HARTCROWSER

Earth and Environmental Technologies

Remedial Investigation Report
PACCAR Site
Renton, Washington

J-1639-09

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Remedial Investigation Report
PACCAR Site
Renton, Washington

Prepared for
PACCAR, Inc.

September 1, 1989
J-1639-09

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DRAFT REMEDIAL INVESTIGATION REPORT
PACCAR SITE
RENTON, WASHINGTON

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This report presents the results of our remedial investigation for the former PACCAR Defense Systems site (PACCAR site) located in Renton, Washington. The purpose of the work is to meet three general objectives:

- Complete a Remedial Investigation/Feasibility Study (RI/FS) using Washington State and EPA guidelines.

  This work was completed as a voluntary effort being coordinated by the Washington State Department of Ecology (Ecology) under the Toxics Control Act. The plan developed to guide the work is incorporated into a draft consent decree which was submitted for public review in late November 1988. The plan was approved by Ecology for publication. The review comment period ended on December 31, 1988. The consent decree was entered into Superior Court in February 1989.

  The PACCAR site was proposed for listing as a National Priority List (NPL) site on June 24, 1988. If the site is placed on the NPL list or a similar state list, then a Remedial Investigation (RI) and Feasibility Study (FS) needs to be completed. This report presents the results of the Remedial Investigation which will form the basis to complete the Feasibility Study, which PACCAR is conducting even though the site has not been placed on the NPL.

- Complete necessary site remediation

  PACCAR, Inc., is using the RI/FS process to assess soil and groundwater quality conditions beneath the site and develop a remedial action plan to achieve applicable remediation standards. This process is being used so that remediation actions can be approved by the regulatory agencies as a voluntary remediation.

o Redevelop the site

In addition to addressing issues about soil and groundwater quality, PACCAR will use information generated in the RI/FS process to plan construction of its proposed Kenworth truck manufacturing facility. Current plans include construction of a large building (initially 400,000 to 600,000 square feet with a maximum build out of 720,000 to 800,000 square feet) within the central area of the site. Building construction is presently scheduled to begin during early 1990.

Construction of the building will require that a substantial portion of the site be permanently covered. Some soils will necessarily be disturbed to possibly remove old foundations and construct new building and equipment foundations, utility conduits, etc.

The purpose of this part of the work is to assess soil quality so it can be determined what soils need to be remediated in the building areas prior to construction. Site remediation within the construction area will be implemented as part of the site preparation and construction activities.

PACCAR anticipates that development, approval, and implementation of a soils plan will be completed independently of a remediation plan for groundwater if such a plan is required. This approach is being used so that redevelopment of the site can be completed in as timely a manner as possible.

1.2 SITE DESCRIPTION AND HISTORY

1.2.1 Site Description

The PACCAR site is located within the City of Renton, about 1/2 mile northeast of the downtown area (Figure 1.1) and is about 82 acres in size. The site is within the Cedar River valley, with land surface elevations ranging between 25 and 40 feet. Upland areas of Renton with land surface elevations greater than 200 to 300 feet bound the valley to the east, west, and south.

The Cedar River is located about 2,000 to 3,300 feet to the southwest and west while Johns Creek and Lake Washington lie about 2,500 to 3,000 feet to the north and northwest. Both Johns Creek and the Cedar River flow into Lake Washington.

Existing facilities, prior to plant closure in 1988 included a foundry, forge shop, machine shops, fabrication, storage, assembly and painting buildings, railway spurs, and other support facilities (Figure 1.2). All production equipment has been sold and has been removed. All waste production and demolition materials were disposed of according to applicable laws and regulations. Most of the southern portion of the site is paved while the northwest and northeast portions are mostly unpaved (Figure 5.11).

Three drainage ditches are present within the northern site area, termed west, middle, and east ditches. The site is also drained (to the north) by a culvert, connected to a storm drainage system, which lies beneath the site. The west drainage channel is equipped with an oil/water separator. Another drainage system drains the foundry area as discussed in Section 4.3. Other site features are discussed in later report sections.

1.2.2 How the Site Was Used

The facility opened in 1907 as a foundry and rail car manufacturing plant. At its peak, the Pacific Car and Foundry (predecessor of PACCAR Defense Systems) plant built rail cars, Sherman tanks, and other military vehicles and employed up to about 2,100 workers. It quit making rail cars in 1984. From 1984 to 1988, military vehicles, castings, forgings, and other industrial products were produced at the site. Manufacturing activities have ceased and the plant was closed during the spring and summer of 1988.

Initially, the site was about 40 acres in size with the activities being conducted on the southern part of the existing site. The site expanded northward and eastward with the last property acquisition occurring in the late 1960s.

A variety of activities occurred at the site with the potential to have adversely affected soil and/or groundwater quality:

- o Industrial fill containing heavy metals and other materials was deposited mostly on the northern half of the site. This practice was discontinued in 1962.
- o Diesel fuel was stored in an above-ground tank facility within the southwestern portion of the plant (monitoring well LW-11 area).
- o The plant was powered by diesel until a natural gas system was installed in 1955. A buried pipeline feeder network (now unused) was used to distribute the fuel generally within the southern half of the existing site.
- o Fuels and solvents were used at the plant which were stored in above-ground or underground tanks. All of these tanks have been removed.
- o Paint spraying operations were conducted throughout the plant.
- o Galvanizing was conducted in the 1940s and 1950s.
- o Transformers containing PCBs were used on the site. A program is currently underway to remove transformers and other electrical equipment containing PCBs.

1.3 PROJECT HISTORY AND STUDY AREA INVESTIGATIONS

1.3.1 Study Area Boundaries

Data have been collected by PACCAR and others to assess the hydrogeologic and soil/water quality conditions on and in the vicinity of the PACCAR Renton site. Regionally, data used in this RI report generally were collected in the area shown on Figure 1.1 bounded by:

- o Cedar River to the west and southwest;
- o Lake Washington to the north;
- o Upland area to the east; and
- o Renton well field to the south.

The location of the PACCAR site is also shown on Figure 1.1 and is briefly described in Section 1.2.

1.3.2 Previous Study Area Investigations

- Dames and Moore completed eight (8) geotechnical reports between 1961 and 1984. This work provides geologic information, especially concerning geologic conditions below depths of about 50 to 60 feet.

- Hart Crowser, Inc., assisted Renton to install and test several production wells including several replacement wells. This work provides geologic and hydrologic information about the aquifer tapped by the Renton well field (Hart Crowser, 1983 and 1987a).

- Applied Geotechnology, Inc., in 1984 (under subcontract to HNTB; HNTB, 1984) assessed the extent and quality of fill materials within the northern part of the site. Their report also provided geologic and groundwater/surface water quality data. Limited additional water quality sampling was completed in December 1984 and July 1985. These reports were submitted to Ecology.

- Ecology and Environment, Inc., in 1986 (under contract to EPA) conducted a site inspection of the PACCAR site. Their work was used to provide the basis for the NPL site nomination. This work included some limited soil and groundwater sampling and analysis of samples from on-site monitoring wells and off-site monitoring wells located within the Renton well field area.

- Landau Associates, Inc., during the summer of 1986, assessed site conditions as part of a real estate purchase and sale agreement for the site. Their work consisted of soil and groundwater sampling based on the findings of previous work, interviews with past employees, and review of historical aerial photographs. They installed monitoring wells and collected hydrologic, soil quality, and groundwater quality data. This testing program also included analysis of samples from Johns Creek. The results of this work are summarized in a report prepared by Hart Crowser, Inc. (1986a) which was submitted to both the Washington State Department of Ecology (Ecology) and EPA.

- Since 1984 CH2M Hill has been assisting the City of Renton in completing an aquifer protection study of their well field. As part of this study Renton has installed monitoring wells, some of which are located between the well field and the PACCAR site. Water level measurements and water quality data are available from these wells. This work is summarized in five (5) reports prepared by CH2M Hill (1984, 1986, 1988a, 1988b, and 1989).

- Since 1986, Hart Crowser, Inc., under contract to PACCAR has evaluated groundwater flow directions in the vicinity of the site and the Renton well field. This work included installing piezometers and making water level measurements to assess which portions of the PACCAR site are within the capture area of the Renton well field. Work completed through August 1987 is documented in a report by Hart Crowser dated October 5, 1987 (1987b) including the results of a well field pumping test conducted jointly by PACCAR and Renton. This report was submitted to EPA and Ecology. The results of later measurements (through June 1989) are presented in this report.

- PACCAR has removed all of the underground and above-ground tanks which stored liquids such as fuel, solvents, and waste oil. This program has been underway since 1986 (see Section 6).

- PACCAR has been actively removing transformers containing PCBs or reducing the PCB concentrations of those remaining on-site since 1980. As of December 1988 the remaining transformers which contain PCBs are below 50 ppm (see Section 6).

- During the autumn of 1987, selected site remediation was completed in the vicinity of monitoring well LW-11 and soil boring LB-24 (Hart Crowser, 1988a). This included excavation of soil containing diesel (approximately 2,000 cubic yards from the vicinity of LW-11) and soil containing a high concentration of lead (approximately 10 cubic yards from near LB-24).

- A Remedial Investigation/Feasibility Study (RI/FS) work plan (Hart Crowser, 1988b) was negotiated and approved by Ecology in May 1988 which was incorporated into a Consent Decree between PACCAR and Ecology. The provisions of the RI portion of the work plan were implemented during the latter half of 1988 and are documented in this report.

- During January of 1989 eight test pit explorations were excavated for an assessment of subsurface conditions along a relocated stormwater sewer pipeline alignment on the east edge of the PACCAR property along Houser Way N. (Hart Crowser, 1989a). Selected samples were chemically analyzed with findings similar to those detected in adjacent areas of the site. Results are incorporated into this report.

- During May of 1989 a monitoring well was installed and sampled adjacent to an underground diesel fuel tank at the PACCAR MIS building located east of the proposed Kenworth site (Hart Crowser, 1989b). These data indicate that the tank has not affected groundwater quality.

- During June and July of 1989, Landau Associates, Inc., (Landau, 1989) under contract to Boeing completed Property Assessments for several land parcels located to the west of the PACCAR site. Monitoring wells were drilled and installed and soil and groundwater samples were collected and analyzed as part of this work. Groundwater analytical results have been incorporated into this report.

1.4 HOW THE REPORT IS ORGANIZED

Our Remedial Investigation report is organized into sections using the recommended RI report outline in the most recent guidance document (EPA, 1988a) as a guide. Major section headings outlined in the guidance outline have been retained, although our report is organized somewhat differently.

- Sections 2.0 and 3.0 present a SUMMARY OF FINDINGS and our RECOMMENDATIONS. These sections provide an overview of our report including preliminary Remedial Action Objectives to begin the Feasibility Study. The remaining report sections should be consulted for supporting details and technical analyses.

- Section 4.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA presents an overview of the regional conditions.

- Section 5.0 PROJECT AREA HYDROGEOLOGY focuses on the PACCAR site and its relationship to pertinent off-site features such as the Cedar River and the Renton well field.

- Sections 6.0 NATURE AND EXTENT OF CONTAMINATION, 7.0 CONTAMINANTS OF CONCERN, and 8.0 CONTAMINANT TRANSPORT describe what contaminants were discovered during the sampling activities, and how they might migrate off the PACCAR site.

- Section 9.0 BASELINE RISK ASSESSMENT presents our results which assesses what risks to the public health and the environment may be present under the existing site conditions.

- Section 10.0 REFERENCES concludes the main report.

Sections 1 through 10 are supported by several appendices which contain a description of how data were obtained. These appendices are presented in a pair of volumes accompanying this report. Selected data such as boring and well logs, grain size analyses, soil and groundwater quality data, groundwater flow assessment maps, and hydraulic conductivity test data are also presented. These appendices include:

- Appendix A - Field Data Collection Procedures
- Appendix B - Laboratory Procedures
- Appendix C - Boring and Test Pit Data
- Appendix D - Well Data
- Appendix E - Hydrologic Data
- Appendix F - Data Validation Procedures and Results

- o Appendix G - Selected Soil Quality Data
- o Appendix H - Selected Groundwater Quality Data
- o Appendix I - Probabilistic Exposure Modeling

1.5 SAMPLE LOCATION AND WELL NUMBERING SYSTEM

Sampling activities on and in the vicinity of the site have been completed by several firms over a 4- to 5-year period as discussed in Section 1.3. A variety of numbering systems were used to designate samples and their location on base maps. Location designations in our report have been divided into locations where:

- o Soil or sediment samples were obtained in test pits, or borings, or as surface grab samples. Wells were not installed at these locations.
- o Monitoring wells were installed.
- o Surface water samples were collected.

Sampling locations are shown on Figures 1.3 and 1.4 (soils) and 1.5 (monitoring wells and surface water). Table 1.1 describes the number designations.

Table 1.1 - Sample Location and Well Numbering Designations

Location Designation	Type*	By(Year)
Soil Samples (Figures 1.3/1.4)		
HNTB-SB Series	SB	HNTB/AGI (1984)
LS-Series	SS	Landau Assoc., (1986)
LSD-Series	SED.	Landau Assoc., (1986)
LB-Series	SB	Landau Assoc., (1986)
Grid Designated Samples**		
example: F13/HT01	T	Hart Crowser (1988)
H8/HB01	B	Hart Crowser (1988)
PRL-TP-Series	T	Hart Crowser (1989)
Wells (Figure 1.5)		
DM-2, DM-3, DM-5	W	Dames and Moore (1984)
MW-1 to MW-4 (on-site)	W	HNTB and AGI (1984)
LW-1 to LW-15	W	Landau Assoc. (1986)
11-OW-1 to 11-OW-3	W	Hart Crowser (1987)
OW-4, OW-5	W	Hart Crowser (1988)
OSP-1 to OSP-13	W/P	Hart Crowser (1988)
OSP-13 (MIS)	W	Hart Crowser (1989)
HC-1I to HC-5I	P	Hart Crowser (1987)
MW-1 to MW-7, MW-10, MW-11 (off-site)	W	CH2M Hill (1986)
MW-8 (off-site)	W	CH2M Hill (1968)
MW-12 to MW-27 (off-site)	W	RH2Eng. - Hydrogroup/ CH2M Hill (1988)
MW-9 (off-site)	W	Hart Crowser (1983)
PW-1 to PW-3	PW	Jansen and Gaudio Drilling (1942 and 1959)
PW-8	PW	CH2M Hill (1967)
PW-9	PW	Hart Crowser (1983)
RW-1 to RW-3 (replacement wells)	RW	Hart Crowser (1987)
SW-3 and SW-4 and SW-1 and SE-1	SW	HNTB/AGI (1984) and Hart Crowser (1988)
LWM-Series	W	Landau Assoc., (1989)

* Sample Type
- SS - Surface Soil
- SED - Sediment
- SB - Soil Boring
- T - Test Pit
- B - Soil Boring
- W - Sampling/Monitoring Well
- P - Piezometer
- PW - Renton Production Well
- RW - Renton Replacement Production Well
- SW - Surface Water

**See Appendix A for explanation of grid designated samples.

Vicinity Map

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington

Regional Study Area

PACCAR Site

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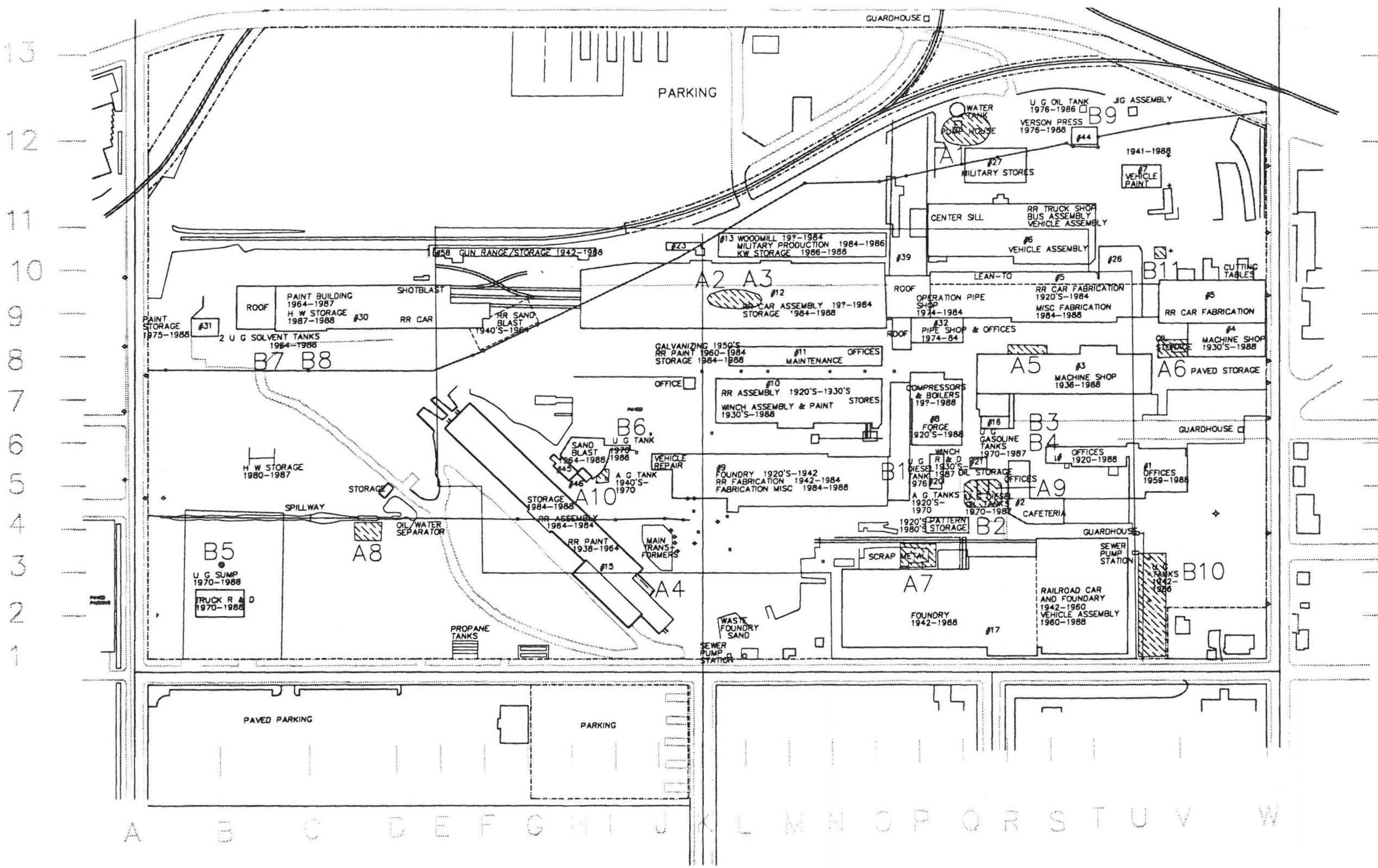
Figure 1.1

