crew and assurance that the construction site will not be disputed as a contaminated site subsequent to construction.

The geohydrologic data, acquired during January through April 1987 and introduced as Appendix I of this report, resulted in the definition of a contamination pattern on the property that allowed repositioning the new building away from the main contaminant dispersion pattern. Thus, the primary scope of the geohydrologic investigation, namely that associated with the newly planned construction, was achieved. The report of this work was contained in a letter dated April 13, 1987 and is presented as Appendix II. One of the conclusions of Appendix II is that there is contamination on the Seminary Ave. site apart from the construction site.

Separate from its impact in terms of identifying a clean construction site, the geohydrologic and geochemical investigations (Appendix I) were aimed at characterizing the contamination and understanding its extent. Subsequent sections of this report address this issue.

FIGURE 1 AC Transit location. Arrow indicates dominant groundwater flow direction

The identified soils and subsurface water characteristics are used in this report as a measure of environmental vulnerability to the identified contaminants, using the Santa Clara Methodology (1, 2). This is a measure of site sensitivity. During the geohydrologic program, soil and water samples were collected and analyzed. These data defined, when assembled according to the Method, the model's second term: contamination severity. Appendix III presents a short description of the 15 elements that make up site sensitivity and the 9 elements that make up contamination severity.

In the subsequent two sections, we present the assigned point values for each one of the 24 factors considered and required by the risk analysis model, with explanatory arguments for the assigned values.

Site Sensitivity

Factor 1 - Assigned point value = 2. Figure 1 shows the location of the AC Transit site in a square roughly 3 x 3 miles. The positions of 8 neighboring wells are identified together with the general direction of the groundwater movement. It shows there is no public well located downgradient of the site. Consequently, a value equal to 0 could be assigned. To be conservative, the value assigned was 2.

Factor 2 - Assigned point value = 2. Figure 1 and Table 1, which is a list of wells, indicate that the nearest public well is located at 7825 San Leandro Street, 0.7 mile southeast of the AC Transit site. A point value of 2 corresponds to this distance.

Factor 3 - Assigned point value = 2. Since no private well is present downgradient, a value equal to 0 could be assigned. Conservatively the value assigned was 2.

Factor 4 - Assigned point value = 5.5. Since no clear definition of this factor is available, the assigned value was equal to the average for the 22 Santa Clara NA sites.

Factors 5, 6, and 7 - Assigned point value for each = 2. The actual deserved point value for each should equal zero since no wells are present downgradient of site.

Factor 8 - Assigned point value = 7.9. This value corresponds to a depth to shallow groundwater of 8 feet.

Factor 9 - Assigned point value = 0. This value is appropriate since no well for potable groundwater is located downgradient of the site.

Factor 10 - Assigned point value = 1.1. The well located at 919 81st Avenue supplies water from 400 feet. The value of 1.1 corresponds to this depth.

TABLE 1

Wells Around AC Transit Site
(1100 Seminary Avenue)

Well Number	Street Address	Well Use	Original Yield (gpm)	Total Well Depth (ft)
2S/3W 8G1	499 High Street	Industrial No longer in use	Unknown	610
2S/3W 8Q1	4701 San Leandro St.	Industrial No longer in use	85	756
2S/3W 9K1	2232 Seminary Ave.	Irrigational No longer in use	Unknown	102
2S/3W 15N1	919 81st Ave.	Industrial Cooling and washing	Unknown	400
2S/3W 15N2	1001 81st Ave.	Irrigational No longer in use	Unknown	128
2S/3W 16D1	1175 57th Ave.	Industrial No longer in use	250	1025
2S/3W 16G1	1034 66th Ave.	Industrial No longer in use	Unknown	71
2S/3W 16R1	7825 San Leandro St.	Industrial Cooling water	1000	510

Factor 11 - Assigned point value = 2.6. Data collected for the first 20 feet indicate a soil material with an overall permeability most likely below 5.10^{-7} cm.s^{-1} ($1.42.10^{-3}$feet/day). Since no data were available for the soil at 20-50 feet, we assumed the highest boundary for the "silt, clay mixtures" (Table II-3, in 205J), 10^{-2} feet/day. This results in a "travel time" of 5,000 days, i.e., a point value of 2.6.