Site Features Map



A1-A10 Former Location of Underground Storage Tank

B1-B10 Former Location of Above Ground Storage Tank

N

0 250 500

Scale in Feet

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Figure 1.2

Soil Sampling Location Plan
Previous Studies through 1986

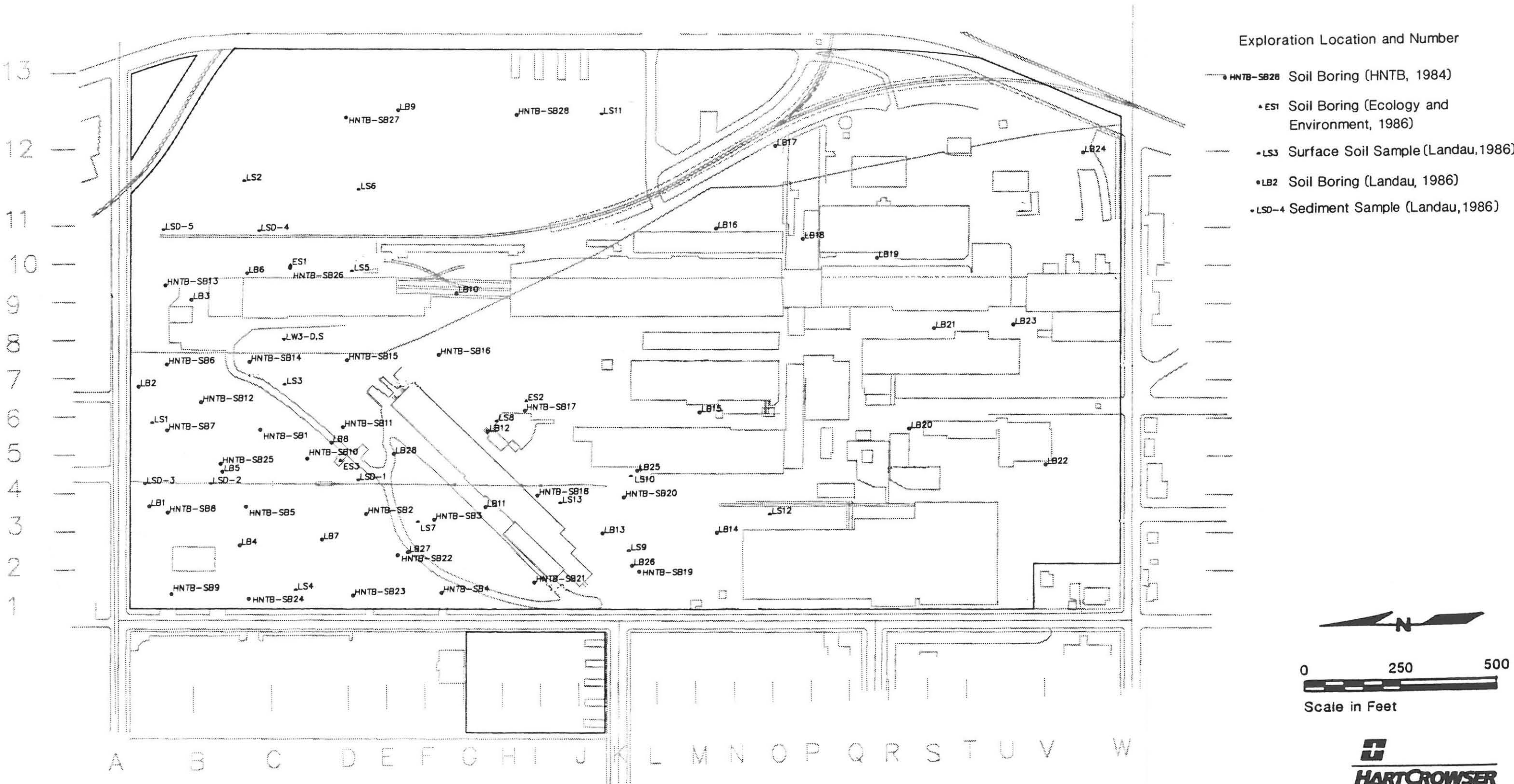

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Figure 1.3

Hart Crowser Boring and Test Pit Location Plan
For RI/FS

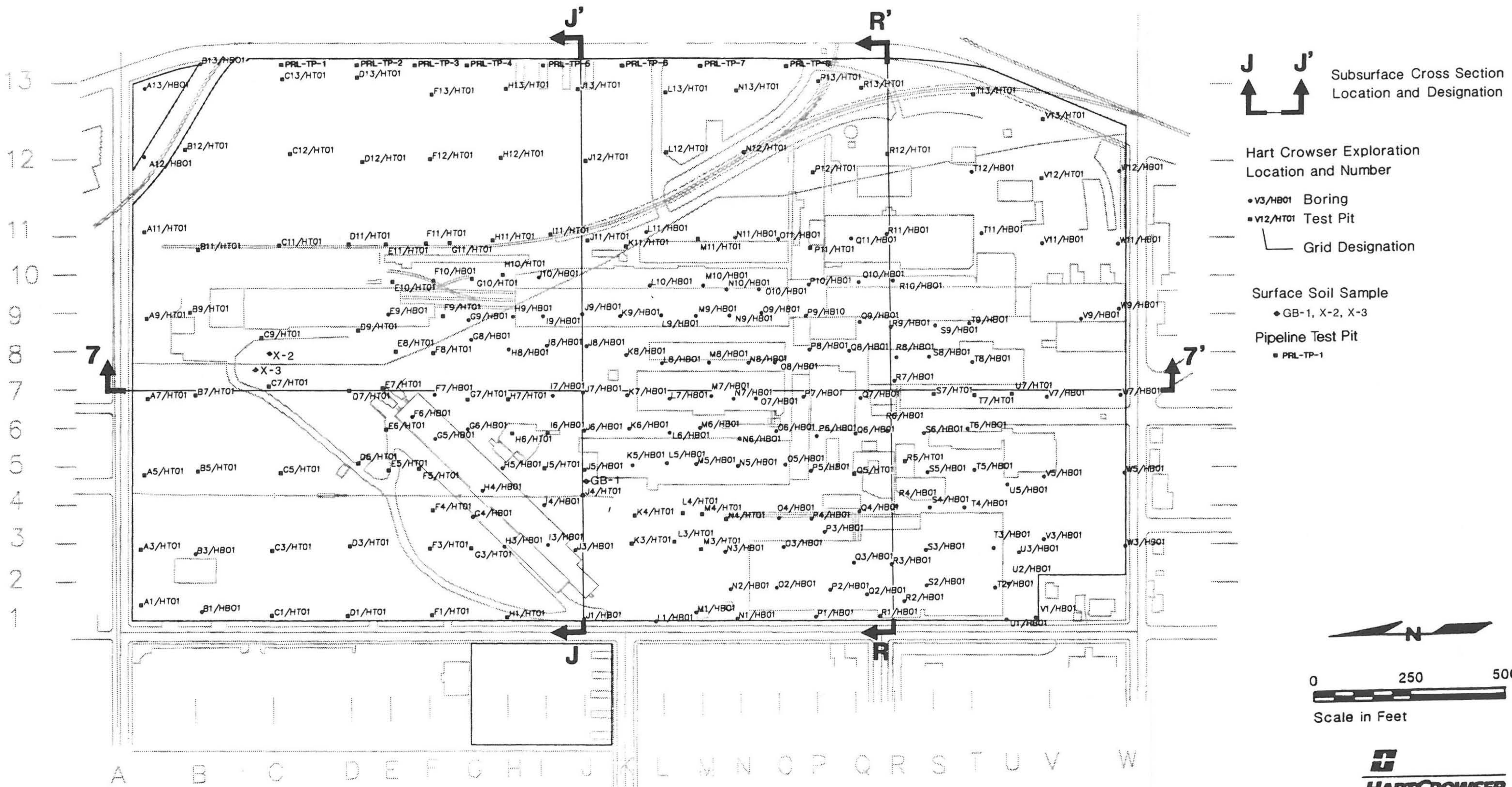

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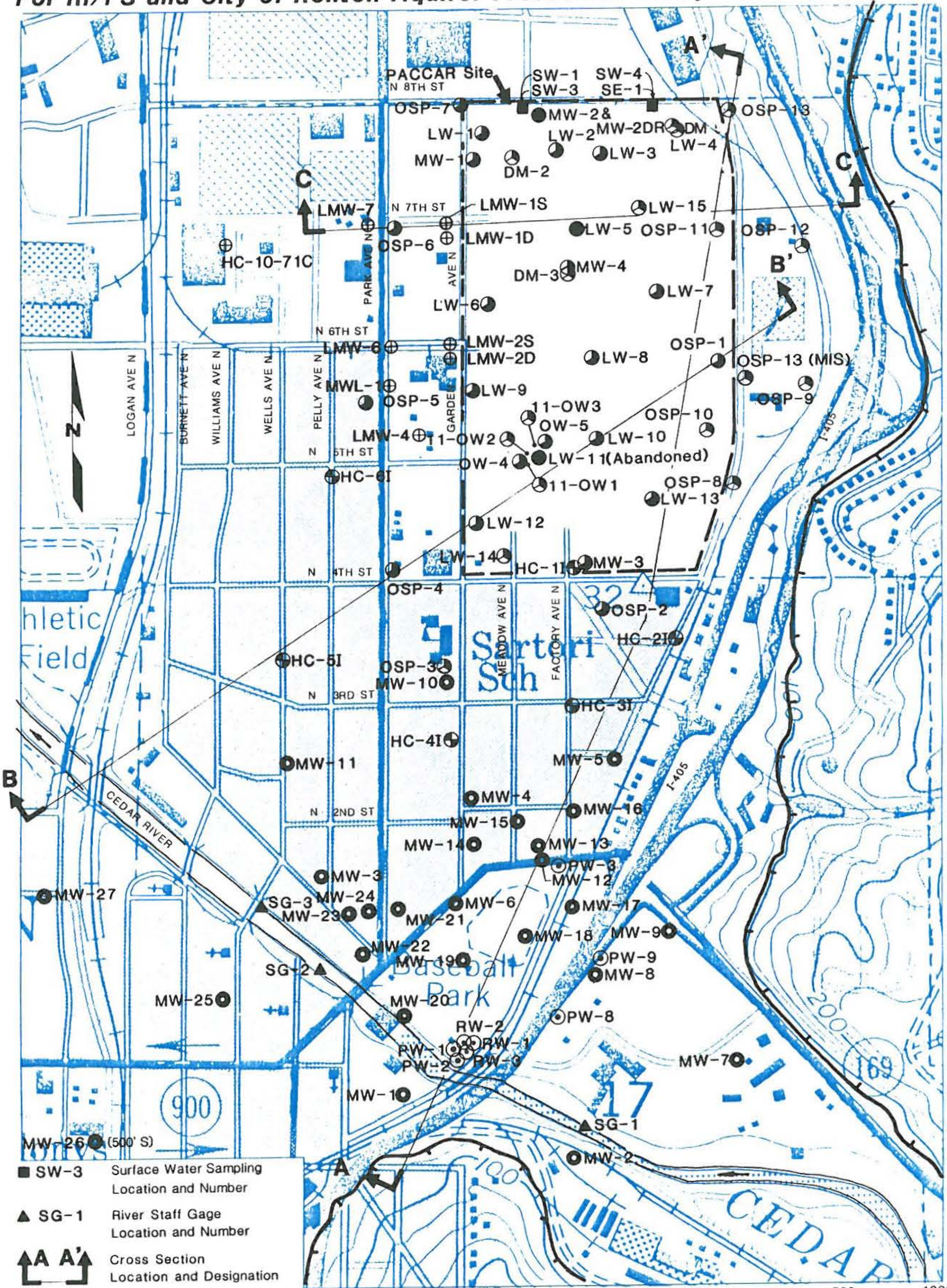
Figure 1.4

Well and Surface Water Sampling Location Plan
For RI/FS and City of Renton Aquifer Protection Study



Note: Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

Exploration Location and Number

DM-1 Single Well PACCAR

LW-1 Dual Well Nest PACCAR

MW-1 Triple Well Nest PACCAR

LMW-7 Monitoring Well by Others (Landau 1989)

PW-1 City of Renton Production Well

MW-2 City of Renton Monitoring Well

HC-1I Hart Crowser Piezometer

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Figure 1.5

2.0 SUMMARY OF FINDINGS

2.1 OVERALL SUMMARY

This remedial investigation (RI) consisted of the collection and analysis of an extensive amount of soil, hydrologic, and water quality data to characterize on-site soil, surface water, and groundwater quality conditions. Off-site contaminant migration routes and potential receptors were identified and a baseline risk assessment was completed to identify possible human health and environmental risks.

The baseline risk assessment indicates that the PACCAR site poses little public health or environmental risk. Arsenic, chromium, lead, and polynuclear aromatic hydrocarbons (PAHs) are the principal soil contaminants of concern. Even under the very conservative exposure assumptions used to develop the risk assessment, carcinogenic and non-carcinogenic risks posed by these soil contaminants are within acceptable published regulatory agency guidelines. Although some increased risk to site workers may occur if soil is disturbed in an uncontrolled manner, the risks are comparable to other common human activities such as eating charbroiled steaks.

Potential risks of contaminant migration from the PACCAR site to City of Renton municipal supply wells are also very small. The few chemical detections which have been observed on and near the site are within the catchment area of the Cedar River beyond the zone of groundwater flow to the supply wells even under heavy pumping conditions. No existing water supply wells are present in the Cedar River catchment area. Based on an assessment of flow volumes, existing and anticipated future land use, and the existing Renton supply system which serves the area, the likelihood that a future domestic wells would be placed within the downgradient Cedar River catchment area is remote.

The site contributes about 10 percent of the storm drainage flow within the North Renton Drainage Basin based on area. Surface water quality samples in ditches which flow off of the site toward Johns Creek and Lake Washington indicate that the water quality is similar to runoff from developed urban areas.

The following sections present additional summaries of our findings. The main body of the report and supporting appendices should be consulted for more detail and supporting discussion.

2.2 POSSIBLE SOURCES OF CONTAMINANTS

Potential sources of contamination were identified based on past history. Many of these sources are no longer present on the site because of changing site operations and waste handling practices and programs implemented by PACCAR to remove possible sources such as tanks. The identified possible sources include:

- Fill Materials.
- Underground and above-ground tanks (now removed).
- Leakage prior to 1955 from abandoned buried diesel distribution lines within the southern part of the plant.
- Transformers and other electrical equipment.
- Painting and galvanizing operations.
- Residues from sand blasting and shot blasting.
- Solvents and degreasing agents used in the machine shop and other operations.

2.3 RESULTS OF SOIL AND FILL ANALYSIS

Soils and fill materials on the site have been screened and tested for a variety of potential contaminants including metals, volatile and semivolatile organic chemicals, and PCBs.

- At a few locations on-site metal concentrations exceed background levels but, except for lead, nearly all values fall within the reported background range. Lead exceeding background levels was detected in a greater number of locations at the site. Concentrations of metals in soils are generally highest in the top several feet and decline with increasing depth. Highest metal concentrations are associated with industrial fill materials. Table 2.1 presents a summary of total metal concentration data.

Table 2.1 - Summary of Target Metal and Organic Concentrations in Soil

Parameter	Typical Concentration Range in mg/kg (ppm)	Highest Concentration in mg/kg (ppm)	Regional Background Concentration in mg/kg (ppm)
Arsenic	ND to 10	180	5 to 30
Cadmium	ND	9.7	<1 to 1.4
Chromium	10 to 100	1,600	10 to 70
Copper	10 to 100	1,600	5 to 20
Lead	ND to 100	19,000	10 to 60
Nickel	10 to 100	330	10 to 70
Zinc	10 to 100	6,400	20 to 80
BTEX	ND	7.3	<0.01
Vinyl Chloride	ND	0.01	<0.01
HPAHs	0.1 to 10	1,085	<0.01 to 0.1
PCBs	ND	24	<0.01

ND = not detected

The large majority of soils on the site would not be designated as dangerous wastes. However, a small number of samples indicate that some soil has the potential to be designated as a dangerous waste if excavated based on total arsenic concentration and EP Tox results for lead.

280 samples were tested for total arsenic. 274 of the samples would not be classified as a dangerous waste (WAC 173-303) based on total arsenic concentrations below 100 ppm. Six of the 280 samples exceeded 100 ppm (*in situ*) which indicates that some of the soil on the site could be designated as a dangerous waste. However, it is unlikely that excavated soil concentrations would exceed 100 ppm As because the number of samples exceeding 100 ppm was small and the samples are of relatively low concentration (maximum 180 ppm).

200 samples were tested for Extraction Procedure Toxicity (EP Tox) metals. Two samples exceeded EP Tox dangerous waste criteria for lead. Soil from one of these locations was removed from the site in 1987 with Ecology approval. It is unlikely that any excavated soil would exceed the EP Tox criteria because of the small number of samples which exceeded the criteria.

- Most of the volatile organic chemicals detected in soils were in the range of less than detection to 0.1 mg/kg (ppm), with a few samples ranging up to 7.3 mg/kg. The compounds detected include constituents associated with fuels (benzene, toluene, ethylbenzene, and xylenes) and solvents (tetrachloroethene, trichloroethene, and 1,2-Dichloroethane).

- Semivolatile organic chemicals were detected in most samples in the range of below detection limits to about 10 mg/kg (ppm) with a few of the samples ranging up to 1,300 mg/kg. We have divided this class of chemical compounds into total hydrocarbon (TPH) and polynuclear aromatic hydrocarbons (PAHs). PAHs are broken into two subgroups; low molecular weight (LPAHs) and high molecular weight (HPAHs).

  Most total petroleum hydrocarbons (TPH) concentrations range below the detection limit to 58,000 ppm. The highest concentrations were measured in near-surface soils and the concentrations generally declined with increasing depth. The highest concentrations were also measured within the southern part of the site where the buried diesel distribution lines are present. GC/FID screening analyses indicate that the high TPH concentrations are predominantly the result of the presence of diesel fuel.

  Low and high molecular weight polynuclear aromatic hydrocarbons (LPAH and HPAH) concentrations range between not detected to 222 mg/kg and not detected to 1,085 mg/kg, respectively. These compounds are associated with fuel and with fill materials containing cinders, coal, and other rubble. Concentrations decline with increasing depth.

- Generally low concentrations of PCBs were detected in site soils. Concentrations range from not detected over most of site to about 5 ppm although one sample detected a concentration of 24 ppm. The presence of PCBs is localized to areas where small spills likely occurred.

o **Groundwater** samples have been obtained from over 70 monitoring wells and have been analyzed for volatile and semivolatile organic chemicals, pesticides and PCBs, and metals. Samples have been obtained from both on-site and off-site monitoring wells.

  - Volatile organic chemicals have been detected in the range of not detected to 3 mg/L (ppm) for shallow on-site monitoring wells (less than about 25 feet deep) to not detected to 1 ppm for deeper on-site wells. Samples from two off-site monitoring wells detected volatile chemicals. Vinyl chloride was the only significant detection at 0.045 ppm (LMW-2D) and 0.004 to 0.005 ppm (OSP-5D) in monitoring two wells west of the site. These wells are located within the Cedar River catchment area. Monitoring well OSP-5D is downgradient of monitoring well LMW-2D which indicates that a significant reduction in vinyl chloride concentrations occurs away from the site. The constituents detected are indicative of fuels and solvents. The vinyl chloride likely is a breakdown product of chlorinated solvents which entered groundwater.

  - Semivolatile organic chemicals were not detected in groundwater beneath most of the site. The highest concentrations were detected in samples adjacent to previous tank (underground or above-ground) locations. The presence of high semivolatile concentrations in site soils, especially within the southern portion of the site, has not had a discernible influence on groundwater quality. No semivolatile organic chemicals were detected in off-site monitoring wells.

  - Pesticides or PCBs have not been detected in groundwater beneath the site, except during an early sampling round where a single low level PCB and several pesticides were reported to have been detected. Later sampling rounds did not confirm the presence of PCBs or the pesticides.

- Metals: Dissolved lead, zinc, and arsenic were the only metals consistently detected in groundwater samples from shallow and deep monitoring wells. Copper, nickel, chromium, cadmium, mercury, selenium, barium, and silver were generally not detected. The range of concentrations for lead, zinc, and arsenic are listed in Table 2.2. The presence of lead in soils has not had a substantive influence on groundwater quality.

Table 2.2 - Summary of Metals Groundwater Data

Parameter		On-Site Concentration Range in ug/L (ppb)	Off-Site Concentration Range in ug/L (ppb)
Arsenic	S	<5 to 130	<5 to 27
	D	<5 to 110	<5 to 45
Lead	S	<5 to 40	<5 to 11
	D	<5 to 30	<5 to <12
Zinc	S	10 to 61	10 to 50
	D	8 to 110	<3 to 29

S = shallow wells less than 25 feet deep.
D = deep monitoring wells greater than 25 feet deep.

- o Surface water samples have been collected and analyzed from two locations where runoff is collected and leaves the site. The quality of runoff from the site is similar to runoff from local urban areas (Bellevue, Washington) (see Tables 6.12 and 6.13). Volatiles and pesticides/PCBs were not detected in these samples and only very low concentrations (2 to 21 ppb) of two phthalate compounds were detected. Copper, nickel, lead, and zinc were detected in surface water samples.

- o Sediments obtained from the bottom of two ditches which collect surface water flow have also been analyzed. Xylene was the only volatile chemical detected (at 0.02 mg/kg) and several semivolatile compounds were detected at concentrations less than about 10 to 11 mg/kg (ppm). The PCB Aroclor 1254 was detected at 3.1 ppm in one sample. Total lead, chromium, nickel, and zinc were detected at concentrations within a similar range as for site soils.

2.4 CONTAMINANT TRANSPORT

2.4.1 Air

Migration via air can occur through volatilization and generation of dust. Volatilization of volatile organic chemicals is not considered significant because of the low concentrations of these chemicals in site soils. Generation of dust is a potential migration pathway which is currently limited by the presence of building foundations and site paving which cover about 50 percent of the site. Migration via this pathway is further limited by clean granular fill materials which cover most of the remaining portions of the site. However, because of the presence of metals in soil, this possible pathway is evaluated in the baseline risk assessment.

2.4.2 Surface Water

Surface water as stormwater flow leaves the site via several ditches and a culvert most of which flows into Johns Creek. Migration of particulates, which contain metals, into the ditches probably occurs during periods of high runoff. However, available data indicate that the runoff is similar to typical urban runoff. This pathway is considered in the baseline risk assessment.

2.4.3 Groundwater

Groundwater beneath the site flows to the west and southwest. Most of the site is upgradient of the Cedar River (termed Cedar River catchment) while the southeast portion of the site is upgradient of the Renton well field (termed Renton Well catchment). The two catchment areas are separated by a groundwater divide which has been defined based on extensive groundwater monitoring. The northern extent of this divide delineates the northern portion of

Zone 2 of the Renton Aquifer Protection Area (APA). Because the Cedar River and the Renton well field are downgradient of the site, migration to these receptors is considered in the baseline risk assessment.

2.5 RESULTS OF BASELINE RISK ASSESSMENT

We took a very conservative "worst case" approach to the risk assessment consistent with recent EPA and Ecology guidance and comment. This is what we found:

- Both carcinogenic and non-carcinogenic risks posed by the site are within acceptable risk levels in general guidance provided by the regulatory agencies. Non-carcinogenic risks, expressed as a hazard index, were below 1.0 and the cumulative upper bound lifetime carcinogenic risks were less than 1 additional case in 10,000.

- Some risk to workers was identified if there is uncontrolled exposure to site soils. The actual risks are lower than those estimated because site access is controlled and the possibility that actual exposures would approach the assumed exposure conditions is remote.

- Potential risks to the Renton well field are very small because few off-site chemical detections have occurred and are beyond the catchment area of the well field even under pumping conditions. In addition flow from the PACCAR site to the well field is only a small percentage of the volume of water which is pumped from the well field. Other than the Renton wells no other water supply wells are present in the area and the possibility that future wells will be installed in this area is remote.

Our assessment indicates that the other constituents of concern and possible exposure routes pose lower risks to human health. Potential environmental risks appear limited to stormwater discharges into Johns Creek, although such risks are likely minor and not substantially different from those posed by ordinary runoff from residential areas typical of the site vicinity.

3.0 RECOMMENDATIONS

3.1 ADDITIONAL WORK

3.1.1 Continuing Groundwater Flow Assessment

Water level measurements should continue to be made on a quarterly basis through the end of 1989 to assess how the groundwater flow system responds to wet weather conditions and low well field pumping rates. Measurements were made toward the end of March and June, and will be made in September of 1989. The need for additional measurements and measurement schedule beyond this period should be reviewed after the September 1989 data are collected.

3.2 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The following preliminary objectives are proposed to further reduce the already low site risk:

- o Reduce contact and related exposures to soil containing PAHs and lead;
- o Reduce contact of water with site soils;
- o Reduce the erosion potential and migration of soil particulates into storm sewers;
- o Monitor the potential for migration of contaminants to the Renton well field, Johns Creek, or the Cedar River; and
- o Reduce the mobility, toxicity, or volume of contaminants.

4.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

4.1 SURFACE FEATURES

Surface features on and in the vicinity of the PACCAR site are shown on Figures 1.1 and 1.2. The site is located within the Cedar River valley which is defined by upland areas to the east, west, and south.

Lake Washington and Johns Creek are located north of the site while the Cedar River lies to the southwest and west. The Cedar River and Johns Creek flow northward into Lake Washington.

The surrounding areas have been developed for residential, commercial, and industrial purposes. Interstate 405 lies to the east and parallels the trend of the valley. Downtown Renton is about one-half to one mile south and southwest of the site.

The PACCAR site is about 82 acres in size. Numerous former buildings and other support facilities existed on the site. About 50 percent of the site was covered with buildings and paving. The remaining portion is covered with a layer of clean sand and gravel (0.5- to 1-foot-thick).

4.2 METEOROLOGY

The PACCAR site lies within the Puget Sound Lowland which is characterized by cool, dry summers and mild, cloudy and rainy winters (Luzier, 1969). Average annual precipitation within the lowland areas ranges from about 39 inches near Puget Sound to more than 70 inches eastward toward the Cascade mountains. Average precipitation at the PACCAR site is estimated to be about 39 to 40 inches based on measurements made at the Seattle-Tacoma Airport located west of the site (NOAA, 1987).

Most of the yearly precipitation falls during the period October to March. Figure 4.1 shows actual precipitation rates and average monthly rates for 1986, 1987, and 1988. These data indicate that below average precipitation rates occurred during mid-1986, most of 1987, and the first and middle portions of 1988.

The average annual temperature is about 51°F (NOAA, 1987). Winter temperatures average between 39°F and 45°F while summer temperatures average in the 60°F to 64°F range.

4.3 SURFACE WATER HYDROLOGY

4.3.1 Three Regional Features

The Cedar River lies to the west and southwest of the PACCAR site and is about 2,000 feet from the site at its closest point (Figure 4.2). The river headwaters at the Cedar Falls dam and flows generally northward into Lake Washington. River flows are largely controlled by discharge from the dam and diversion to the City of Seattle water system at Landsburg. Highest flows are present during late winter and early spring and lowest flows are present during late summer and early autumn.

Johns Creek is a smaller surface water flow channel which lies about 2,000 feet north of the site. A major portion of flow in this creek is contributed from drainage of the uplands area located east of the Cedar River Valley.

Lake Washington is about 2,700 to 2,800 feet north and northwest of the site. The lake receives discharge from the Cedar River, Johns Creek, surface water runoff, and storm drains.

4.3.2 Regional Storm Water Drainage System

The PACCAR site is located in the North Renton Storm Drainage Basin (City of Renton, 1988). The North Renton Basin includes approximately 773 acres and is divided into two sections. The area east of Interstate 405 is called the Highlands region and the area west of Interstate 405 is called the Valley region (Figure 4.2).

The area included within the Highlands region is primarily residential. All of the water collected in the Highlands region is discharged to the Valley region through several culverts which cross under Interstate 405 (Figure 4.2).

The area included in the Valley region is primarily industrial. Water collected in the Valley storm sewers including flow from the

Highlands region is discharged to Lake Washington.

Drainage water flows to Lake Washington via one of two pathways:

Discharge through Johns Creek

Most of the water collected in the North Renton Basin discharges through a pipe which runs north along Garden Avenue North from North 8th Street to Lake Washington Boulevard. From there it discharges through a series of culverts and open ditches until it reaches Lake Washington (Figure 4.2).

Discharge through the Cedar River

Some of the water collected in the North Renton Basin discharges through a concrete line which runs from North 6th Street to the Cedar River. However, the capacity of this line is inadequate during high flow periods. Backflow from the line sometimes flows north along Garden Avenue North and discharges through the 48- to 72-inch pipe into Johns Creek during periods of high storm water flow.

4.3.3 Surface Water Flow on the PACCAR Site

Flow Entering the Site

Storm sewers enter the PACCAR site at two locations, all of which are at the southern edge of the property (Figure 4.3). A dual 24-inch line enters at the southeast corner of the site and carries water which has been collected on approximately 50 acres southeast of the property. This line runs across the property and discharges through the North Renton Basin, Johns Creek discharge. The small line which enters the property in the southwest corner of the site crosses only the corner of the site before it joins the North Renton Basin, Cedar River discharge. Both lines receive stormwater from the PACCAR site.

Flow on the Site

Flow on the site occurs in ditches and storm sewers. Major flow directions on-site are shown on Figure 4.3. The capture areas of discharge points are shown on Figure 4.2.

Most of the site is drained by underground storm sewers; however, there are three open ditches, which are shown on Figure 4.3; all of them enter the North Renton Basin, Johns Creek discharge. The west ditch is approximately 550 feet long. The middle ditch is approximately 300 feet long. The 1,000-foot-long east ditch receives flow from the eastern boundary of the site adjacent to Houser Way North, and runs along the existing railroad tracks. All three ditches collect water from storm sewers, surface runoff, and shallow groundwater.

Although the water table fluctuates, its elevation is generally above the bottom of the west ditch; therefore, water may be present in this ditch throughout the year. However, during years of low precipitation the west ditch has been dry. The other two ditches are often dry.

Flow Exiting the Site

Flow leaves the site at various locations as shown on Figure 4.3. All of the surface water collected on-site leaves the property at the western and northern boundaries.

Most of the water collected on-site drains north. The three ditches and the major storm sewer line leave the property at the northern property boundary via culverts and flow into the Garden Avenue North pipe and through the North Renton Basin, Johns Creek discharge.

There are several surface water discharge points along the western property line (Figure 4.3). These drains discharge to Garden Avenue North storm sewer and travel through the North Renton Basin, Cedar River discharge; although some of the water discharged along the west property boundary may flow into the North Renton Basin, Johns Creek discharge during very heavy rainfalls.

4.3.4 PACCAR Site Contribution to Surface Water Flow

The volume of water collected on the PACCAR site is small relative to the total volume of water collected in the North Renton drainage basin. The site represents only 10 percent of the area of the drainage basin.

Water collected on the PACCAR site mixes as it flows into the regional surface water flow system. Mixing occurs as:

1. Water collected in one of the on-site capture areas joins and mixes with the water collected south of the site in the primary north south trending conduit.

2. Water leaving the property across the northern property line joins and mixes with water collected in the Highlands region as well as other sources within the Valley region such as I-405.

3. Water leaving the site across the west boundary joins and mixes with water collected from other areas within the North Renton Basin.

4. Storm sewers discharge into and mix with water in Johns Creek and the Cedar River.

5. The Cedar River and Johns Creek discharge to Lake Washington.

4.4 GEOLOGY AND HYDROGEOLOGY OF THE STUDY AREA

4.4.1 Geology of the Area

The PACCAR site is located in the Cedar River Valley, north of Downtown Renton and south of Lake Washington (Figure 4.4). The valley was created by glacial erosion and has since been partially filled with glacial and non-glacial sediments. Glacial drift uplands define the valley perimeter to the east and south, while bedrock defines the perimeter to the west.

The most recent deposits that fill the valley are delta fan and alluvial deposits of the Cedar River estimated to be roughly 100 feet thick in the Renton area (Figure 4.5). Several hundred feet of very dense glacial and interglacial materials underlie the valley sediments. The coarser portions of the delta fan deposits make up the Cedar River Aquifer which provides water to the Renton wells. Following the retreat of the last glaciation the Cedar River eroded a channel into the existing glacial drift plain and deposited a delta fan outward into a marine embayment that occupied the valley. These fan deposits consist of coarse gravel and cobbles near the former mouth of the river (in the vicinity of the Renton well field) and grade progressively finer-grained in a radial outward direction (toward the site and Lake Washington). The approximate extent of the very coarse deposits which comprise the Cedar River Aquifer is shown on Figure 4.4. Fan deposits that occur beneath the site are likely to be predominantly sand and silty sand. Overlying the delta fan deposits are more recent alluvial deposits of the Cedar River consisting of sand, gravel, silt, and peat.

4.4.2 Hydrogeology of the Study Area

The study area is composed of two regional systems; Glacial Drift Uplands and the Cedar River Valley. Regionally, the flow system is characterized by recharge in the uplands and discharge to the valley. Recharge within the valley occurs from the infiltration of incident precipitation. The Cedar River is the major discharge point for groundwater flow from the uplands as well as within the valley although some groundwater flows into Lake Washington from the areas located north of the site. Groundwater generally flows to the west and northwest toward the Cedar River.

The regional groundwater flow system is locally altered by pumping from the City of Renton well field. When the well field is pumping it becomes a local groundwater discharge point. Pumping causes groundwater to flow toward the wells from the surrounding area (termed capture area). Pumping also induces some infiltration of Cedar River water into the aquifer, although the well field capture area extends beneath and to the west side of the Cedar River (Hart Crowser, 1987b; CH2M Hill, 1988a, 1989).

The aquifer capture area extends to the north and encompasses a portion of the PACCAR site. This is discussed further in Section 5.0.

4.5 DEMOGRAPHY AND LAND USE

4.5.1 The Site

Land use within the 82-acre site is zoned industrial, however, most of the site's former buildings have been demolished and the site is not actively being used except for some minor storage and fabrication operations. The former PACCAR Defense Systems operation was closed in 1988. Demolition permits for removal of a substantial number of the buildings on the site have been issued. Demolition of most of the remaining structures is occurring in 1989.

4.5.2 Land Use around the Site

Land use around the site is generally characterized as follows:

- North
  - Parking Lots
  - Warehouses
  - Light Manufacturing Operations

- East
  - Primarily Residential (upland east of I-405)
  - Warehouses and Computer Center
  - Some Light Commercial Operations

- Southeast
  - Warehouse and Light Commercial Operations
  - Commercial Corridor along I-405

- South and Southwest
  - Residential Areas
  - Warehouses and Offices
  - Light Commercial Operations

- West and Northwest
  - Heavy Manufacturing Operations (Boeing)
  - Parking Lots
  - Commercial Office Buildings
  - Residential Area

4.5.3 Summary of Total Land Use

The land use of approximately 538 acres defined as the primary impact area in a draft Environmental Impact Statement (dEIS) for the site (NBBJ, 1989), is the area north and east of Cedar River and north and west of I-405 up to Johns Creek and bordered by Lake Washington to the north. Land use percentages are shown in Table 4.1.

Industrial uses comprise just less than 50 percent of this total area. Transportation-related land uses, which include public right-of-way and railroads, account for over 20 percent of the total area.

Table 4.1 - Summary of Land Use

Land Use	Area in Acres	Percent of Total
Public Right of Way	89.9	16
Industrial	259.3	48
Commercial/Retail	22.6	4
Commercial/Office	24.2	5
Public/Civic	20.5	4
Open Space/Park	21.9	4
Residential	73.9	14
Railroad	25.7	5
Total	538.0	100

Source: NBBJ, 1989.

Actual and Average Monthly Precipitation–Sea Tac Airport 1986 to 1988

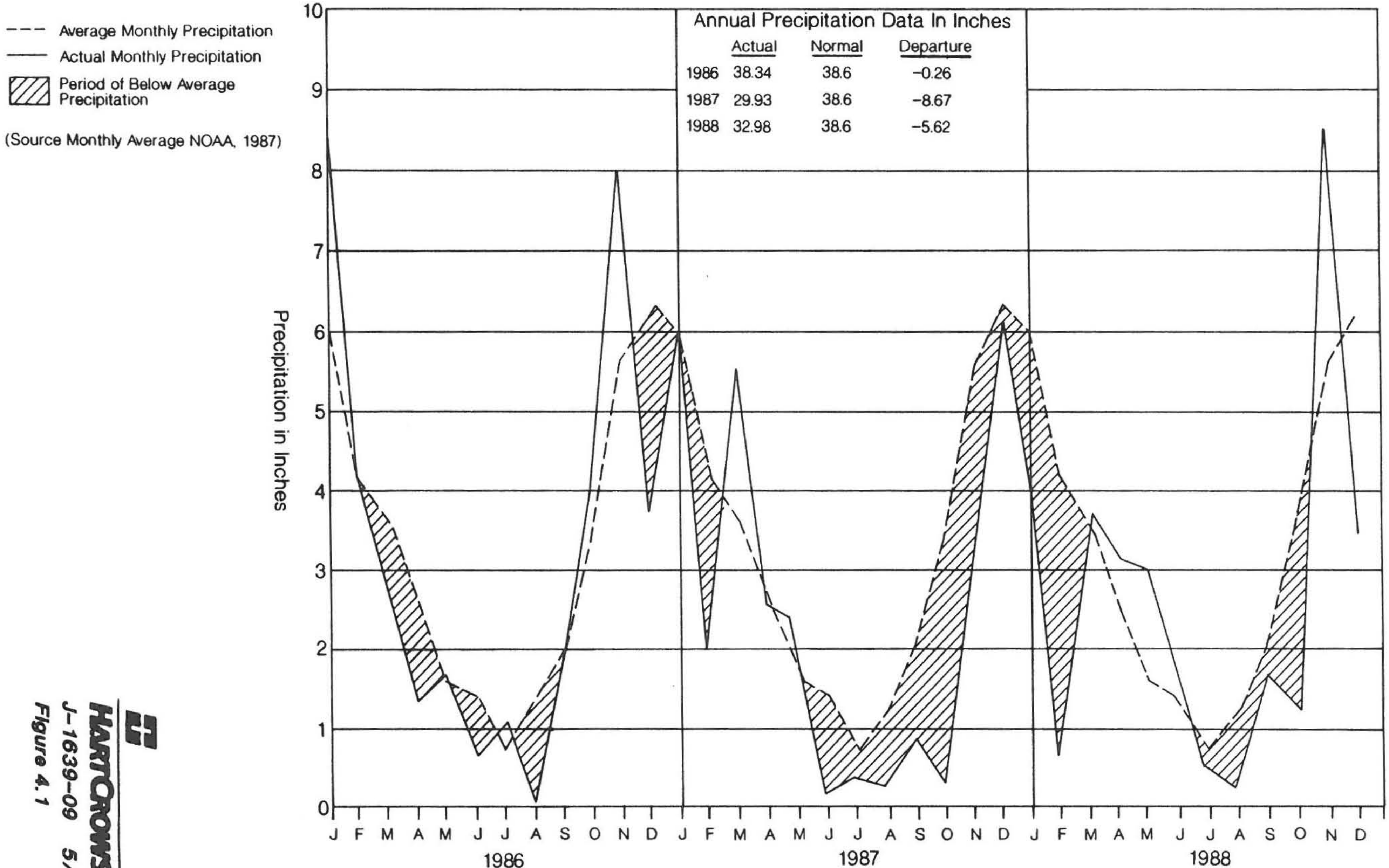

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Figure 4.1

Regional Surface Water Drainage Map

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington

Drainage Basin Boundary

Surface Water Flow Direction

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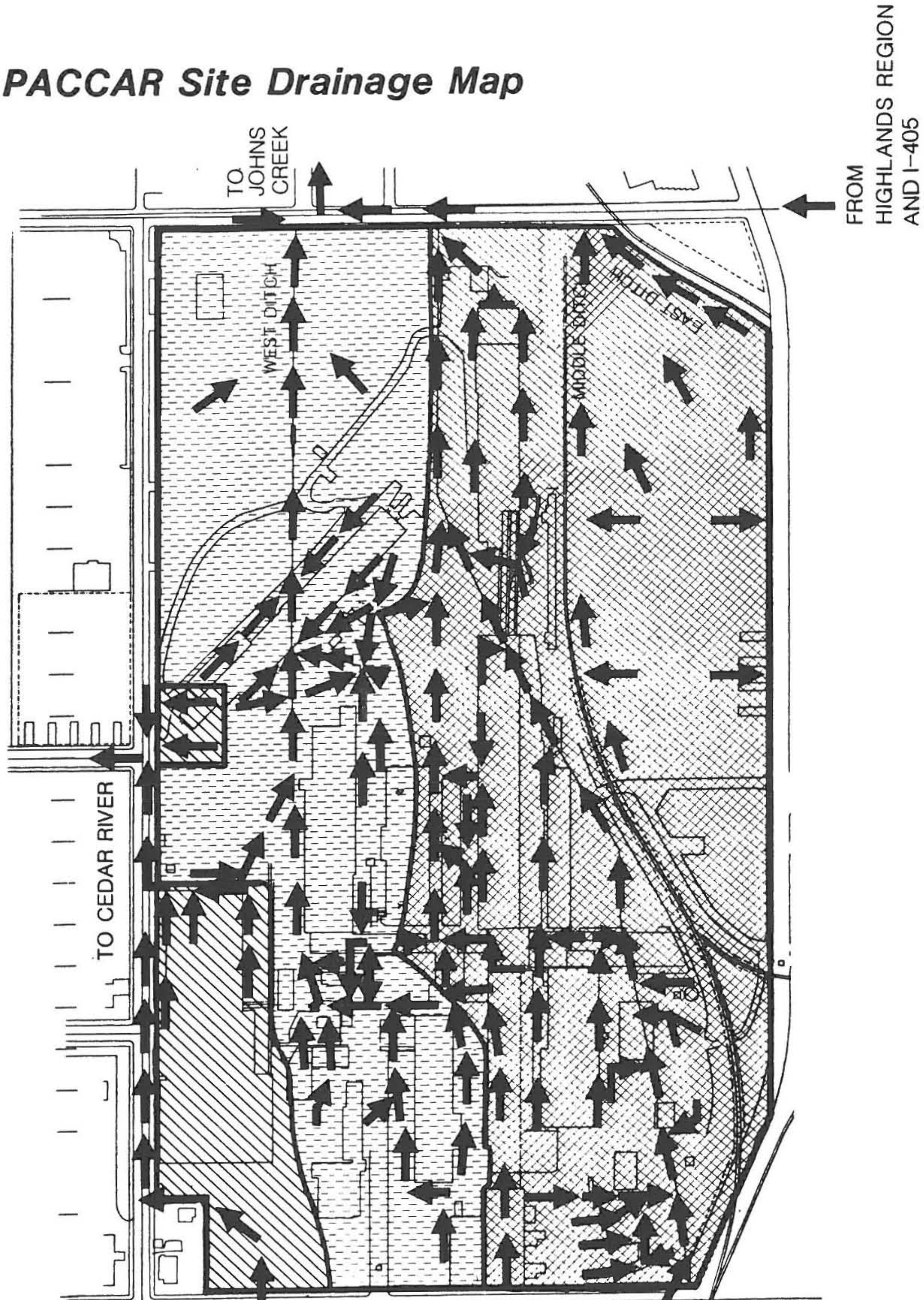
Figure 4.2

PACCAR Site Drainage Map



Cedar River Drainage

Johns Creek Drainage via West Ditch

Johns Creek Drainage via Middle and East Ditch and Buried Storm Culverts

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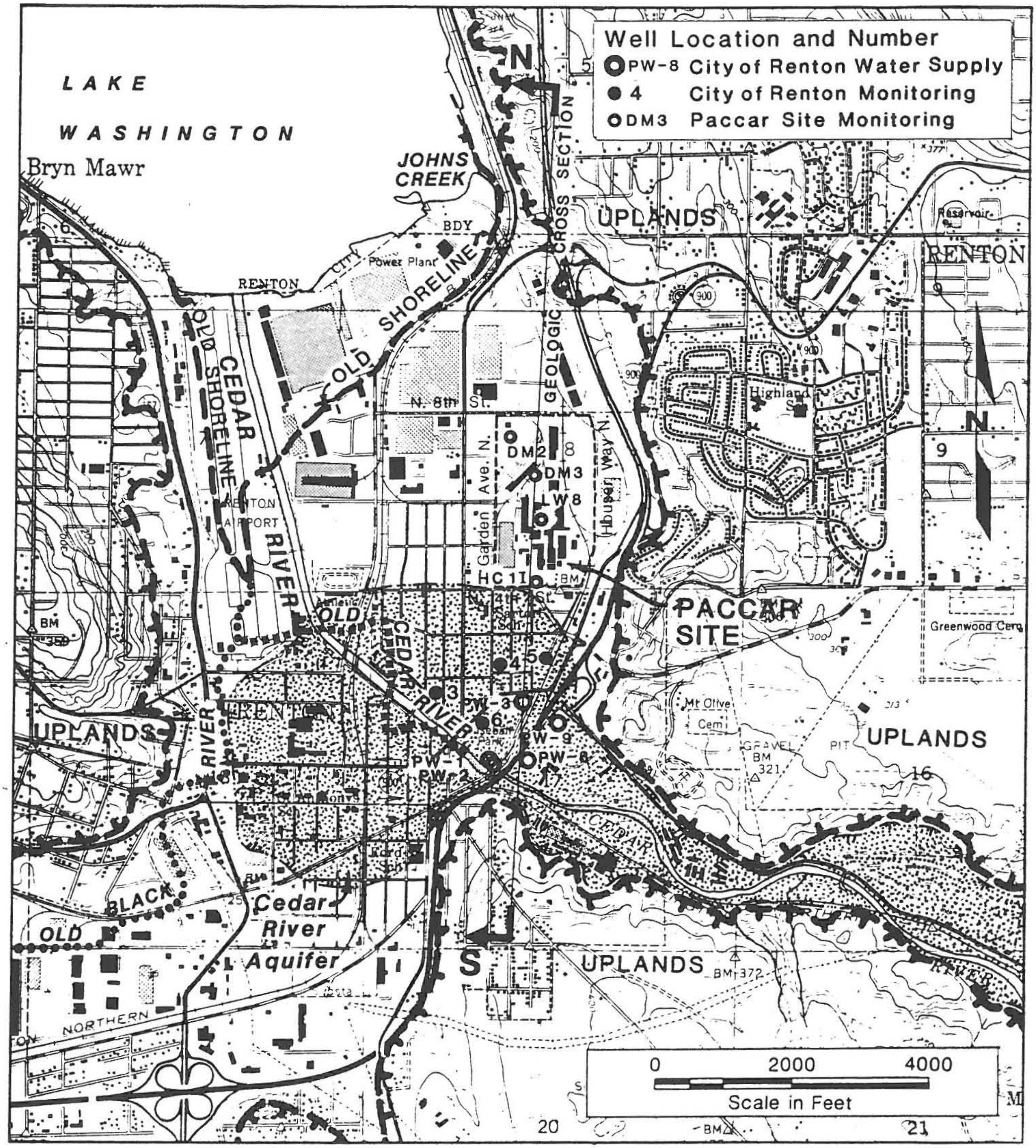
Figure 4.3

Regional Hydrogeologic Map Showing Extent of Cedar River Aquifer



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington Limits of Cedar River Aquifer and old shoreline and old river channels from CH2M Hill, 1988, Figure 2-5.

Valley Boundary

Old Shoreline Lake Washington

Old Cedar River Channel

Old Black River Channel

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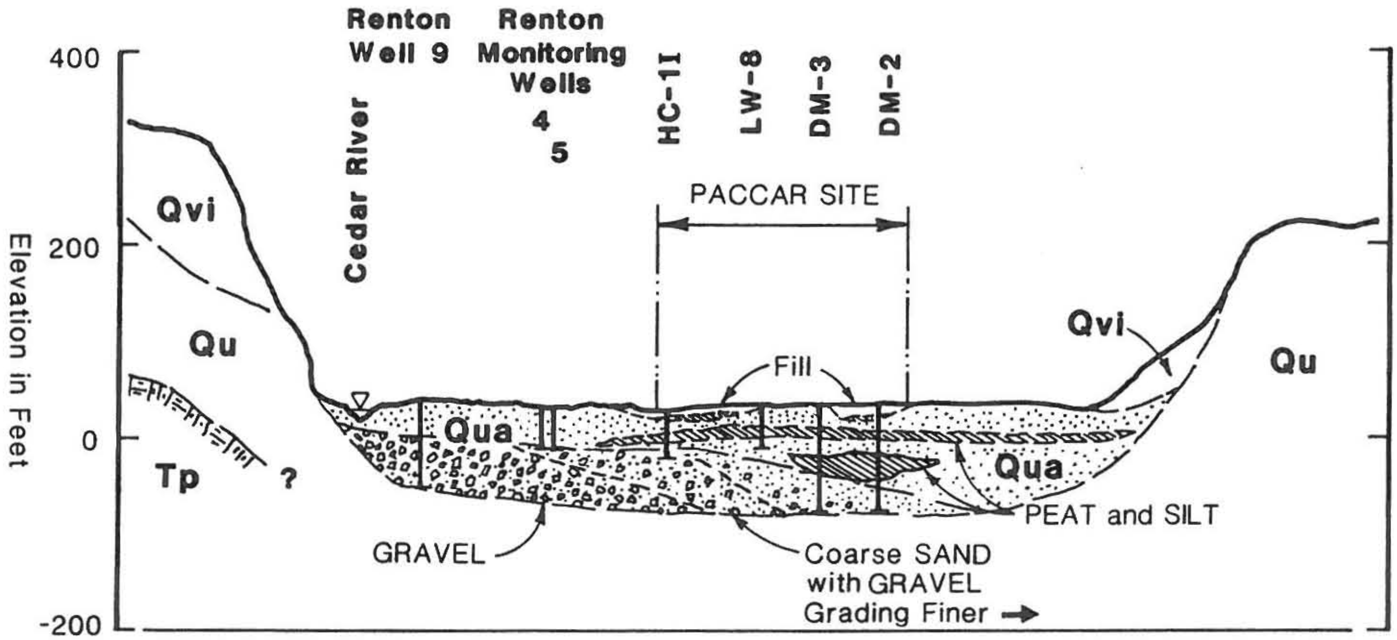
Figure 4.4

Vicinity Geologic Cross Section



Qua Undifferentiated Cedar River Alluvium

Qvi Vashion Ice-contact Deposits

Qu Undifferentiated Glacial Drift

Tp Bedrock

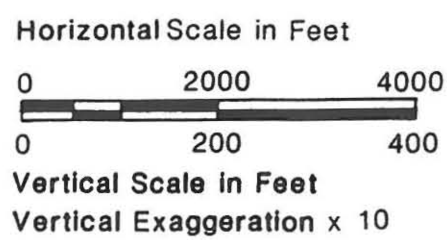


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Figure 4.5

Land Use Map

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington

M Manufacturing
P Parking
R Residential with Light Commercial
C Commercial
O Offices
W Warehouse
L Light

Note: Area north and east of Cedar River and north and west of I - 405 up to Johns Creek and bordered by Lake Washington was considered for land use percentage calculations.

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Figure 4.6

5.0 PROJECT AREA HYDROGEOLOGY

5.1 GEOLOGY AND SOILS

5.1.1 Geology

Figures 5.2 through 5.6 present our interpretation of the geologic conditions which exist beneath the PACCAR site. The trends of the geologic sections are shown on Figure 5.1. These sections were developed based on materials encountered in borings, test pit excavations, and monitoring wells contained in Appendices C and D.

For discussion and analysis purposes we have divided the geologic system beneath the project area into several units:

- UPPER AQUITARD - This unit is comprised of variable materials including fill, silt/clay, and peat layers. The fill materials are a silty, sandy gravel matrix with fragments of scrap metal, brick, coal, slag, ash, and wood over most of the site (Figures 5.4 through 5.6). The fill overlies a silty sand/sandy silt material about 5 to 10 feet thick, although this material may be absent beneath portions of the site. The fill materials are discussed further below.

- UPPER SAND - The Upper Sand unit underlies the Upper Aquitard unit and consists of fine to medium sand with some gravelly and/or silty zones. The top of the Upper Sand lies at depths of about 5 to 10 feet and the zone varies in thickness from 5 to 20 feet. The Upper Sand grades into the Delta Deposits (discussed below) south of the PACCAR site.