Factor 12 - Assigned point value = 3. Because of the proximity of San Francisco Bay and because potential contaminants are intercepted at a shallow depth by subsurface waters, the relevance of deeper layers' permeability is questionable in the case of the Seminary Ave. site. Thus, conservatively 60% of maximum point value is assigned.

Factor 13 - Assigned point value = 3. Same explanation as for Factor 12.

Factor 14 - Assigned point value = 4. The subsurface shallow and localized water cannot sustain steep gradients for long periods. The value of 4 corresponds to a gradient equal to 0.8%.

Factor 14a - Assigned point value = 5. The information gathered does not indicate the presence of cross-contaminating conduits. Conservatively, the middle of the scale value is assigned.

Unlike the calculation procedure outlined in the 205J document (1), where for most factors a range rather than a point value was assigned (as a reflection of uncertainty in estimation), we deliberately have chosen a point value; this by no means reflects an increased confidence in our estimates. Thus our point value is nothing more than the middle point of a range for the particular factor.

The summation of the point values assigned for factors 1 through 14a produces a value equal to 44.1. In comparison, the 22 NA (no action) sites in the Santa Clara Groundwater Basin produced an average site sensitivity parameter equal to 65.1 when the same middle-of-the-range point for each factor is calculated. Compared to the 22 NA sites in Santa Clara, the Seminary Ave. site has almost the lowest sensitivity grade; only one out of 22 sites had a lower grade (is a less troublesome site) than the Seminary Ave. site. Figure 2 presents the average Santa Clara NA values and the Seminary Ave. values. It is clear that the site is a better site than most of the 22 NA sites of Santa Clara County because of the proximity of the Bay, and the lack of private wells downgradient of the site. It is also a better site because no potable water and no superficial usable groundwater is encountered around it.