- MIDDLE AQUITARD - This unit lies beneath the Upper Sand beneath most of the PACCAR site. It consists of interbedded peat, clay, silt, and sand ranging in thickness between 5 and 30 feet. The top of the unit is 20 to 30 feet below ground surface. The middle aquitard disappears south and beneath the northeastern portion of the PACCAR site.

- LOWER SAND - The Lower Sand unit underlies the Middle Aquitard beneath most of the PACCAR site. It is comprised mostly of fine to medium and medium sand with occasional silty and gravelly zones. We interpret this zone to range in thickness from 60 to 70 feet the top of which lies at depths of 30 to 80 feet below ground surface. The Lower Sand lies immediately beneath the Upper Sand within the northeastern portion of the site, where the data indicate the Middle Aquitard thins and disappears. The Lower Sand materials grade coarser into the Delta Deposits to the south.

- DELTA DEPOSITS - Coarse-grained deposits of sand and gravel are present south of and beneath the southern portion of the PACCAR site. These materials were deposited as a deltaic fan and comprise the Cedar River Aquifer tapped by the Renton well field (see Sections 4.4 and 5.4). As shown on Geologic Section A-A' the Upper Sand, Middle Aquitard, and Lower Sand either disappear or grade into the Delta Deposits. These deposits are as much as 80 to 90 feet thick within the central portion of the well field area.

- LOWER AQUITARD - This unit underlies the Delta Deposits and Lower Sand. This unit is interpreted to be composed of glacial and interglacial deposits that formed the valley floor prior to deposition of the overlying deltaic fan and river (alluvial) deposits. Renton monitoring well MW-9 penetrated this unit to a depth of 400 feet (Hart Crowser, 1983). Drilling of this well encountered interbedded silty sand and sandy silt/clay deposits below about 80 feet (see Appendix D for well log).

5.1.2 Fill Materials

Fill materials had been placed on the site during various periods up to 1962. Since 1962 limited placement of clean granular fill has occurred for roadways and storage areas. Figure 5.7 presents our interpretation of the thickness of these materials beneath the PACCAR site. The greatest fill thicknesses are present beneath the eastern and northern areas of the site. In these areas generally 4 or more feet of fill are present. Relatively thick fills are present beneath other smaller areas of the site (Figure 5.7).

Figure 5.8 presents the general distribution of fill which contains obvious industrial materials (such as brick or metal scraps) and fill which did not contain industrial materials. The largest area of visibly clean fill materials is located within the northeastern portion of the site.

5.2 HYDROLOGY

Based on the site geologic data, six (6) major hydrogeologic zones have been identified beneath the site for discussion purposes:

- Upper Aquitard
- Upper Sand
- Middle Aquitard
- Lower Sand
- Delta Deposits, and
- Lower Aquitard

5.2.1 Depth to Groundwater

The local water table generally lies within the **Upper Aquitard** or **Upper Sand** zones beneath the site. The depth to the water table varies over the site and generally ranges between 2 and 8 feet below ground surface. Seasonal precipitation causes the water table to fluctuate about 2 to 7 feet throughout the year. The water table is higher in the mid-winter and early spring and lower in late summer and early fall.

5.2.2 Groundwater Flow Directions and Gradients

Upper Aquitard and Upper Sand

The groundwater elevation contour maps for the **Upper Aquitard** and **Upper Sand** zones are shown on Figure 5.9 using data collected in 1986. These contours are based on the linear interpolations of the water level elevations between wells for each representative zone. Similar groundwater contours resulted using data collected in 1988.

In the **Upper Aquitard** and **Upper Sand** zones, the general groundwater flow direction is in a westerly direction. The average estimated horizontal groundwater flow gradient of the **Upper Aquitard** zone is about 0.005 and **Upper Sand** zone ranges between approximately 0.002 and 0.025 to about 0.005 and 0.006. Some localized groundwater flow discharges into the drainage ditches, especially during higher water table conditions.

Lower Sand Zone

An extensive amount of water level data has been collected from wells which tap the **Lower Sand** unit. These data have been collected in a regional monitoring system which includes wells drilled on and off the PACCAR site by PACCAR and the City of Renton. The monitoring system within the **Lower Sand** zone now consists of over 55 PACCAR wells or piezometers and 27 City of Renton wells (Figure 5.1).

Natural flow directions in the area to the west and northwest are toward the Cedar River and Lake Washington (CH2M Hill, 1988a). However, the City of Renton operates a well field which alters the natural flow directions when the wells are pumping. Figure 5.10 shows the groundwater elevation contour map prepared for August 26, 1987. As shown on the map, pumpage from the Renton well field has altered the natural flow directions. Well field pumpage creates an extended capture area which extends out from the well field. A portion of the capture area extends northward toward and encompasses a portion of the southeast corner of the PACCAR site.

Six additional piezometers, OSP-8 through OSP-13, were installed during November/December 1988 to assist in refining the position of the divide beneath the eastern portions of the PACCAR site. These wells were surveyed and water level measurements in these wells were incorporated into groundwater flow maps prepared during and after December 1988.

The majority of the site is separated from the well field by a groundwater divide. Groundwater on the north side of the divide flows toward the Cedar River while groundwater flowing on the south side of the divide flows toward the well field. These two (2) areas are termed the Cedar River and Renton Well catchments, respectively, in the remaining sections of this report.

Additional flow maps have been prepared for other times which show the groundwater divide to be roughly located in the same area as that shown for the end of August 1987 (Figure 5.10).

Maps have been prepared for:

- May 5, 1987
- June 15, 1987
- June 24, 1987
- June 25, 1987
- June 26, 1987
- July 29, 1987
- August 26, 1987
- September 22, 1987
- October 20, 1987
- November 23, 1987
- December 21, 1987
- February 22, 1988
- April 27, 1988
- June 29, 1988
- September 30, 1988
- December 29, 1988
- March 27-28, 1989
- June 27-28, 1989

These maps are presented in Appendix E.

The groundwater flow maps indicate that the groundwater divide was relatively stable for the measurement period. (Figure 5.10 shows the area where the divide is present based on data collected from May 1987 to June 1989.) These measurements include ones made during very low precipitation conditions where the well field was being extensively pumped and the capture area would be larger as compared to wetter periods. For example, the August 26, 1987, map was prepared using data collected during the very dry summer of 1987 when precipitation was well below normal (Figure 4.1). The northern most portion of the divide area is defined by data collected on August 26, 1987.

The position of the divide was also assessed during an aquifer stress test conducted during June 24 to 26, 1987. During this period the well field was pumped at rates between 11,400 and 15,000 gpm (about two to three times the average monthly pumping rate). The groundwater divide during this pumping remained in approximately the same location as that shown on Figure 5.10.

The hydraulic gradient within each catchment area (for the **Lower Sand**) varies with position on the PACCAR site. Within the Cedar River catchment area the gradient ranged between 0.002 to 0.025 with a mean of about 0.010. The gradient within the Renton Well catchment was significantly ($P<0.01$) lower and ranged between 0.002 to 0.017, with a mean of about 0.006.

Figure 5.9 also presents the groundwater elevations for selected zones in an east to west direction across the site. The figure indicates the presence of vertical downward flow gradients across the underlying peat units between the more permeable water-bearing zones. The magnitude of the average vertical flow gradients changes from near zero in the eastern half of the site where the peat zones are largely absent to about 0.1 to 0.2 near the western boundary.

5.2.3 Hydraulic Conductivity and Average Flow Rate

Twenty (20) *in situ* hydraulic conductivity tests were performed as part of the field work. The procedures are outlined in Appendix A.

Table 5.1 presents the results of this testing using the hydrologic zones discussed in Section 5.1. The hydraulic conductivity ranged between 5×10^{-7} meters/second (m/sec) in LW-12S screened in interbedded silt and fine sand within the **Upper Sand** zone to 1×10^{-4} m/sec in MW-5 screen in medium to coarse sand with gravel within the **Delta Deposits** near the PACCAR site. The mean of all the values is about 2.8×10^{-5} m/sec. (about 8 feet per day). Hydraulic conductivity, along with hydraulic gradient and porosity data, can be used to estimate the approximate rate of groundwater movement. Using a hydraulic conductivity of 8 feet per day, a hydraulic gradient of 0.006 feet per feet and a porosity of 25 percent, we estimate a groundwater flow velocity of 0.2 feet per day or about 73 feet per year.

Table 5.1 - Summary of Hydraulic Conductivity Test Data

Unit	Well Number	Hydraulic Conductivity Feet/Second	Hydraulic Conductivity Meter/Second	Depth of Midpoint Screen from Top Casing in Feet	Description
Upper Aquitard	MW-1S	7.3×10^{-6}	2.2×10^{-6}	4	Fine sandy SILT w/Gravel
	LW-7S	5.0×10^{-6}	1.5×10^{-6}	7	GRAVEL
	MW-1I	6.1×10^{-5}	1.9×10^{-5}	22	SAND interbedded w/SILT
	Average	2.4×10^{-5}	7.6×10^{-6}	--	
Upper Sand	MW-3I	2.6×10^{-5}	7.9×10^{-6}	20	Gravelly SAND Well-Graded
	LW-2S	1.3×10^{-4}	3.9×10^{-5}	12	Silty, fine SAND
	LW-9S	7.4×10^{-6}	2.3×10^{-6}	14	SILT w/fine to medium SAND
	LW-10S	2.5×10^{-4}	7.6×10^{-5}	6	Fine SAND
	LW-12S	1.6×10^{-6}	4.9×10^{-7}	13	Interbedded SILT and fine SAND
	OSP-1S	3.1×10^{-4}	9.4×10^{-5}	19	Very sandy GRAVEL
	OSP-7D	8.7×10^{-6}	2.6×10^{-6}	32	Fine SAND
	OW-5S	2.4×10^{-6}	7.3×10^{-7}	15	Fine SAND
	MW-10	4.6×10^{-5}	1.4×10^{-5}	27	Interbedded SILT, SAND, and GRAVEL
	Average	9.0×10^{-5}	2.7×10^{-5}	--	
Middle Aquitard	LW-1D	4.3×10^{-7}	1.3×10^{-7}	32	SILT and PEAT
	LW-9D	2.9×10^{-5}	8.8×10^{-6}	34	PEAT and SILT w/fine SAND
	Average	1.5×10^{-5}	4.6×10^{-6}	--	
Lower Sand	OSP-1D	1.8×10^{-4}	5.5×10^{-5}	47	Fine SAND
	OSP-2D	2.1×10^{-4}	6.4×10^{-5}	39	Silty, fine to medium SAND
	OW-4D	2.0×10^{-4}	6.1×10^{-5}	41	Slightly gravelly, fine SAND
	Average	2.0×10^{-4}	6.1×10^{-5}	--	
Delta Deposits (near PACCAR site)	MW-5	3.4×10^{-4}	1.0×10^{-4}	39	Medium to coarse SAND w/ Gravel
	MW-6	2.6×10^{-4}	7.9×10^{-5}	40	Coarse SAND w/Gravel
	OSP-3D	1.1×10^{-5}	3.4×10^{-6}	42	Fine SAND w/interbedded fine to medium SAND
	Average	2.0×10^{-4}	9.1×10^{-5}	--	
Delta Deposits (middle well field RW-1, RW-2, RW-3)*	**Average**	2.6×10^{-2}	7.9×10^{-3}	60 to 70	Sandy to very sandy, cobbly GRAVEL

* Source: Hart Crowser, 1987b

These values compare with a hydraulic conductivity of 7.9×10^{-3} m/sec estimated using data collected during pumping tests of replacement wells RW-1, RW-2, and RW-3 (Hart Crowser, 1987a). These wells are screened within the central portion of the Cedar River Aquifer. The higher hydraulic conductivity estimate (as compared to these values estimated at sites closer to the PACCAR site) within the central well field area is consistent with our geologic model. We expect the hydraulic conductivity to generally decrease toward the PACCAR site because the materials become finer-grained.

5.2.4 Aquifer Width and Thickness

The width of the aquifer within each catchment area varies as the groundwater divide shifts as shown on Figure 5.10. Within the Cedar River catchment the aquifer width varied between 1,100 feet (335 meters) and 3,000 feet (914 meters), with a weighted average of about 2,300 feet (691 meters). This width was estimated by measuring the distance between the north boundary of the divide and the north boundary of the PACCAR site roughly perpendicular to the groundwater flow direction.

The aquifer width within the Renton Well catchment area is smaller. It varied between 250 feet (76 meters) and 2,300 feet (701 meters) with a weighted average of 980 feet (299 meters). This width was estimated by measuring the distance south of the divide and the projection of the flow path downgradient of the southeast corner of the PACCAR site, roughly perpendicular to the groundwater flow direction.

Aquifer thickness was estimated using the geologic cross sections and boring logs which have been drilled on and adjacent to the PACCAR site. An aquifer thickness of 65 feet (20 meters) to 160 feet (50 meters) is estimated.

5.3 RECHARGE AND DISCHARGE

5.3.1 Regional Groundwater Recharge and Discharge

Regional groundwater flow is largely influenced by the Cedar River. The river acts as the major discharge point for groundwater flow from the uplands as well as within the valley.

Regionally, the flow system is characterized by recharge in the upland areas and discharge to the valley. Recharge within the valley occurs from infiltration of incident precipitation.

The PACCAR site lies within an area where precipitation is sufficient to recharge the groundwater system depending on land surface characteristics. Surface slopes and the hydraulic conductivity of surface materials also affect the amount of precipitation which infiltrates into site soils.

The amount of precipitation available to recharge the groundwater system beneath the site is estimated to be about 10 inches per year or 25 percent of the average annual precipitation rate of 39 inches per year. This estimate is based on the following:

- o The area receives about 39 inches of precipitation per year as measured at the Seattle-Tacoma Airport (NOAA, 1987).

- o Runoff is estimated to be about 30 percent based on runoff estimates for developed areas (Farris et al., 1979) which are 50 percent paved (see below).

- o Evapotranspiration rate of 45 percent. This rate is based on work completed by Washington State University (WSU, 1968).

Approximately 50 percent of the PACCAR site is currently covered with building slabs and foundations, asphalt, or concrete (Figure 5.11). If the new plant is constructed, at least 50 percent of the site will remain covered with building roofs and slabs, asphalt, or concrete. Substantial groundwater recharge is not expected in these areas.

The northwest and eastern portions of the site are unpaved and some infiltration occurs. However, the northern portion of the site is drained by several ditches (see Section 4.3) which collect and divert water to Johns Creek. Some of the water that infiltrates the near-surface soils likely is diverted into surface water channels, especially within the northwestern portion of the site. This is based on:

- o The near-surface soil materials are relatively fine-grained (see Section 5.1 and Figures 5.4 through 5.6), and

- o Evaluation of groundwater flow directions within the **Upper Aquitard** and **Upper Sand** indicate that the ditches divert near-surface groundwater.

5.4 WATER SUPPLIES

5.4.1 Sources

Groundwater is the primary source of municipal water supply in the area. The City of Renton obtains most of its water from relatively shallow wells (less than 100 feet deep) located within the coarse delta fan deposits that occur at the mouth of the Cedar River (see Section 5.1). These deposits make up what has been termed the "Cedar River Aquifer" (CH2M Hill, 1988a) the approximate extent of which is shown on Figure 4.4. There are no other water supply wells of record within half a mile of the site (HNTB, 1984) or known private wells in north Renton.

Renton currently operates five (5) production wells that tap the aquifer (Figure 5.1). These wells have a combined permitted water right of 11,400 gallons per minute (CH2M Hill, 1988a). Combined average pumping rates are less than the maximum permitted water right (Table 5.2).

Actual average pumping rates range between approximately 4,000 and 8,000 gallons per minute. Higher pumping averages result during the drier portions of the year while lower volumes are pumped during wetter portions of the year. Peaking pumping rates also vary and may be higher than the averages listed in Table 5.2. For example, on August 8, 1986 a combined pumping rate of 10,375 gpm was reported (CH2M Hill, 1988a - Table 3.1).

Somewhat higher averages (for the wetter portion of the year) were pumped during early 1988. Pumping rates of 5,500 and 8,800 gpm were recorded during the period February to May 1988 as compared to about 4,000 gpm for the preceding three months. These higher pumping averages were caused by pumping of production well PW-3 to limit migration of contaminants introduced into the aquifer from pipe leakage beneath a nearby service station. Water from PW-3 was pumped into the Cedar River.

Table 5.2 - Average Pumping Rates; Renton Well Field May 1987 to July 1989

Month	Total Gallons Pumped x 1,000	Approximate Average Rate in Gallons per Minute
1987		
May	239,750	5,600
June	304,100	7,000
July	312,350	7,200
August	307,400	7,100
September	246,350	5,700
October	205,100	4,800
November	173,750	4,000
December	172,100	4,000
1988		
January	180,350	4,200
February	238,100	5,500
March	236,450	5,500
April	378,350	8,800
May	272,750	6,300
June	281,000	6,500
July	341,299	7,900
August	313,971	7,000
September	242,216	5,600
October	193,952	4,400
November	181,645	4,200
December	185,262	4,200
1989		
January	176,458	4,000
February	171,370	4,300
March	189,777	4,300
April	189,824	4,400
May	228,913	5,100
June	251,626	5,800
July	272,553	6,100

Note: From February to May of 1988, PW-3 was pumping groundwater into the Cedar River

The closest well to the PACCAR site is PW-3 located about 1,600 to 1,700 feet south of the south property line. The remaining four (4) wells are located at greater distances between 2,100 and 2,600 feet south of the site. Renton also obtains water from other sources including wells drilled on the uplands and Maplewood Golf Course and Springbrook Spring.

Renton recently implemented a well replacement program which included the drilling of replacement wells for wells PW-1, PW-2, and PW-3 (Hart Crowser, 1987a). These wells are designated as RW-1, RW-2, and RW-3, respectively. Wells PW-1 and PW-2 have been abandoned while well PW-3 has been placed in reserve as an emergency water supply source. Reserve well PW-3 is now designated as PW-3A by the City of Renton.

5.4.2 Groundwater Quality

Sampling and analysis of groundwater samples obtained from the Renton production wells which tap the Cedar River Aquifer indicate that this groundwater meets existing and proposed drinking water standards (CH2M Hill, 1988a). Water quality analyses have been conducted for a variety of constituents including priority pollutant volatile and semivolatile compounds and metals by Renton and PACCAR (HNTB, 1984; CH2M Hill, 1988a).

However, in late 1987 several volatile organic chemicals were detected in production well PW-3. These chemicals included benzene, toluene, ethylbenzene, and xylenes which are major components of gasoline. The source of these chemicals was traced to leaking piping from an underground fuel tank beneath a nearby service station. Renton is working with the owner to implement a remedial action plan to prevent further contamination of the underlying aquifer and to remediate existing contamination.

5.4.3 Aquifer Protection Program

Renton conducted a well field protection study to define the boundaries of an Aquifer Protection Area (APA) which is being incorporated into a city ordinance. The results of the study are documented in a report prepared by CH2M Hill (1988a). The information used to define the APA includes data collected by PACCAR, which is documented in this report and a report prepared by Hart Crowser (1987b).

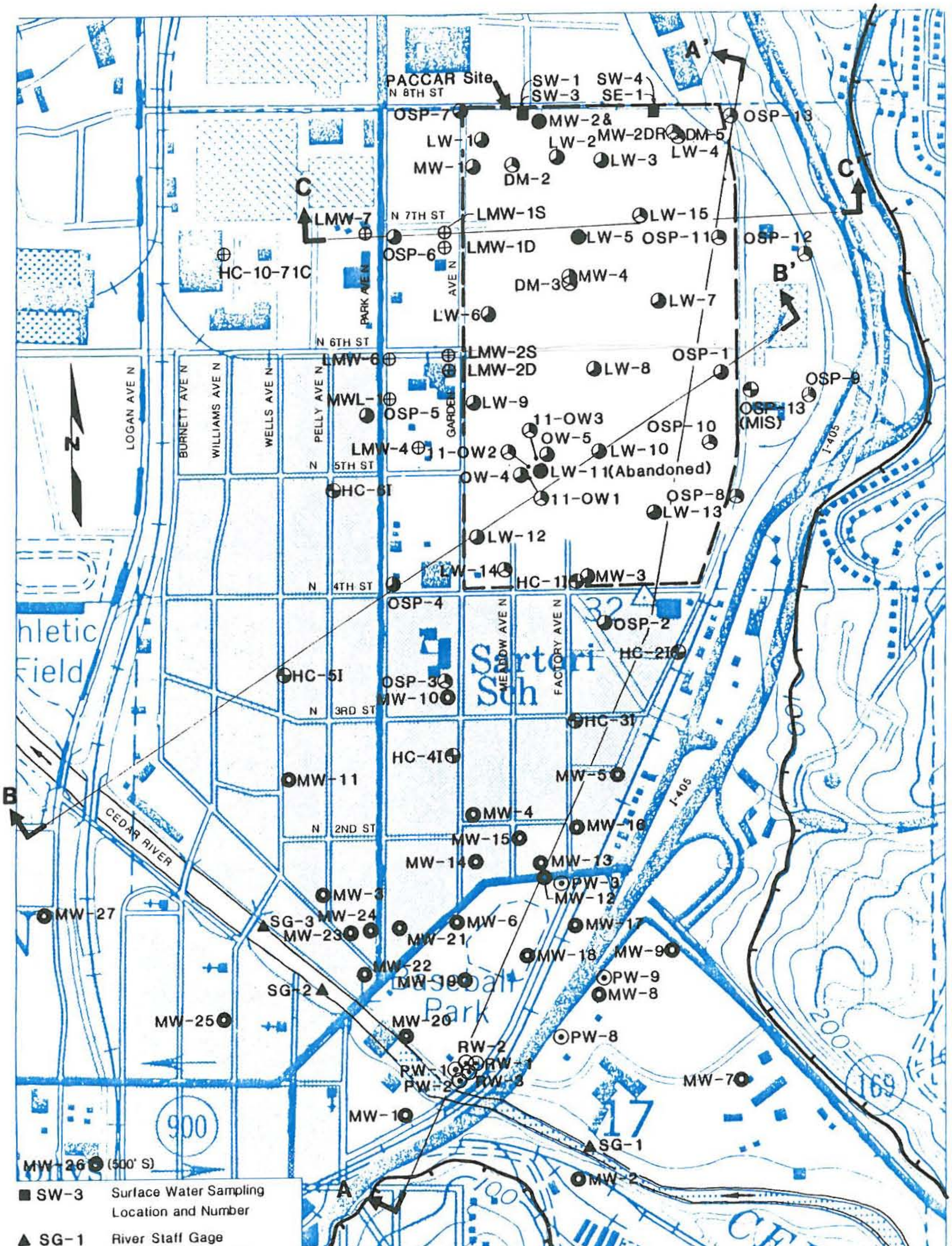
- o The APA consists of two (2) zones: Zone 1 and Zone 2 (Figure 5.12). Certain land use activities are restricted within each zone with the intent of minimizing the possibility of aquifer contamination within the "capture area" of the well field.

- o Zone 1 is defined as the area where the travel time of aquifer water to the well field is less than one (1) year. Changes in land use or construction of new facilities that could lead to degradation of groundwater quality <u>shall</u> be prohibited in this zone. Such activities or facilities which will be excluded include surface impoundments, waste piles, landfills, and hazardous waste treatment and storage facility operations.

- o Zone 2 is defined as the area outside Zone 1 but which still lies within the capture or recharge area of the well field. Changes in land use or construction of new facilities which could lead to degradation of groundwater within the aquifer <u>may</u> be prohibited. Decisions will be made on a case-by-case basis.

None of the PACCAR site falls within Zone 1. However, a portion of the southeast corner of the site falls within Zone 2.

Well Location Map Showing Cross Section Trends



Note: Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

Exploration Location and Number

DM-1 Single Well PACCAR

LW-1 Dual Well Nest PACCAR

MW-1 Triple Well Nest PACCAR

LMW-7 Monitoring Well by Others (Landau 1989)

PW-1 City of Renton Production Well

MW-2 City of Renton Monitoring Well

HC-1I Hart Crowser Piezometer

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Figure 5.1

Geologic Section A-A' and B-B'

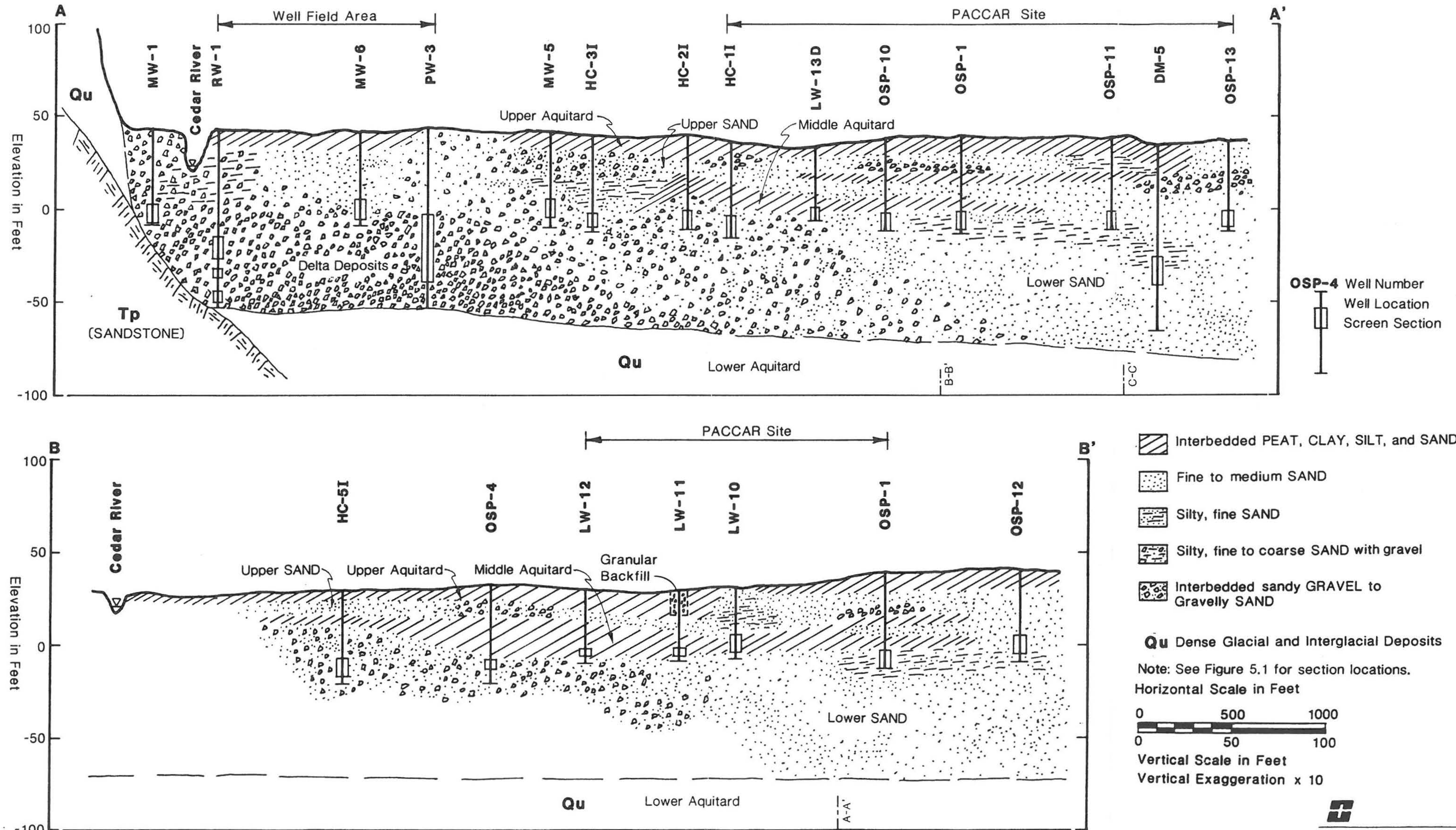

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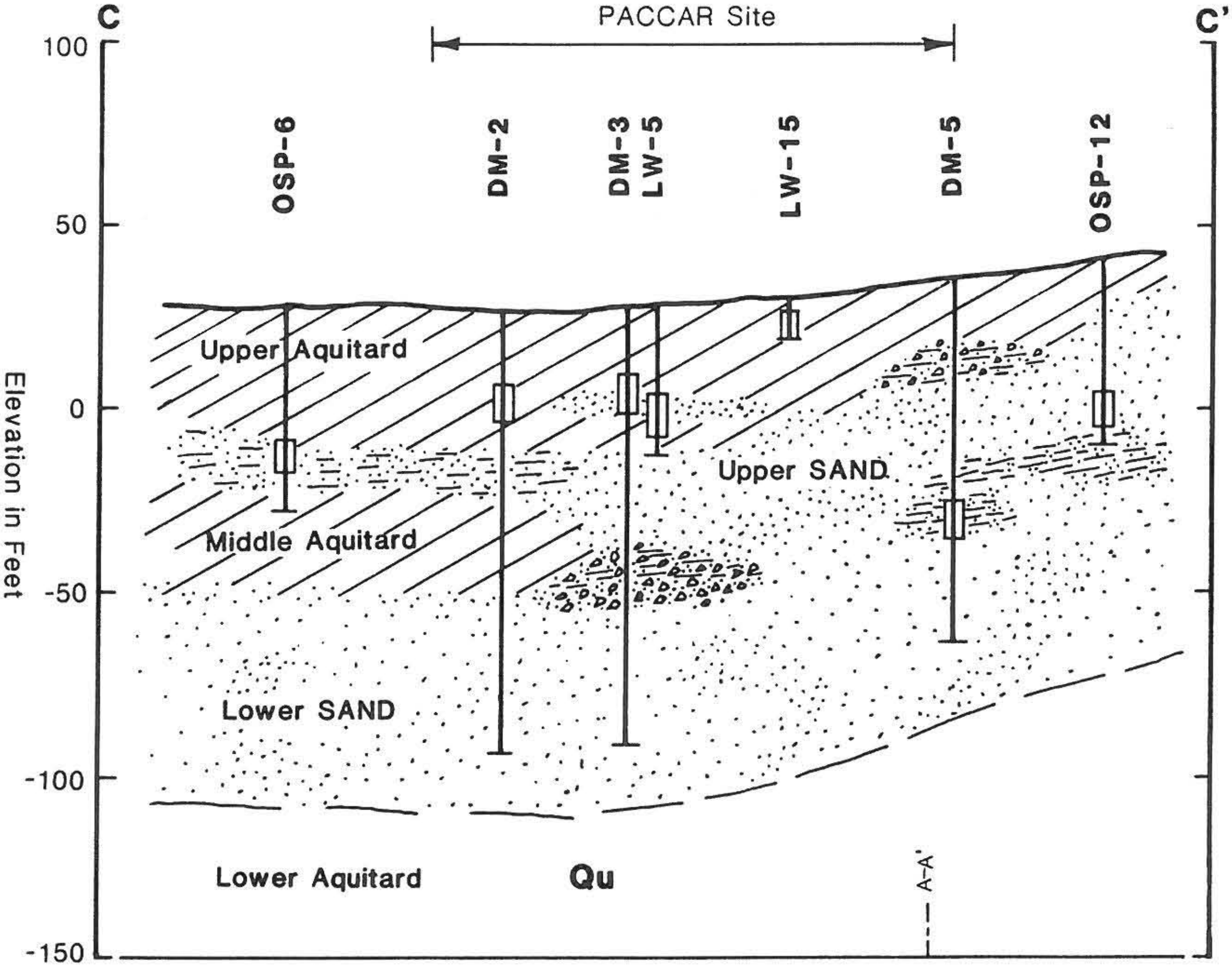
Figure 5.2

Geologic Section C-C'



Interbedded PEAT, CLAY, SILT, and SAND

Fine to medium SAND

Silty, fine SAND

Silty, fine to coarse SAND with gravel

Interbedded sandy GRAVEL to Gravelly SAND

Qu Dense Glacial and Interglacial Deposits

OSP-6 Well Number

Well Location

Screen Section

Note: See Figure 5.1 for section location.

Horizontal Scale in Feet

0 500 1000

0 50 100

Vertical Scale in Feet

Vertical Exaggeration x 10

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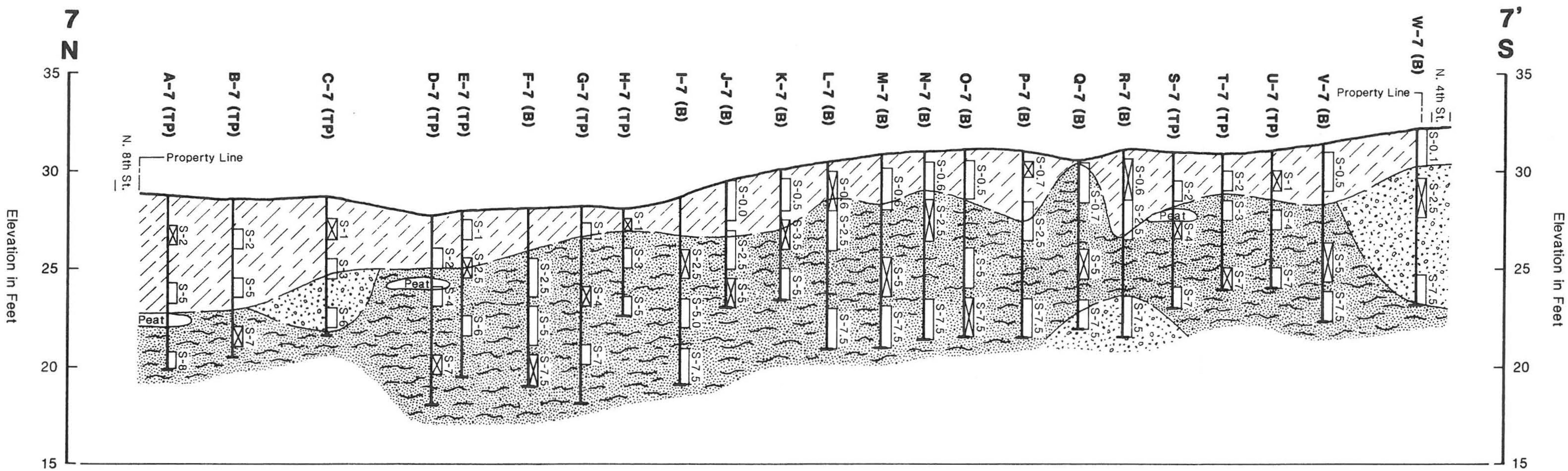
Figure 5.3

Generalized Subsurface Cross Section 7-7'



S-1 Sample Location and Number

S-2 Sample Submitted for Chemical Analysis

FILL Silty, sandy GRAVEL matrix with fragments of scrap metal, bricks, coal, slag, ash, and wood.

Silty SAND/Sandy SILT

Gravelly SAND/Sandy GRAVEL

Note: See Figure 1.4 for section location.

Vertical Exaggeration x 40

Horizontal Scale in Feet

0 200 400

0 5 10

Vertical Scale in Feet

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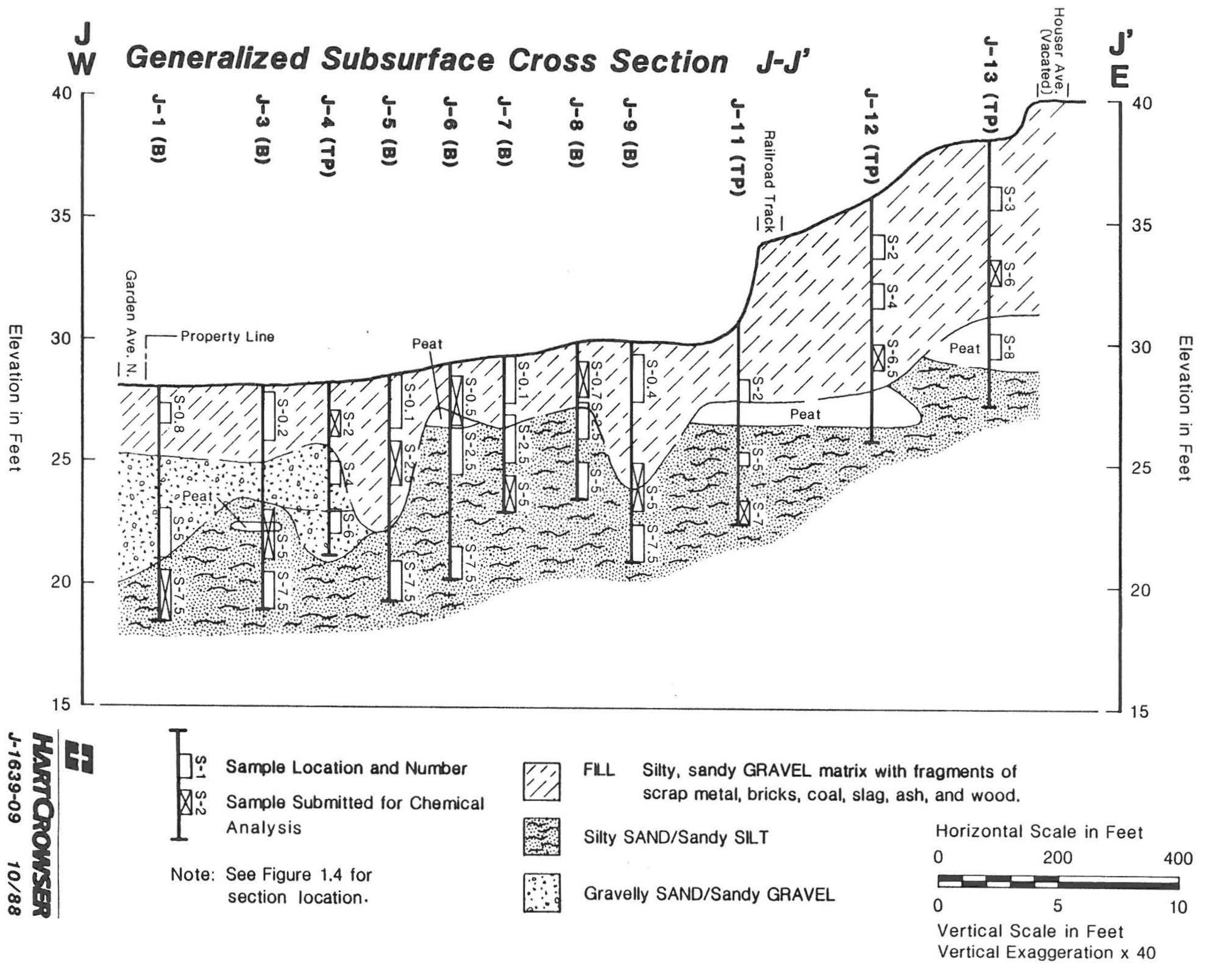
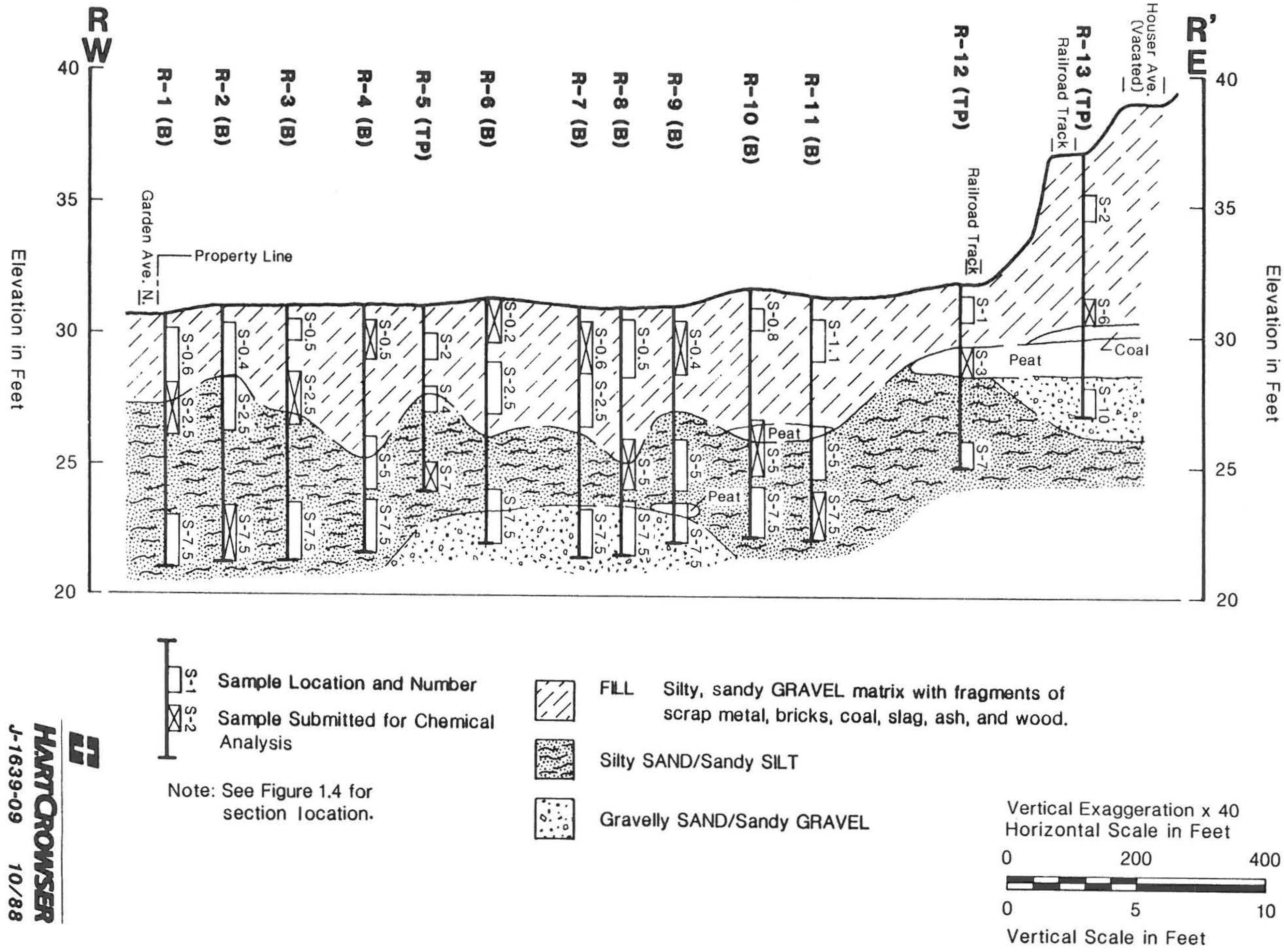
Figure 5.4



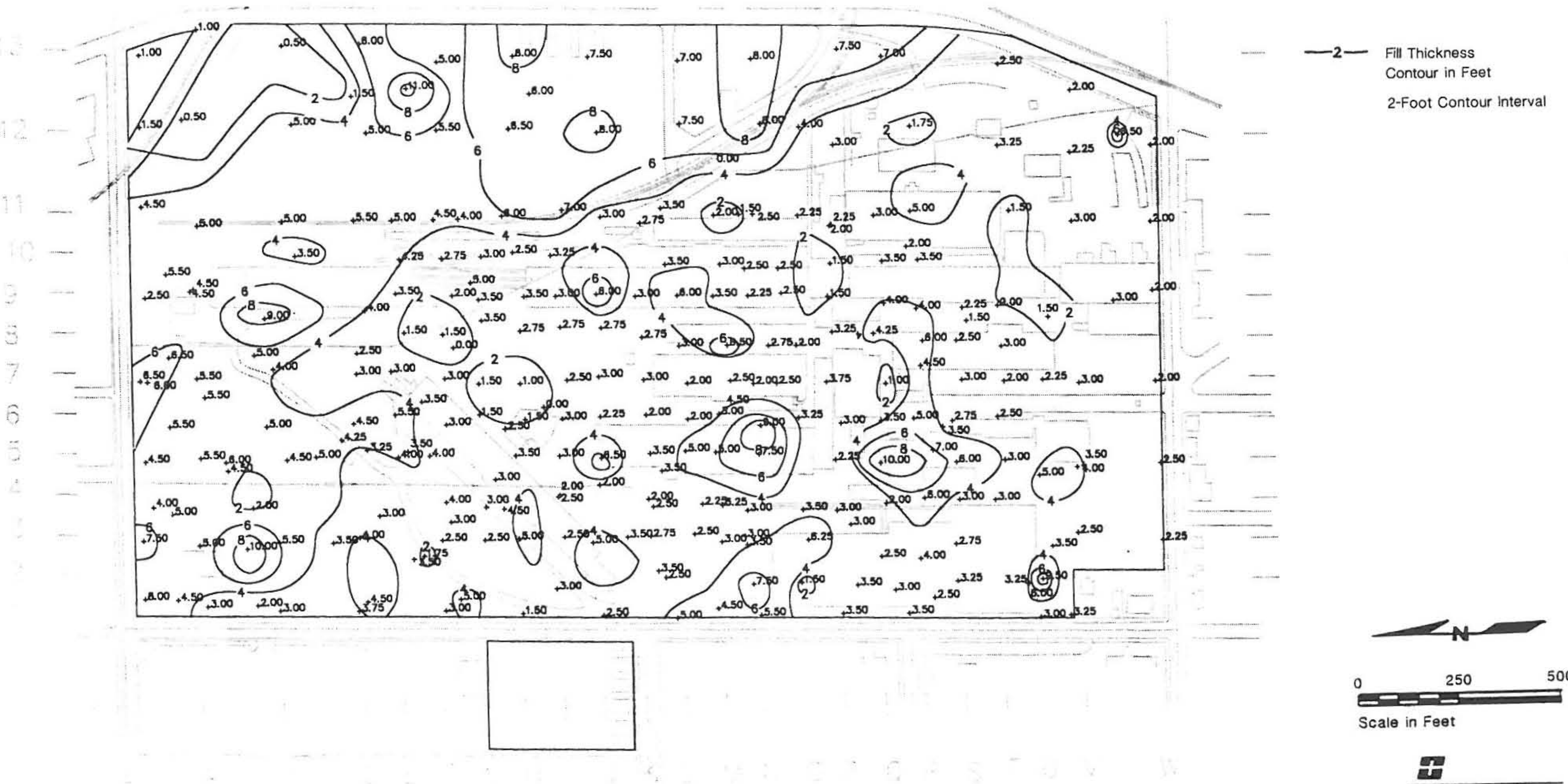
HARTCROWSER
J-1639-09 10/88
Figure 5.5

Generalized Subsurface Cross Section R-R'