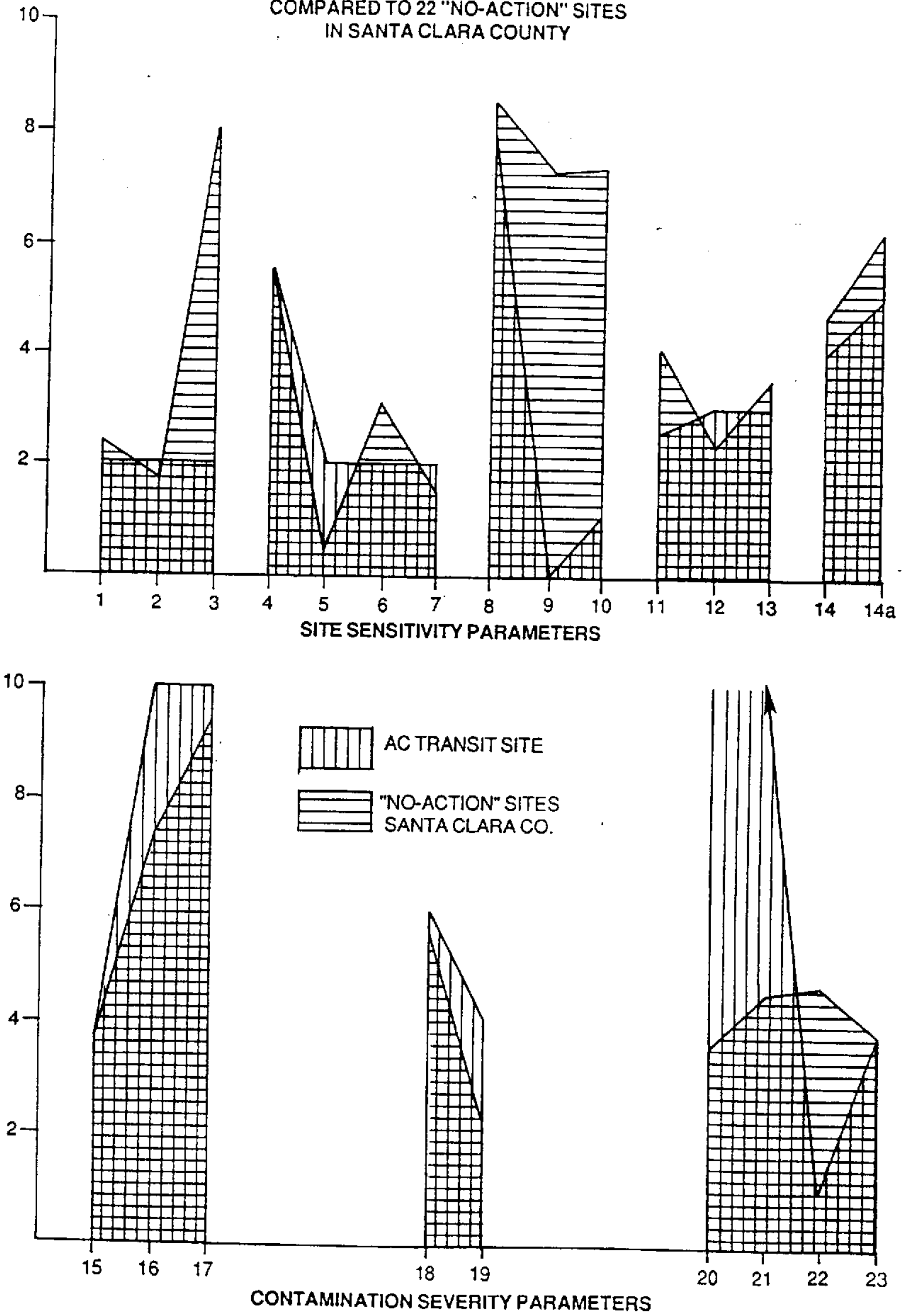
Contamination Severity

Soil and water chemical analyses results are collected and included in this report as Appendix IV. A summary of these data is presented in Table II-1 of Appendix II.

Factor 15: Assigned point value = 3. This value corresponds to the LD50 - humans characteristic for benzene and equal to 130 mg/kg.

FIGURE 2

SITE SENSITIVITY AND CONTAMINATION SEVERITY
AT A.C. TRANSIT, 1100 SEMINARY AVE.,
COMPARED TO 22 "NO-ACTION" SITES
IN SANTA CLARA COUNTY



Factor 16: Assigned point value = 10. Benzene is a carcinogen thus a maximum point value is assigned.

Factor 17: Assigned point value = 10. Both benzene and toluene are mutagenic, thus a maximum point value is assigned.

Factor 18: Assigned point value = 6. Among the four contaminants identified at the site, benzene (a nonpolar molecule), is the least prone for sorption.

Factor 19: Assigned point value = 4. This value corresponds to the bioaccumulation of ethyl benzene and possibly xylene.

Factor 20: Assigned point value = 20. Since in one case xylene isomers in excess of 20 mg.L^{-1} were determined, a maximum value of 20 is possibly assigned.

Factor 21: Assigned point value = 10. This is an average value between a maximum of 20 and zero because the only contaminants found in soil was TPH. No traces of benzene, ethyl benzene, toluene, or xylene were found in the soil.

Factor 22: Assigned point value = 1. Assuming a contamination spread of 0.2 miles, a point value equal to 1 is appropriate.

Factor 23: Assigned point value = 4. There are four contaminants identified at the site, consequently the point value of 4.