HARTCROWSER
J-1639-09 10/88
Figure 5.6

Fill Thickness Map



HARTCROWSER
J-1639-09 1/89
Figure 5.7

Fill Type Map

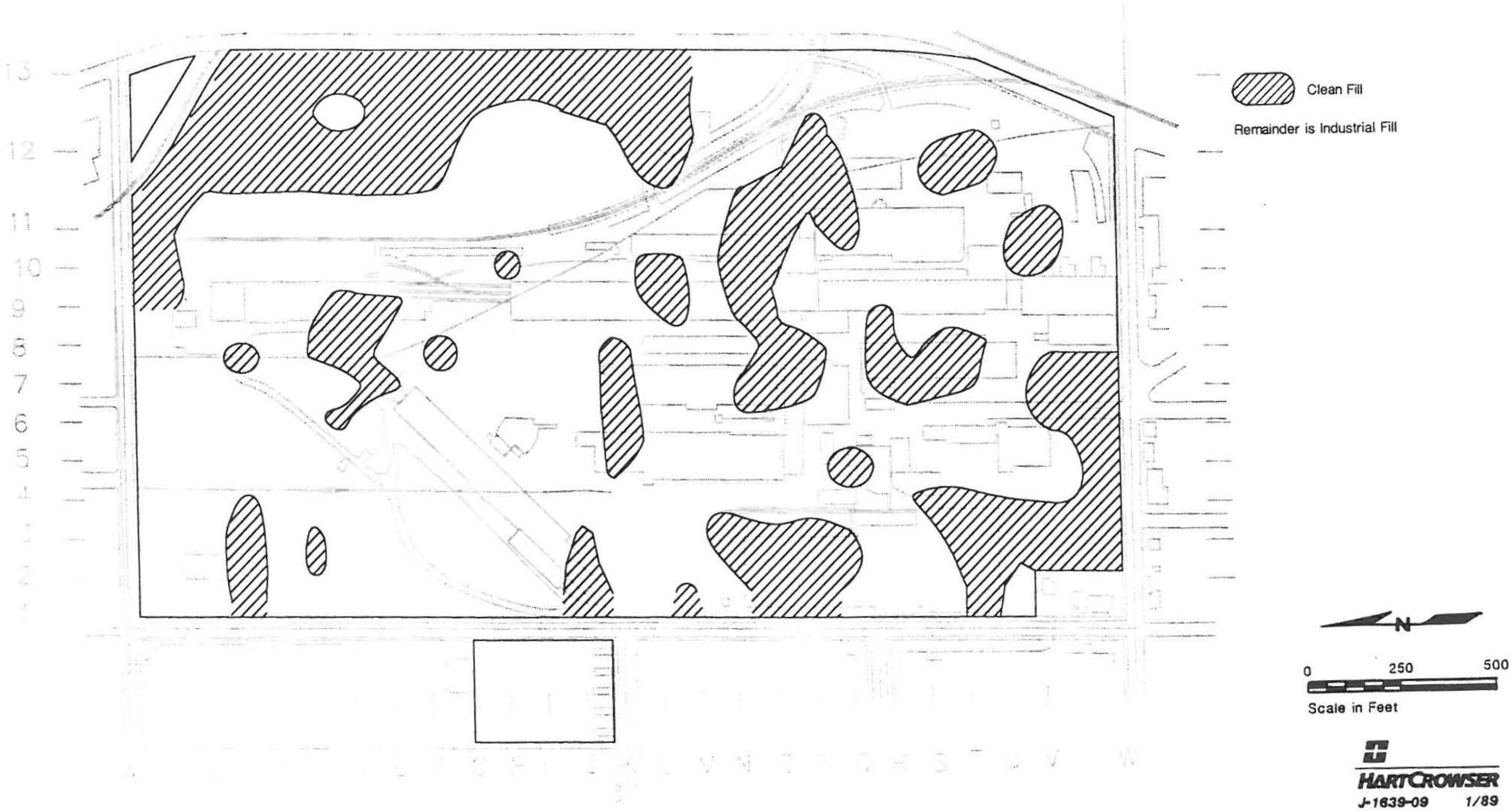
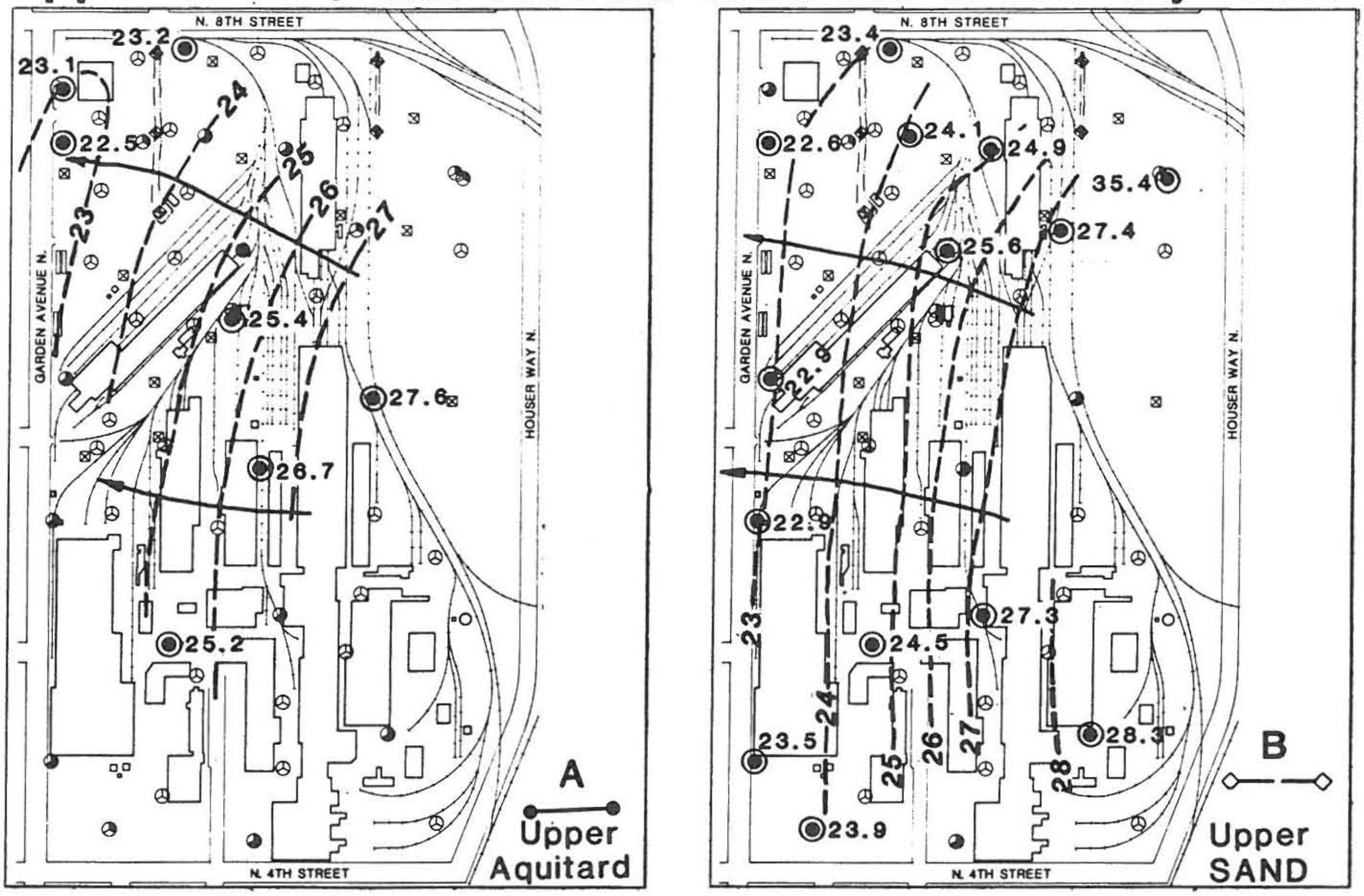
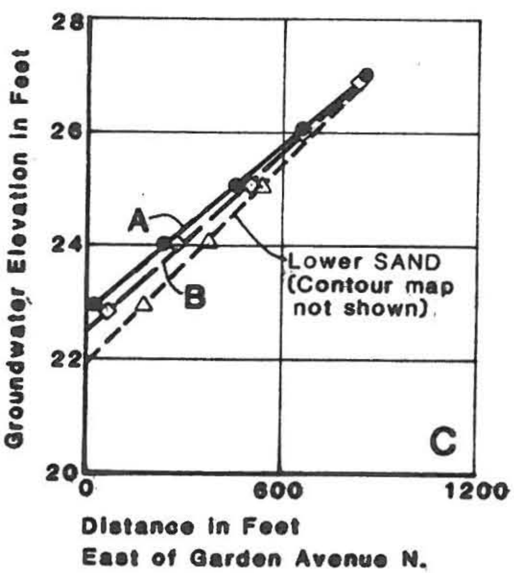


Figure 5.8

Groundwater Flow Direction Map (Upper Aquitard and Upper SAND) and Vertical Gradient Trend July 1986.





Vertical Gradient Trend

◎ 25.3 Spot Elevation in Feet

— 23 — Elevation Contour in Feet

⟵ Groundwater Flow Direction

Source: Hart Crowser (1986)

0 600
Scale in Feet

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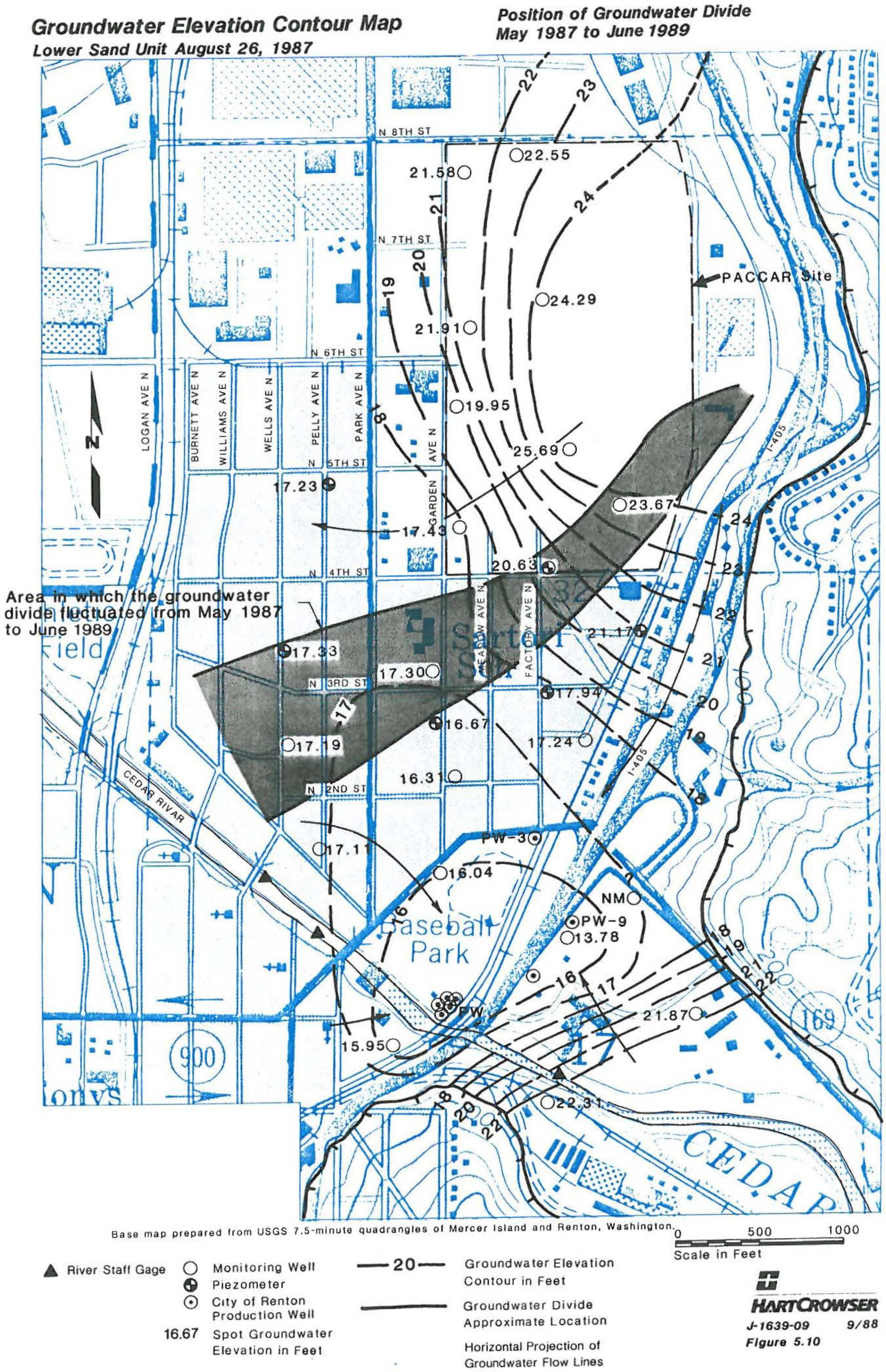
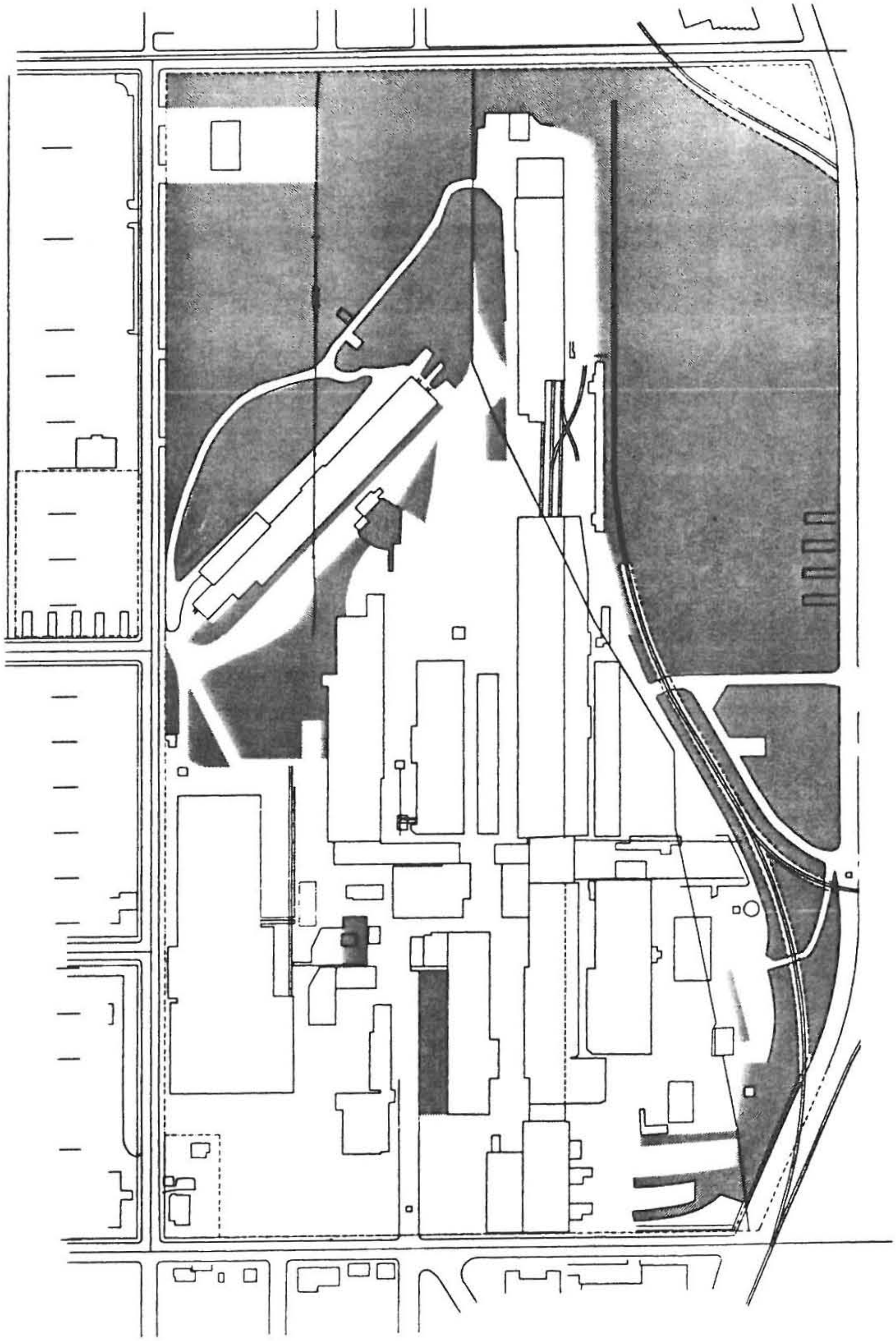
Figure 5.9



Groundwater Elevation Contour Map
Lower Sand Unit August 26, 1987
Position of Groundwater Divide
May 1987 to June 1989
N 8TH ST
N 7TH ST
N 6TH ST
N 5TH ST
N 4TH ST
N 3RD ST
N 2ND ST
LOGAN AVE N
BURNETT AVE N
WILLIAMS AVE N
WELLS AVE N
PELLY AVE N
PARK AVE N
GARDEN AVE N
MEADOW AVE N
FACTORY AVE N
PACCAR Site
I-405
CEDAR RIVAR
Area in which the groundwater divide fluctuated from May 1987 to June 1989
Baseball Park
22.55
21.58
24.29
21.91
19.95
25.69
23.67
17.23
17.43
20.63
21.17
17.33
17.30
17.94
16.67
17.24
17.19
16.31
17.11
16.04
PW-3
NM
PW-9
13.78
PW
21.87
15.95
22.31
Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.
0
500
1000
Scale in Feet
River Staff Gage
Monitoring Well
Piezometer
City of Renton Production Well
16.67 Spot Groundwater Elevation in Feet
20
Groundwater Elevation Contour in Feet
Groundwater Divide Approximate Location
Horizontal Projection of Groundwater Flow Lines
HARTCROWSER
J-1639-09
9/88
Figure 5.10

Covered and Uncovered Portions of PACCAR Site



Unpaved Areas

Percent unpaved approximately 50%

HARTCROWSER
J-1639-09 12/88
Figure 5.11

Aquifer Protection Area (APA) Map

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington

Actual APA Boundary

Legal APA Boundary

Zone 1

Zone 2

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J-1639-09 12/88

Figure 5.12

6.0 NATURE AND EXTENT OF CONTAMINATION

6.1 SOURCES

6.1.1 Fill Materials

As discussed in Sections 1.2 and 5.1, up to 10 to 11 feet of fill materials have been placed on the site. The greatest thicknesses of fill are present within the northern and eastern portions of the site (Figure 5.7).

Much of the fill contains industrial materials such as foundry sand, wood, metal, brick, and slag. These materials contain potential sources of contaminants, especially heavy metals. Assessment of the presence, distribution, and concentrations of metals in soils beneath the site was a major objective of the project, which is discussed further in Section 6.2.

However, portions of fill are visually different and do not contain these industrial materials (Figure 5.8). The fill located within the northeastern portion of the site may have been derived from excavation during construction of nearby Interstate 405 (HNTB, 1984).

6.1.2 Underground Tanks

Underground tanks have been used to store a variety of materials used in plant operations. These materials include fuels (gasoline and diesel), waste oil, waste hydraulic oil, lacquer thinner, and cellosolve (a solvent used to clean hoses and guns used to apply polyurethane foam insulation). Cellosolve is composed of 2-Ethoxyethanol.

All of the underground tanks were removed during the period 1985 to 1988. The former tank locations are shown on Figure 1.2. A summary of selected tank data is presented in Table 6.1.

Table 6.1 - Summary of Underground Tanks

Location*	Contents	No. of Tanks	Size in Gallons	Year Installed	Year Removed
B1	Diesel	1	1,000	1973	1987
B2	Diesel	2	12,000	1973	1986 and 1987
B3	Gasoline	1	3,000	1951	1987
B4	Gasoline	1	3,000	1951	1987
B5	Waste Hydraulic Oil	1	575	1970	1988
B6	Diesel	1	5,000	1979	1986
B7	Lacquer Thinner	1	5,000	1972	1986
B8	Cellosolve	1	5,000	1972	1986
B9	Waste Oil	1	900	1979	1986
B10	Diesel	8	8,000	1942	1985
B11	Diesel	1	4,000	1958	1985

* Locations shown on Figure 1.2.

6.1.3 Above-ground Tanks and Fuel Distribution Lines

Above-ground tanks were used to store fuels, materials used in plant processes, and some waste oil. Diesel, cellosolve, foaming agents, and waste/skimmer oil were stored in above-ground tanks. Above-ground tanks were also used to store carbon dioxide, Freon, propane, and oxygen.

The location of those tanks which contained fluids which may have leaked and contaminated soil or groundwater are shown on Figure 1.2. A summary of selected tank data is presented in Table 6.2.

Table 6.2 - Summary of Above-ground Tanks*

Location**	Contents	No. of Tanks	Size in Gallons	Year Removed
A1	Diesel	1	180	1989
A2	Cellosolve	1	350	1986
A3	Foaming Agent	8	250 to 300	1986
A4	Foaming Agent	2	300	1986
A5	Waste Oil	1	1,000	1988
A6	Waste Oil	1	50	1988
A7	Waste Oil	1	500	1989
A8	Skimmer Oil	1	500	1989
A9	Diesel	3	10,000	1972
A10	Diesel	1	5,000	1979

* - Other above-ground tanks containing carbon dioxide, Freon, oxygen, and propane have been used on the site. These tanks have either been removed or emptied of their contents except for a 2,500-gallon propane tank which will be removed in 1990.
  - Tanks located at A9 were replaced by underground tanks B-2 while the tank located at A10 was replaced by underground tank B-6 (see Table 6.1).

** Locations shown on Figure 1.2.

The major storage area for fuels in above-ground tanks was located in Area A-9 east of the former foundry and immediately north of former Building No. 2 (Figure 1.2). From the 1920s to 1972 diesel was stored in several above-ground tanks. The above-ground tanks were removed in 1972 and underground tanks were installed. The age of the storage area and soil data indicate that spills occurred in this area.

Prior to 1955, plant operations used diesel to fuel facility operations. Buried lines were used to distribute diesel to various buildings generally located within the southern portion of the site. In 1955, the plant was converted to natural gas. The buried diesel lines still exist, and leakage from the lines has likely occurred in the past.

6.1.4 Transformers

Transformers and other electrical equipment containing PCB oils have been used on the site. Pertinent data are summarized in Table 6.3.

Table 6.3 - Summary of Oil Filled Electrical Equipment

Item	Location	No. of Items	Volume in Gallons
TB-1*(**)	West side, Bldg. 9	8	458
TB-3*(**)	Roof, Bldg. 15	5	372
TB-4*(**)	Roof, No. of Bldg. 8	4	239
TB-5*(**)	East side, Bldg. 3	3	150
TB-6*	Roof, Bldg. 5	1	400
TB-7* (**)	Roof, Bldg. 6	1	265
TB-9*(**)	East side, Bldg. 3	5	687
TB-10*(**)	Northwest corner, Bldg. 4	4	200
TB-12*(**)	Roof, Bldg. 2	3	117
TB-13*(**)	Gun Range	1	20
TB-14*(**)	Vault, Inside Bldg. 32	3	225
TB-15*(**)	Pole P4	4	198
TB-17*(**)	Roof, Bldg. 9	3	219
TB-18*(**)	Roof, Bldg. 26	3	207
TB-19*(**)	West, Roof, Bldg. 12	3	228
TB-20*(**)	North, Roof, Bldg. 10	3	225
TB-22*(**)	Platform, N-S Craneway	3	90
TB-27(**)	Roof, Bldg. 17	2	530
TB-28(**)	East side, Bldg. 17	2	737
TB-29*(**)	OPT Vault, Bldg. 17	1	1,730
TB-30*	CQT Vault, Bldg. 17	1	1,720
TB-33*(**)	Pole P26	3	30
TB-36	Bldg. 17, North End	1	210
10,000 KVA	Main Substation	3	3,306
5,000 KVA*(**)	Main Substation	3	2,580
7,500 KVA	Main Substation	1	1,390
Oil C/B's(***)	Main Substation	3	1,200
Oil C/B's(**)	Main Substation	3	36
Spare Transformers*(**)	Bldg. 33	8	597
Oil Switch(**)	Pole P22	1	5
Outside Perimeter Light Loop*(**)		8	164
Capacitors:*(**)	Main Substation	6	27
	TB-27, Roof, Bldg. 17	6	11
	TB-2, Roof, Bldg. 12	6	11
	TB-4, Roof, Bldg. 8	6	8
	TB-9, East side, Bldg. 3	9	12
	Bldg. 17, LPM Room	35	67
	Bldg. 8, Induction Heater (IH)	4	2
	Bldg. 3, Heat Treat	8	16

* Removed from plant (as of July 1989)
(**) Location where one or more vessels contained PCBs at some time during site operations.
(***) Previous unit, now replaced, contained PCBs.

Starting in 1979 PACCAR implemented a program to reduce the amount and concentrations of oil containing PCBs. As shown in Table 6.3 most of the electrical facilities have been removed from the site. As of July 1989 all of the electrical equipment on the site which contain PCBs were below 50 ppm.

6.1.5 Other Possible Sources

Painting operations were conducted as part of the manufacturing operations on the site. Painting occurred at various locations on the plant including in former buildings No. 7, 11, 15, and 30 (Figure 1.2). Paint residues and solvents may have been deposited along with other fill materials and some spillage or overspraying may have occurred.

Galvanizing operations occurred during the 1950s; in former building No. 11. Spillage and disposal of materials containing metals has the potential to have caused some contamination.

Sand blasting of railroad cars was conducted prior to 1964. Most of this activity was focused on preparing new steel for painting although some paint stripping of railroad cars to be repaired occurred. This paint may have had high total metal contents. The waste grit was deposited with other fill materials.

After 1964 sand blasting was used for preparing individual steel parts for painting and the waste was shipped off-site for disposal. EP Tox testing of this material did not classify it as a dangerous waste. This activity lasted until 1988.

Shot blasting of railroad cars using steel balls rather than sand was started in 1964 and continued to about 1986. Waste from this activity was shipped off-site for disposal. EP Tox testing beginning in the early 1980s classified a portion of this waste as a dangerous waste.

Solvents and degreasing agents were used in the machine shop and other operations. Spillage of these materials may have occurred.

6.2 SOILS AND VADOSE ZONE

To evaluate soil quality, soil samples were collected from each sampling location (i.e., test pit or boring) shown on Figure 1.4 and subjected to a suite of qualitative and quantitative chemical analyses. Over 600 samples were visually classified as to material type and were screened in the field for volatile compounds using a photoionization detector. Over 200 discrete soil samples were analyzed for total petroleum hydrocarbons (TPH) and priority pollutant metals (both total and leachable using the EP Tox method). Depending on the field evaluation, soil samples were analyzed for a combination of priority pollutant volatile organic compounds (GC/MS), semivolatile organic compounds (GC/MS), polychlorinated biphenyls (PCBs), and GC/FID screen. Selected soil quality data are summarized in Appendix G.

6.2.1 Metals

Soil samples sent to the laboratory were analyzed for total and EP Tox metals. The metals analyzed were arsenic, cadmium, chromium, copper, lead, nickel, and zinc. The recent and historical total and EP Tox metal results are presented at four (4) selected depth ranges (0 to 2, >2 to 4.5, >4.5 to 7, and >7 feet). Where the data allowed, metals concentrations were contoured. In other cases the metal concentration is plotted next to the sample location.

Histograms were also prepared showing the overall concentration distribution of each metal. These histograms use data collected during the most current work.

Overall, total metals concentrations were generally highest in the industrial fill materials which were deposited on parts of the site (see Section 5.1.2). Metal concentrations were also high in and around former buildings No. 12 and 30. These data support findings in earlier reports by HNTB (1984), E&E (1986), and Hart Crowser (1986a). The metals that are present in highest concentrations are lead, chromium, copper, nickel, and zinc. Arsenic and cadmium were also detected in soil samples, though, at lower concentrations.

Leaching test results using the EP Tox method indicate that arsenic, cadmium, chromium, copper, and nickel are not very leachable. In fact, most metals were undetectable using the EP Tox test.

Arsenic

Total arsenic concentrations ranged from 1 mg/kg to 180 mg/kg with the majority of sample concentrations falling within the 2 mg/kg to 10 mg/kg range (Figure 6.1). Regional background concentrations of arsenic in soils range between 5 to 30 mg/kg (METRO, 1985a). Surficial (0 to 2 feet) arsenic concentrations (Figure 6.2) were variable over the site, with highest concentrations (>80 mg/kg) detected in four locations: V9/HB01 in the south central portion of the site near former buildings No. 4 and No. 5; LW-11 in the south central part of the site (grid location R5); M8/HB01 and N8/HB01 in the central portion of the site between former buildings No. 10 and No. 11; and H8/HB01 in the north central portion of the site near former building No. 12.

The depth distribution of arsenic is presented on Figures 6.2 through 6.5. Generally, elevated concentrations of arsenic were measured within localized areas in the upper 7 feet of soil. Arsenic concentrations were relatively low (<10 mg/kg) at depths exceeding 7 feet.

Leaching test results using the EP Tox test were all less than detected (<0.2 mg/L, Figures 6.36 through 6.39).

However, 6 of 280 samples would be classified as Dangerous Waste under Washington State regulations based on exceeding 100 ppm total arsenic.

Cadmium

Total cadmium concentrations ranged from less than detected to 9.7 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figures 6.6 through 6.10). Regional background concentrations of cadmium in soils range between 0 and 1.4 mg/kg (METRO, 1985a). The highest cadmium concentrations were detected in the surface fill materials. The concentration of cadmium in soil declined with increasing depth.

The EP Tox results for cadmium are presented on Figures 6.36 through 6.39. Cadmium concentrations did not exceed the detection limit in all but 10 samples tested for EP Tox. None exceeded the EP Tox limit. The highest concentrations detected were 0.06 mg/kg and 0.04 mg/kg at F10/HB01-0.7' and D3/HT01-3', respectively. F10/HB01 is located near the south entrance to former building No. 30. D3/HT01 is located in the northwest field.

Chromium

Total chromium concentrations ranged from less than detected to 1,600 mg/kg with the majority of sample concentrations falling within the 10 mg/kg to 70 mg/kg range (Figures 6.11 through 6.15). Regional background concentrations of chromium in soils range between 10 and 70 mg/kg (METRO, 1985a). The highest chromium concentrations were detected in the surface fill materials of the northwest field. A high value of 1,600 mg/kg was detected in one location, J12/HT01-6.5', in the eastern field. Generally, the concentration of chromium declined with increasing depth.

The EP Tox results for chromium are presented on Figures 6.36 through 6.39. EP Tox test results were all less than detected (<0.1 mg/kg).

Copper

Total copper concentrations ranged from 9 mg/kg to 1,600 mg/kg with the majority of sample concentrations falling within the 10 mg/kg to 100 mg/kg range (Figures 6.16 through 6.20). Regional background concentrations of copper in soils range between 5 to 20 mg/kg (METRO, 1985a). Copper concentrations were highest in near-surface soils near the former railroad car assembly and painting buildings (No. 12, No. 15, and No. 30). Copper concentrations were generally lower in the underlying soils.

The EP Tox results for copper are presented on Figures 6.36 through 6.39. Copper concentrations did not exceed the detection limit in any but 5 samples tested for EP Tox. The highest concentrations detected were 0.7 ppm and 0.3 ppm at B1/HB01-0.2' and F1/HT01-2', respectively.

Lead

Total lead concentrations ranged from less than detected to 8,400 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figures 6.21 through 6.25). Lead concentrations of 19,000 mg/kg were previously detected at two locations, LW-9S and LB-24 (Hart Crowser, 1986a). Regional background concentrations of lead in soils range between 10 to 60 mg/kg (METRO, 1985a).

Lead concentrations generally greater than 100 mg/kg were detected in the surface soils (0 to 2 feet) over most of the site. Concentrations were highest (>1,000 mg/kg) near the former railroad car assembly and painting buildings (No. 12 and No. 30), the southeast portion of the site (former buildings No. 5, No. 6, No. 13), and the northwest field near former railroad assembly building No. 15.

The distribution of lead with increasing depth is presented on Figures 6.22 through 6.25. The peak concentrations occurred between the surface and 7 feet, with considerably lower values in the underlying natural materials. Specifically, lead concentrations exceeding 1,000 mg/kg were detected in two areas: to the east of former building No. 12 near the railroad tracks; and former buildings No. 5 and No. 6 in the southeast region of the site. Metal scrap, foundry sand and brick, coal, cinder, and ash materials were encountered in both of these areas.

The EP Tox results for lead are presented on Figures 6.40 through 6.43. Lead concentrations did not exceed the detection limit in any but 10 samples tested for EP Tox. Only 2 exceeded the EP Tox limit. The material at LB-24 was excavated and removed in 1987. Concentrations were highest near the former railroad assembly and painting buildings (No. 12 and No. 30) at F10/HB01-0.7' (9.4 mg/kg), K11/HT01-2' (1.5 mg/kg), and J9/HB01-5' (0.5 mg/kg). The soils in this area had total lead concentrations greater than 1,000 mg/kg.

Nickel

Total nickel concentrations ranged from less than detected to 330 ppm with the majority of sample concentrations falling within the 10 ppm to 100 ppm range (Figures 6.26 through 6.30). Regional background concentrations for nickel in soils range between 10 and 70 mg/kg (METRO, 1985a). Nickel concentrations were the highest at F10/HB01 (130 mg/kg), G4/HB01 (150 mg/kg), and B1/HB01 (160 mg/kg). F10/HB01 and G4/HB01 are near the former railroad car assembly and painting buildings No. 30 and No. 15, respectively. B1/HB01 is located in the northwest corner of the site.

Nickel concentrations were considerable lower in the lower fill and natural materials (>2 feet). Nickel concentrations were highest near the railroad tracks, east of former building No. 12 (N12/HT01-4'), and in the northwest field (B5/HT01-3').

The EP Tox results for nickel are presented on Figures 6.40 through 6.43. Nickel concentrations did not exceed the detection limit in any but 6 samples tested for EP Tox. Concentrations were highest at F1/HT01-2' (0.8 mg/L) and B1/HB01-0.2' (0.6 mg/L) near the northwest property line. In addition, leachable nickel was detected at N12/HT01-4' (0.5 mg/L) located near the railroad tracks east of former building No. 12.

Zinc

Total zinc concentrations ranged from 21 ppm to 6,400 ppm with the majority of sample concentrations falling within the 10 mg/kg to 100 mg/kg range (Figure 6.31). Regional background concentrations for zinc in soil range between 20 and 80 mg/kg (METRO, 1985a). Zinc concentrations were highest in near-surface soils over most of the site. Concentrations were highest (>1,000 mg/kg) near former railroad car assembly and painting buildings No. 12 and No. 30 (F10/HB01 and E9/HB01), former foundry building No. 17 (Q2/HB01), former railroad car assembly building No. 10 (M8/HB01 and N8/HB01), and the northwest field near former railroad car assembly building No. 15 (F1/HT01).

The distribution of zinc with increasing depth is presented on Figures 6.32 through 6.35. The peak concentrations occurred between the surface and 7 feet, with considerably lower values in the underlying natural materials. Specifically, zinc concentrations exceeding 1,000 mg/kg were detected in three areas: to the east of former buildings No. 12 and No. 13 in the east field/parking lot (J12/HT01-6.5'); the northwest field near assembly former building No. 15 (D3/HT01-3'); and railroad car painting building No. 30 (E10/HT01-4'). Metal scrap, foundry sand and brick, coal, cinder, and ash materials were encountered in these areas.

The EP Tox results for zinc are presented on Figures 6.40 through 6.43. Zinc concentrations exceeded the detection limit in 32 samples tested. Values ranged from 0.1 mg/L to 9.5 mg/L. Concentrations were highest near the former railroad car assembly and painting buildings (No. 12 and No. 30) at E10/HT01-4' (9.5 mg/L), F10/HB01-0.7' (8.6 mg/L), J12/HT01-6.5' (2.8 mg/L), and K11/HT01-2' (0.4 mg/L). High concentrations were also detected in the northwest field (i.e., former building No. 15) and near the former foundry building (No. 17). The soils in these areas had total zinc concentrations between 500 mg/L and 1,000 mg/L.

6.2.2 Volatile Organics

The presence of volatile hydrocarbons was qualitatively assessed in the field using a portable photoionization detector (H-Nu Model PI-101 w/10.2 eV Lamp) and evaluating the odor of the sample. Based on this assessment, selected samples were further analyzed in the laboratory for volatile organic chemicals by GC/MS.

The sum of volatile organic compounds ranges from less than detected to 7.3 mg/kg with the majority of sample concentrations falling within the less than detection to 0.1 mg/kg range (Figure 6.44). The distribution of previous volatiles data at the PACCAR site is similar to the volatiles data collected during the current work.

Aromatic Volatile Organics (BTEX)

The volatile organic compounds benzene, chlorobenzene, toluene, ethylbenzene, and xylenes were detected in site soils and are typically associated with solvents and/or petroleum products (e.g., gasoline). Gasoline hydrocarbons typically range from 4 to 12 carbon atoms per molecule and have a unique GC/FID signature (Figure 6.45). BTEX compounds detected in soils may have been introduced by gasoline spilled on the surface or by an underground storage tank leak. Many of the soil samples which exhibited elevated BTEX concentrations also exhibited characteristic GC/FID "signatures" indicative of gasoline sources or diesel fuel (Figure 6.45). The total concentration of BTEX in soils is presented at four selected depth ranges (0 to 2, >2 to 4.5, >4.5 to 7, and >7 feet) on Figures 6.46 to 6.50.

(0 to 2 Feet). Total BTEX ranges from less than detected to 2.4 mg/kg with the majority of sample concentrations within the non-detectable range. The highest BTEX concentration was measured at P11/HT01 located near the north side of former building No. 6 in the south eastern portion of the site. The GC/FID screen analysis of soil obtained from this test pit indicated the presence of diesel fuel, PAHs, and gasoline-range hydrocarbons. The GC/FID screen analysis for several surrounding explorations (e.g., Q11/HB01) indicate primarily gasoline-range hydrocarbons. A gasoline odor, H-Nu measurement of 8.0 units, and an oily substance were also observed during the test pit excavation.

(>2 to 4.5 Feet). Total BTEX ranged from less than detected to 3.18 mg/kg with the majority of sample concentrations within the non-detectable range. The highest BTEX concentrations (>1.0 mg/kg) were measured at J5/HB01, O5/HB01, and T2/HB01. J5/HB01 is located near the north entrance to former building No. 9 in the central portion of the site. GC/FID screen analysis for J5/HB01 and surrounding explorations (e.g., J6/HB01 and K6/HB01) indicated the presence of gasoline-range hydrocarbons. Above-ground (A10 - Figure 1.2) and underground (B6 - Figure 1.2) diesel storage tanks were present in this area from 1940s to 1970 and 1970 to 1986, respectively. O5/HB01 is located near the south entrance to former building No. 9 in the central portion of the site. A GC/FID screen analysis was not performed on this soil. GC/FID screen analysis of soils collected at P6/HB01 and Q5/HB01 revealed gasoline-range and diesel-range hydrocarbons. These explorations are in the vicinity of the LW-11 site where fuels have historically been stored (tanks locations B-2 and A-9 on Figure 1.2). T2/HB01 is located near the southern wall of the former foundry building (No. 17) in the south western corner of the site. Though a GC/FID screen was not performed on soil collected from this boring, analysis of soils in the vicinity indicated the presence of gasoline. In addition, a gasoline-like odor was encountered during drilling and a H-Nu measurement of 65 units was obtained.

(>4.5 to 7 Feet). Total BTEX ranged from less than detected to 2.9 mg/kg with the majority of sample concentrations within the non-detectable range. The highest BTEX concentrations (>1 mg/kg) were measured at A3/HT01, R5/HT01, and U2/HB01. A3/HT01 is located in the far north western corner of the site. GC/FID screen analysis indicated diesel-range hydrocarbons (i.e., 12 to 24 carbon atoms per molecule). R5/HT01 is located south of the LW-11 site in the south central portion of the site. Diesel fuel was a primary constituent of the soils in this area based on the GC/FID screen analysis. Historically, gasoline was stored in underground tanks (B3 and B4) between former buildings No. 16 and No. 21. U2/HB01 is located south of the former foundry building (No. 17) in the south western corner of the site. Underground tanks (B10 - Figure 1.2) containing diesel fuel were removed from this area in 1985. GC/FID screen analysis of surrounding borings (e.g., U3/HB01) also indicate the presence of gasoline-range hydrocarbons.

(>7 Feet). Total BTEX ranged from less than detected to 7.3 mg/kg with the majority of sample concentrations within the non-detectable range. The highest BTEX concentrations (>1 mg/kg) were measured at C9/HT01 and G5/HB01. C9/HT01 is located west of former building No. 30 in the north central portion of the site. C9/HT01 is near the site of two solvent tanks (B6 and B7 - Figure 1.2) that were removed in 1986. Specifically, the tanks contained lacquer thinner (B6) and cellosolve (B7). BTEX compounds are associated with both of these industrial solvents. G5/HB01 is located at former building No. 15. Low molecular weight hydrocarbons (e.g., solvents) were identified via GC/FID screen analysis as the primary source material.

Vinyl Chloride (VC)

Vinyl chloride was detected in groundwater beneath the site but was reportedly not used in any of the manufacturing operations. However, vinyl chloride is a breakdown product of common solvents such as tetrachloroethene and trichloroethene (Wilson, et al., 1986). The biodegradation sequence of these industrial compounds include intermediate components such as 1,2 dichloroethane and 1,1 dichloroethane (Tsentas and Supkow, 1985).

Vinyl chloride was not detected in any soil samples submitted to the laboratory during the most recent sampling program. Trichloroethene was detected in soils obtained at N5/HB01 (depth of 5 feet). The concentration was 0.003 mg/kg.

Historical data exist for one exploration (LB4) in the far north western corner of the site (Hart Crowser, 1986a). The location is in the vicinity of the truck research and development area that has been active from 1970 through the present. The concentration of vinyl chloride in the soils was 0.01 mg/kg. The concentrations of precursors tetrachloroethene, trichloroethene, and trans-1,2-dichloroethene were less than detection, 0.006 mg/kg, and 0.022 mg/kg, respectively. In addition, tetrachloroethene was detected at LW8S (0.002 mg/kg) located in the central portion of the site and LS1 (0.0032 mg/kg) near former building No. 30 in the north eastern portion of the site (Hart Crowser, 1986a; Ecology and Environment, 1986).

In contrast to the soils data, vinyl chloride was detected in groundwater samples (see Section 6.3). The source of vinyl chloride to the groundwater is still not fully understood because vinyl chloride was not used on-site during manufacturing operations. The maximum concentration of vinyl chloride detected in groundwater exceeded those found in soil (0.12 ppm versus 0.01 ppm). The following scenario may explain this inconsistency. Solvents and degreasing agents (e.g., containing tetrachloroethene) were used as part of machine shop, painting, and galvanizing operations. Spillage may have introduced these materials to the soils and groundwater. Intermediate degradation products such as trans-1,2-dichloroethene, cis-1,2-dichloroethene, and total-1,2-dichloroethene were detected in several wells. These intermediate degradation products probably have degraded to produce vinyl chloride.

6.2.3 Semivolatile Organics

Comparison of Semivolatile Analyses

The sum of semivolatile organic compounds ranges from less than detected to 1,310 ppm with the majority of sample concentrations falling within the 1.0 ppm to 10 ppm range. Specific semivolatile compounds in soil are summarized in Appendix G. The following sections discuss the individual groups of semivolatile compounds detected in soil at the PACCAR site (i.e., PAHs, chlorinated hydrocarbons, phenol compounds, and phthalates).

A statistical comparison between each indicator constituent (TPH, GC/FID screen, low molecular weight polynuclear aromatic hydrocarbons - LPAH, and high molecular weight polynuclear aromatic hydrocarbons - HPAH) was made using an analysis of variance (ANOVA) and log-log (base 10) regression techniques. Based on soil data collected throughout the PACCAR site (Hart Crowser and previous data), a highly significant relationship ($p = 0.0001$) exists between TPH versus GC/FID screen (reported as phenanthrene), TPH versus LPAH, LPAH versus GC/FID screen, HPAH versus GC/FID screen, and LPAH versus HPAH. The correlation between TPH versus HPAH was less significant ($p = 0.05$).

Total Petroleum Hydrocarbons (TPH)

All samples sent to the laboratory were analyzed for TPH. The TPH results are presented at four selected depth ranges (0 to 2, >2 to 4.5, >4.5 to 7, and >7 feet) on Figures 6.51 to 6.55.

(0 to 2 Feet). The TPH concentration ranged from less than detected to 58,000 mg/kg with the majority of sample concentrations falling within the 100 to 1,000 mg/kg range (Figure 6.51 and 6.52). The highest on-site TPH concentrations of 24,000 mg/kg, 15,000 mg/kg, 58,000 mg/kg, and 25,000 mg/kg were measured at O6/HB01, P10/HB01, P11/HT01 and R4/HB01, respectively. O6/HB01 is located in the south central part of the site between former buildings no. 9 and no. 10. The elevated TPH concentration is probably localized to this boring, based on data from surrounding explorations. GC/FID screen analysis of soil samples obtained from this area indicates a probable source of diesel fuel origin (based on O4/HB01 chromatogram).

P10/HB01 and P11/HT01 are located in the south eastern portion of the site between former buildings No. 5 - No. 12 and No. 6 - No. 13, respectively. GC/FID screen analysis of soil samples obtained from these explorations and surrounding explorations indicate the presence of diesel fuel and high molecular weight hydrocarbons such as PAHs (see PAH section).

R4/HB01 is located in the south central part of the site near LW-11. LW-11 is the location where, while removing an underground diesel tank, the presence of diesel-like materials within soil was discovered. GC/FID screen analysis of soil samples obtained from this area also indicates a probable diesel fuel source (Figure 6.44). In addition, low concentrations of PAHs were also present with the diesel fuel. Surrounding exploration locations, at greater depths (R5/HT01-7, Q5/HT01-4, and Q6/HB01-3), have similar chromatogram signatures.

(>2 to 4.5 Feet). The TPH concentration ranges from less than detected to 35,000 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figures 6.51 and 6.53). The highest TPH concentrations of 9,300 mg/kg, 12,000 mg/kg, 18,000 mg/kg, and 35,000 mg/kg were measured at J5/HB01, N12/HT01, Q9/HB01 and T2/HB01, respectively. J5/HB01 is located near the north entrance to former building No. 9 in the central portion of the site. GC/FID screen analysis of soil samples collected from this area indicates the presence of high molecular weight hydrocarbons such as PAHs (J4/HB01 and J6/HB01). N12/HT01 is located near the former railroad tracks in the east central portion of the site. A GC/FID screen was not analyzed for this soil sample. Q9/HB01 is located adjacent to former building No. 5 in the south central portion of the site. GC/FID screen analysis of Q9/HB01 and other soil samples (Q7/HB01 and Q8/HB01) obtained from this area indicates a possible diesel fuel source. The extent of this 10,000 mg/kg contour interval can be further evaluated with additional GC/FID screen data for Q10/HB01 and Q11/HB01. T2/HB01 is located near the southern wall of the former foundry building (No. 17) in the south western corner of the site. There is not a soil GC/FID screen analysis for this location, though, analysis of other soils collected in the area (U3/HB01, T3/HB01, etc.) indicate the presence of diesel fuel and PAHs.

(>4.5 to 7 Feet). The TPH concentration ranged from less than detected to 7,950 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figures 6.51 and 6.54). The highest TPH concentration was measured at R8/HB01. A GC/FID screen was not analyzed for this soil sample. GC/FID screen analysis of other soils collected in this area (R5/HT01 and Q7/HB01) indicate the presence of diesel fuel and low levels of PAHs.

(>7 Feet). The TPH concentration ranged from less than detected to 4,200 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figures 6.51 and 6.55). The highest TPH concentration was measured at T3/HB01. A GC/FID screen was not analyzed for this soil sample. GC/FID screen analysis of other soils collected in this area (U1/HB01 and U3/HB01), at various depths, indicate the presence of diesel fuel and low concentrations of PAHs.

Polynuclear Aromatic Hydrocarbons (PAHs)

Polynuclear aromatic hydrocarbons consist of three or more fused benzene rings in linear, angular, or cluster arrangements and contain only carbon and hydrogen (Zedeck, 1980). Over 200 different PAHs are found in the environment. LPAHs are derived from a variety of fuel- and combustion-related sources. The primary source of HPAHs is the combustion of fossil fuels for heating (e.g., coal-fired industrial furnaces and coke production). PAH concentrations in crude and refined petroleum products are usually in the range of 0.2 to 7.4 percent (Gilchrist et al., 1972; Jewell et al., 1972).