The summation of all nine point values, which together represent the severity of the contamination episode at AC Transit, amounts to a value equal to 68.0. The average severity term calculated for the 22 Santa Clara-NA sites is equal to 45.0 and the severity term for the 73 "on-going-action" sites is equal to 64.3. Figure 2, introduced earlier, indicates that the two critical factors in the severity term are factors 20 and 21, the actual contamination magnitude in groundwater and soil, respectively. For factor 20 we assigned a maximum value (equal to 20) based on one single determination equal to 20 mg.L^{-1} for xylene isomers. However, the inclusion of the Seminary Ave. site in the same group as "on-going-action" Santa Clara sites, which may seem to be suggested by the high severity term, is not justified for several reasons:

1. Among the 73 Santa Clara sites for which action is required, there are 26 (35.6%) for which the groundwater contamination (factor 20) is assigned the maximum grade, 20, the same grade assigned by us to the Seminary Ave. site. While the groundwater at the site is contaminated in excess of 1 ppm with 4 chemical species, the 26 Santa Clara sites are in average characterized by 9 incidents of contamination in excess of 1 ppm, more than twice compared to the Seminary Ave. site. The model does not make this distinction.

2. Two-thirds of the Santa Clara sites for which further action is required are contaminated with 10 or more chemical species. At the site, there are four chemicals of interest. This figure is close to the average number found for the 22 Santa Clara sites, 3.8, for which "no-action" is required. Clearly the Seminary Ave. site belongs in the same group with "no action" sites.

3. Although a contamination plume was not thoroughly mapped, the chemical distribution data seem to indicate a relatively localized contamination. This is most likely the result of a limited petroleum product discharge and certainly a consequence of a good (self-confined) geohydrologic environment.

Conclusions

1. Detailed soil descriptions introduced on several plates of Appendix I indicate the presence at the site of a predominantly fine soil material with an estimated hydraulic conductivity below 5.10^{-7} $cm.s^{-1}$. Transfer of fluid contaminants through such a soil is sensibly restricted.

2. Interlayered with the fine soil is a coarser material that may conduct contaminants and enhance their dispersion in the environment. However, the proportion of such lenses (conduits) is limited.

3. The site soils characteristically have a high degree of water saturation; this fact coupled with the low density of petroleum products limits the downward percolation of fuel contaminants. They will move, however, horizontally by a mechanism explained in Appendix I.

4. Favorable features are the lack of potable use of water and the general absence of any wells in a direction downgradient of the site.

5. The proximity to the San Francisco Bay with its frequent tides and the low elevation of the site result in a fluctuating depth of the capillary fringe in the soil. When a fuel contaminant is already released in the subsurface -- which is the case at the site -- the variable elevation of the groundwater seems to favor further dispersion of the contaminant.

6. Following a grading system used to prioritize contaminated sites in the Santa Clara Groundwater Basin, a relatively risk "contamination severity" term was calculated. This score was caused primarily by a single determination equal to 20 ppm xylene isomers in one groundwater sample.

7. In terms of compounded toxicity, soil sorption and bioaccumulation characteristics, two out of the only four chemical species identified at the site (xylene and ethyl benzene) rank first and second (i.e. they are the least toxic) in a group of 19 compounds investigated in the Santa Clara project (phthalate esters not included) (1, 2).

8. Analyzed soil samples did not reveal any fuel components except TPH.

9. No traces of 1,1 - Dichloroethane, 1,1 - Dichloroethylene, 1,1,1 - Trichloroethane, Trichloroethylene, Trichloromethane, Methylene Chloride, or Vinyl Chloride were found in any of the tested water samples. This proves that the fuel is the sole primary contaminant since all four identified compounds (xylene, ethyl benzene, toluene, and benzene) are fuel constituents.

10. The combination of favorable site hydrology, minimal water use and limited contamination suggest that the "no-action" alternative should be given serious consideration.

REFERENCES

1. Assessment of Contamination from Leaks of Hazardous Materials in the Santa Clara Valley Groundwater Basin, (205J Report), 1985. University of California, Berkeley - SEEHRL, n. 85-6.

2. Assessment of Contamination from Leaks of Hazardous Materials in the Santa Clara Valley Groundwater Basin, (205J Report), Technical Appendix: Chemical Summaries, 1985, University of California, Berkeley - SEEHRL, n. 85-8.

3. Guidelines for Addressing Fuel Leaks, 1985. California Regional Water Quality Control Board.

4. Newill, Vaun A., 1987. Keynote Address at the Thirteenth Annual Research Symposium U.S. EPA "Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste", Cincinnati, OH.