Low Molecular Weight PAH (LPAHs)

Surficial (0 to 2 feet) LPAH concentrations ranged from less than detected to 222 mg/kg with the majority of sample concentrations falling within the 0.1 mg/kg to 1.0 mg/kg range (Figure 6.56 and 6.57). Total LPAH concentrations of about 280 mg/kg were detected at LW-11VS (Hart Crowser, 1986a). Total LPAH concentrations were highest in the central portion of the site from former building No. 12 in the east to former building No. 9 in the west. Total LPAH concentrations were also high in the south central portion of the site near LW-11.

Concentrations generally greater than 0.1 ppm were recorded over the entire former manufacturing building footprint area.

The distribution of LPAHs with increasing depth is presented on Figures 6.56 through 6.60, based on data from the current sampling event and historical data (Ecology & Environment, 1986; HNTB, 1984; Hart Crowser, 1986a). The peak concentrations occurred between the surface and 4.5 feet (predominantly fill material), with considerably lower values in the underlying native materials. The relatively high LPAH concentrations encountered near the surface likely reflects the presence of industrial fill materials. For example, the fill material at borings J5/HB01 and J6/HB01 contained slag, foundry sand and bricks, cinders, coal, and other rubble which may have been a source of LPAHs (see Appendix C). The high levels of LPAHs detected in the area of LW-11 may reflect a fuel oil spill or leak that previously occurred.

High Molecular Weight PAH (HPAHs)

Surficial (0 to 2 feet) HPAH concentrations ranged from less than detected to about 1,100 mg/kg with the majority of sample concentrations falling within the 1.0 mg/kg to 10.0 mg/kg range (Figures 6.61 and 6.62). Total HPAH concentrations were highest in the central portion of the site from former building No. 12 in the east to former building No. 15 in the west. Total HPAH concentrations were also high in the south western portion of the site near LW-11 and the former foundry building (No. 17). Concentrations generally greater than 0.1 mg/kg were recorded over most of the site.

The distribution of HPAHs with increasing depth is presented on Figures 6.61 through 6.65, based on data from the current sampling event and historical data (Ecology & Environment, 1986; HNTB, 1984; Hart Crowser, 1986a). The peak concentrations occurred between the surface and 4.5 feet (predominantly fill material), with considerably lower values in the underlying native materials. The relatively high HPAH concentrations encountered near the surface likely reflects the presence of industrial fill materials. For example, the fill material at explorations J8/HB01, I11/HT01, and I10/HB01 contained ash, slag, foundry sand and bricks, cinders, coal, and other rubble which may be a source of HPAHs (see Appendix C). The high levels of HPAHs detected in the area of LW-11 may reflect a fuel oil spill or leak that previously occurred.

Phthalates

The sum of phthalate compounds ranged from less than detected to 3.0 mg/kg with the majority of sample concentrations falling within the 0.1 mg/kg to 1.0 mg/kg range (Figure 6.66). Several soil samples collected in 1986 (Hart Crowser, 1986a) had total phthalate concentrations exceeding the maximum concentration detected during this recent sampling period. The highest phthalate concentrations were detected in the surface fill materials (0 to 4.5 feet). Values exceeding 1.0 mg/kg were obtained at four locations: N8/HB01-0.6', B1/HB01-0.2', R12/HT01-3', and E7/HT01-2.5'.

Phenol Compounds

The sum of phenol compounds ranged from less than detected to 1.6 mg/kg with the majority of sample concentrations falling within the non-detectable range (Figure 6.67). The highest total phenol concentrations occurred in the surface fill materials (0 to 2 feet). With the exception of one location (A3/HT01-5'), concentrations were generally below the detection limit in the near-surface fill and underlying native materials.

6.2.4 Polychlorinated Biphenyls (PCBs)

Total PCB concentrations ranged from less than detected over most of the site to 5.0 mg/kg near former building No. 9 in the central portion of the site as indicated on Figures 6.68 and 6.69. A single location (LB-7) had a total PCB concentration of 24 mg/kg. Aroclor-1254 and -1260 were the only PCB compounds detected in the soils of this site. Total PCB levels were highest (>1 mg/kg) at five locations, J6/HB01, F1/HT01, H11/HT01, U2/HB01, and X-3. J6/HB01 (0-2 feet) is located on the perimeter of former building No. 9 and had individual PCB concentrations of 2.4 mg/kg for Aroclor-1254 and 2.3 mg/kg for Aroclor-1260. F1/HT01 (2 feet) is located along the west central property line of the site. Aroclor-1254 and -1260 concentrations were 0.81 mg/kg and 0.91 mg/kg, respectively.

Similarly, historical PCB levels were the highest in the north western portion of the site near former building No. 15 (Hart Crowser, 1986a). D11/HT01 (1.5 feet) and H11/HT01 (5.5 feet) are located near the former railroad tracks in the northwest quadrant. The location of X-3 (surface) was in the vicinity of test pits C7/HT01 and C9/HT01 (former Building No. 30). A surface soil sample was collected in and around existing railroad ties and tracks that had visible signs of oil-like staining. Suspected sources of PCBs are leakage of transformer oil containing PCBs and waste oil/grease used for railroad track and switch lubrication. Total PCB levels of 1.43 mg/kg were measured at U2/HB01-5′ located near the southern wall of the former foundry building (No. 17).

6.3 GROUNDWATER

Groundwater samples have been obtained from on-site and off-site wells since June of 1984. Through July of 1989 over 75 wells have been sampled and over 100 samples have been analyzed for a variety of constituents including priority pollutants:

- Volatile and Semivolatile (Extractable) Chemicals;
- Pesticides and PCBs; and
- Total and Dissolved Metals.

The number and types of analyses completed are summarized in Tables 6.4 and 6.5 which indicate the well number and date of sampling, who completed the sampling, and the category of chemicals analyzed. Figures 6.70 through 6.81 show the sampling locations and analytical results based on the laboratory analyses of the collected groundwater samples.

Table 6.4 - Summary of Water Quality Analyses - <u>On-Site</u> Sheet 1 of 3

Location	HNTB (1984)				AGI (1985)				E&E (1986)				Landau (1986)				Hart Crowser				Hart Crowser				Hart Crowser			
	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M
Date Sampled	June 1984				Dec. 1984				Feb. 1986				June/ July 1986				Feb. 1988				July 1988				Feb. 1989			
LW-1S													x	x	x	x					x	x		x				
LW-1D																x					x			x				
LW-2S													x	x	x	x					x	x		x				
LW-2D													x	x	x	x					x							
LW-3S													x	x	x	x					x	x		x	x	x		x
LW-3D													x	x	x	x					x	x		x	x	x		x
LW-4S													x	x		x												
LW-5VS													x	x	x	x												
LW-5S													x	x	x	x								x				
LW-5D													x	x	x	x								x				
LW-6S													x	x	x	x					x	x		x	x	x		x
LW-6D													x			x					x	x		x	x	x		x
LW-7S													x	x	x	x												
LW-7D													x	x	x	x												
LW-8S													x	x		x					x							
LW-8D													x	x		x					x							
LW-9S													x	x	x	x					x	x		x	x	x		x
LW-9D													x	x	x	x					x	x		x	x	x		x
LW-10S													x	x		x					x	x						
LW-10D													x	x		x					x			x				
LW-11S													x	x		x												
LW-11D													x	x		x												
LW-12S													x	x	x	x	x	x		x	x	x		x	x	x		x
LW-12D													x	x		x	x	x		x	x	x		x	x	x		x
LW-13S													x	x		x	x	x		x	x	x		x				
LW-13D													x	x		x	x	x		x				x	x	x		x
LW-14S													x	x	x	x	x	x		x	x	x		x				
LW-15S													x	x	x	x					x			x				

Notes: V = volatiles
S = semivolatiles (Base/Neutral/Acid extractables)
P = pesticides/PCBs
M = metals
@ = only phthalates and polynuclear aromatic hydrocarbons (PNAs) were analyzed
(2) = depth in feet where indicated

Table 6.4 - Continued

Sheet 2 of 3

	HNTB (1984)				AGI (1985)				AGI (1985)				E&E (1986)				Landau (1986)			
Location	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M
Date Sampled	June 1984				Dec. 1984				July 1985				Feb. 1986				June/ July 1986			
MW-1S(3)	x	x	x	x		@	x	x		@	x	x								
MW-1D(20)	x	x	x	x		@	x	x		@	x	x					x	x	x	x
MW-2S(3)	x	x	x	x		@	x	x		@	x	x								
MW-2I(20)						@	x	x		@	x	x								
MW-2D(20)	x	x	x	x		@	x	x		@	x	x					x	x	x	x
MW-3D(18) (or 3-I)	x	x	x	x		@	x	x		@	x	x	x	x	x	x	x	x		x
MW-4S(3)						@	x	x					x	x	x	x	x	x		x
DM-2D																	x	x	x	x
DM-3D																	x	x		x

Notes: V = volatiles
S = semivolatiles (Base/Neutral/Acid extractables)
P = pesticides/PCBs
M = metals
@ = only phthalates and polynuclear aromatic hydrocarbons (PNAs) were analyzed
(2) = depth in feet where indicated

Table 6.4 - Continued

Location	Hart Crowser				Hart Crowser				Hart Crowser				Hart Crowser			
	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M
Date Sampled	Feb. 1988				July 1988				Oct. 1988				Feb. 1989			
MW-1S(3)																
MW-1D(20)					x	x		x								
MW-2S(3)																
MW-2I(20)																
MW-2D(20)					x	x		x								
MW-3D(18) (or 3-I)	x	x		x	x	x		x					x	x		x
MW-4S(3)																
DM-2D								x								
DM-3D					x	x		x								
OW-4S									x	x		x		x		
OW-4D									x	x		x		x		
OW-5S									x	x		x		x		
OW-5D									x	x				x		
MW-2DR									x	x		x				
11-OW1				x												
11-OW2				x												
11-OW3				x												

Notes:
V = volatiles
S = semivolatiles (Base/Neutral/Acid extractables)
P = pesticides/PCBs
M = metals
@ = only phthalates and polynuclear aromatic hydrocarbons (PNAs) were analyzed
(2) = depth in feet where indicated

Table 6.5 - Summary of Groundwater Quality Analyses - Off-Site

Location	HNTB (1984) V	S	P	M	E&E (1986) V	S	P	M	CH2M Hill (1988) V	S	P	M	Hart Crowser V	S	P	M	Hart Crowser V	S	P	M	Hart Crowser V	S	P	M	Landau (1989) V	S	P	M
Date Sampled	June 1984				Feb. 1986				June 1986				Feb. 1988				Oct. 1988				Feb. 1989				July 1989			
OSP-1S																	x	x		x								
OSP-1D																	x	x		x								
OSP-2S																	x	x		x								
OSP-2D																	x	x		x	x	x		x				
OSP-3D																	x	x		x								
OSP-4S																	x	x		x								
OSP-4SR																	x	x		x								
OSP-4D																	x	x		x				x*				
OSP-5S																	x	x		x								
OSP-5D																	x	x		x	x							
OSP-6S																	x	x		x								
OSP-6D																	x	x		x								
OSP-6DR																	x	x		x								
OSP-7S																	x	x		x	x	x		x				
OSP-7D																	x	x		x	x	x		x				
OSP-13(MIS)	See note (sampled during May 1989)																											
LMW-1S																									x			x
LMW-1D																									x			x
LMW-2S																									x	x		x
LMW-2D																									x			x
LMW-4S																									x	x		x
LMW-6S																									x			
LMW-7S																									x			
HC-10-71-C																									x			

Table 6.5 - Continued

Location	HNTB (1984)				E&E (1986)				CH2M Hill (1988)				Hart Crowser				Hart Crowser				Hart Crowser				Landau (1989)			
	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M	V	S	P	M
Date Sampled	June 1984				Feb. 1986				June 1986				Feb. 1988				Oct. 1988				Feb. 1989				July 1989			
Renton Wells																												
MW-1									x	x	x	x																
MW-4					x	x	x	x	x	x	x	x	x	x		x												
MW-5					x	x	x	x	x	x	x	x	x	x		x												
MW-6					x	x	x	x																				
MW-7									x	x	x	x																
MW-10													x	x		x	x	x		x				x*				
PW-1					x	x	x	x																				
PW-2	x	x	x	x																								
PW-3	x	x	x	x																								
PW-8					x	x	x	x																				

Notes:
SR = Sample Replicate
V = Volatiles
S = Semivolatiles (Base/Neutral/Acid extractables)
P = Pesticides/PCBs
M = Metals
* = (arsenic only)
OSP-13(MIS) was installed as part of a tank replacement project at the MIS facility located east of the site. Dissolved metals, BTEX, Total Petroleum Hydrocarbons, cyanide, pH, specific conductivity, and temperature were assessed. No evidence of diesel fuel leakage or other contaminants was discovered.

6.3.1 Volatiles

On-Site - Groundwater samples from over 40 locations on the PACCAR site have been analyzed for priority pollutant volatile compounds from both shallow and deep monitoring wells (Table 6.4). The sum of the volatiles ranged from not detected to about 3 mg/L (ppm) for shallow wells and from not detected to about 1 ppm for the deeper wells. The distribution of sampling locations and compounds detected are presented on Figures 6.70 and 6.71. The constituents detected are indicative of fuels (gasoline) and solvents.

Off-Site - Groundwater samples have been obtained from 31 wells including PACCAR, City of Renton, and Boeing monitoring wells and selected Renton production wells (Table 6.5). No volatile compounds have been detected in any wells located within the Renton Well catchment area (Figures 6.70 and 6.71) during this study. Although several fuel-related volatile chemicals have been detected in groundwater samples from PW-3 during other sampling efforts. These chemicals were traced to a leaking underground fuel storage tank system at a nearby service station. Only two off-site wells, sampled during the period of the remedial investigation, detected the presence of volatile compounds. Vinyl chloride was detected at 0.045 mg/L (July 1989) in LMW-2D and at 0.004 mg/L (October 1988) and 0.005 mg/L (February 1989) in samples from OSP-5D. Chloroform (LMW-2D) and 1,1 Dichloroethene (LMW-4) were also detected west of the site at the reported detection limit of 1 ppb. These wells are located downgradient from wells LW-6D and LW-9D where the highest on-site vinyl chloride concentrations have been detected.

Comment - Intermittent detections of acetone and methylene chloride were reported on the analytical data sheets received from the laboratories. Acetone concentrations ranged from less than the reported detection limits of 5 to 12 ppb up to 440 ppb while reported methylene chloride concentrations ranged from less than the reported detection limits of 1 to 3 ppb up to 330 ppb. The highest values for both these compounds were qualified on the laboratory reports because these compounds were also detected in either trip or method blanks analyzed by the laboratory. We do not consider the results to be representative of what is in groundwater beneath and downgradient of the PACCAR site for the following reasons:

- o These compounds were inconsistently detected in groundwater samples. Most of the detections occurred in samples analyzed from early (pre-1988) sampling rounds largely as a result of laboratory contamination. These compounds were and are used as part of many analytical procedures and are ubiquitous to the laboratory environment. Laboratory quality control procedures have improved in recent years; however, it is still relatively common to have detection of acetone and methylene chloride because of laboratory contamination;

- o These constituents were also detected in trip and method blanks; and

- o The concentrations are typically near the reported detection limits.

6.3.2 Semivolatiles

On-Site - Groundwater samples from over 40 on-site wells have been analyzed for semivolatile compounds. Sampling locations and number of sampling rounds are listed in Table 6.4 while the distribution of analytical results is shown on Figures 6.72 and 6.73.

This class of chemicals was not detected beneath most of the site. The highest concentrations of semivolatile compounds were detected in samples from monitoring wells LW-3S, LW-12S, LW-12D, and LW-11S. The source of the semivolatiles appears to be leaking (now removed) diesel tanks near LW-12, leaking (now removed) solvent tanks near LW-3, and spillage of diesel fuel in the vicinity of LW-11.

Pentachlorophenol was reported in a sample from MW-3I taken by Ecology and Environment, Inc. (during February 1986, under contract to EPA). However, four (4) subsequent samplings by Landau Assoc. (June/July 1986) and Hart Crowser, Inc. (February and July 1988, and February 1989) and a prior sampling by HNTB (June 1984) did not detect this compound. Based on the bulk of the data we do not believe that the Ecology and Environment result is representative of site conditions.

Off-Site - Groundwater samples have been obtained from 26 monitoring wells located off of the PACCAR site (Table 6.5). With one exception, no semivolatile chemicals were detected in any of the off-site wells (Figures 6.72 and 6.73).

Pentachlorophenol was reported in a sample (taken during February 1986) from Renton monitoring well MW-5 located south of the PACCAR site by Ecology and Environment. Subsequent sampling by CH2M Hill in June 1986 (for Renton) and by Hart Crowser, Inc., in February 1988 did not detect the presence of this compound. Similarly to the Ecology and Environment results reported for MW-3I (discussed above), we do not believe pentachlorophenol is present in groundwater beneath and downgradient of the PACCAR site.

Similarly phthalate compounds were also detected in some of the groundwater samples especially in the earlier data. These constituents are common laboratory or sampling procedure contaminants, are typically near the reported detection limit, and were detected in trip and method blanks. Where reported concentrations generally ranged between 2 and 10 ppb of phthalate compounds.

6.3.3 Pesticides and PCBs

On-Site - Priority pollutant pesticides and PCBs have been analyzed from samples obtained in June 1984, December 1984, July 1985, February 1986, and June/July 1986 (Table 6.4). Sampling locations are presented for on-site shallow and deep wells on Figures 6.74 and 6.75.

Pesticides or PCBs were not detected in 37 of the 39 samples tested. Very low concentrations of several of this class of compounds were detected in wells MW-1S and MW-2S in the June 1984 sampling round (Figure 6.74). However, analysis of samples obtained from these wells during two (2) additional sampling rounds did not detect either pesticide or PCB compounds.

Off-Site - Analyses for pesticides and PCBs have been completed for off-site groundwater samples obtained in February and June 1986 (Table 6.5) from City of Renton monitoring wells (MW-1, MW-4, MW-5, MW-6, and MW-7) and from selected production wells (PW-1 and PW-8).

These compounds were not detected in any of the groundwater samples from off-site wells.

6.3.4 Metals

Analyses for dissolved and total metals have been performed on groundwater samples obtained from on-site and off-site wells since June of 1984. Dissolved metals data for shallow and deep monitoring wells are listed in Tables 6.6 and 6.7 while total metals data are listed in Tables 6.8 and 6.9. A comparison of total and dissolved metals concentrations conducted on samples taken at the same time is presented in Table 6.10. In this report dissolved metals are those reported for water samples field filtered through a 0.45 micron filter prior to preservation with nitric acid.

Comparison of Dissolved and Total Metal Concentrations

Total metal concentrations are higher than dissolved metal concentrations for corresponding sampling locations. For example, for samples obtained during July 1988 (Table 6.10) total metal concentrations were substantially higher as compared to dissolved.

The cause of the higher total metals concentrations is the higher suspended solids concentrations in unfiltered versus filtered samples. Preservation with acid causes metals (even if naturally occurring) attached to the suspended solids to dissolve into the water phase. Suspended solids analyses for samples obtained in July/August 1986 indicate suspended solid concentrations ranged between 55 and 1,200 milligrams per liter (mg/L) with an average of about 465 mg/L for 29 samples analyzed.

In our analyses we have generally used dissolved metals concentrations. Our use of dissolved metals data is based on the following:

- o Higher total metal concentrations are the result of relatively high suspended solids content in well water samples.
- o Migration of metals in water saturated soil materials beneath the site will be in the dissolved phase.

Table 6.6 - Summary of Dissolved Metals Data for Shallow Wells**

Location		Date	SS**	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ba	Fe**	Al**	Ag
On-Site - East																
LW-4S	D	7/86	*	*	<2	<10	<1	10	<20	<1	*	*	*	*	*	*
LW-7S	D	6/86	55	<1	<2	<10	<1	38	<20	<1	*	*	*	*	*	*
OSP-1S	D	10/88	*	<1	<2	5	1	13	<5	*	*	*	*	*	*	*
LW-13S	D	7/86	63	<1	<5	<10	<5	17	80	<1	*	*	*	*	*	*
	D	2/88	*	11	<31	<9	<3	21	14	*	*	*	*	*	*	*
	D	7/88	*	2	<2	7	2	16	10	*	*	*	*	*	*	*
LW-15S	D	6/86	170	<1	<5	<10	<5	39	30	<1	*	*	*	*	*	*
	D	7/88	*	<1	<2	7	3	13	73	*	*	*	*	*	*	*
On-Site - Middle																
MW-2D	D	7/88	*	<1	<2	17	<1	14	6	<1	*	*	*	*	*	*
LW-2S	D	7/86	440	<1	<5	<10	5	47	70	<1	<1	*	*	34	34	*
	D	7/88	*	<1	<2	6	4	26	<5	*	*	*	*	*	*	*
LW-3S	D	7/86	520	<1	<5	<10	<5	53	90	<1	*	*	*	*	*	*
	D	7/88	*	<1	<2	9	3	16	7	*	*	*	*	*	*	*
	D	2/89	*	*	*	6	*	21	<5	*	*	*	*	*	*	*
LW-5S	D	7/86	170	*	<5	<10	<1	54	60	<1	*	*	*	*	*	*
	D	7/88	*	1	<2	7	<1	18	<5	*	*	*	*	*	*	*
MW-4S	D	7/86	*	*	*	40	8	37	30	*	*	*	*	*	*	*
LW-8S	D	8/86	1,100	*	<5	<10	<5	12	<20	<1	<1	*	*	*	*	*
LW-10S	D	8/86	340	*	<5	<10	<5	52	40	<1	<1	*	*	*	*	*
OW-5S	D	10/88	*	<1	<2	7	<1	19	21	*	*	*	*	*	*	*
LW-11S	D	6/86	240	<1	<2	10	<1	17	160	<1	<1	*	*	61	63	*
OW-4S	D	10/88	*	<1	<2	<5	<1	28	<5	*	*	*	*	*	*	*
On-Site - West/South																
OSP-7S	D	10/88	*	<1	<2	18	<1	19	11	*	*	*	*	*	*	*
	D	2/89	*	*	*	22	*	29	10	*	*	*	*	*	*	*
LW-1S	D	6/86	340	<1	<5	10	<5	10	<20	<1	<1	*	*	1.1	1.1	<10
	D	7/88	*	3	<2	<5	<1	15	9	*	*	*	*	*	*	*
MW-1	D	7/86	290	<1	<5	<10	<5	16	12	<1	*	*	*	*	*	*
(18' - 23')	D	7/88	*	8	<2	<5	<1	18	<5	*	*	*	*	*	*	*
LW-6S	D	6/86	1,100	<1	<5	<10	<1	11	30	<1	<1	<200	<10	13	13	<10
	D	7/88	*	1	2	<5	3	12	6	*	*	*	*	*	*	*
	D	2/89	*	*	*	<5	*	11	<5	*	*	*	*	*	*	*
LW-9S	D	6/86	1,200	2	<5	<10	<5	16	13	1	<1	<200	<20	55	56	1
	D	7/88	*	1	<2	9	1	15	15	*	*	*	*	*	*	*
	D	2/89	*	*	*	7	*	13	15	*	*	*	*	*	*	*
LW-12S	D	6/86	60	2	<5	<10	<5	16	30	<1	<1	<200	200	16	16	<10
	D	2/88	*	6	49	<9	<3	18	35	*	*	*	*	*	*	*
	D	7/88	*	1	<2	7	<1	14	16	*	*	*	*	*	*	*
	D	2/89	*	*	*	7	*	15	28,29	*	*	*	*	*	*	*
LW-14S	D	6/86	200	*	<5	<10	<1	21	<200	<1	*	*	*	*	*	*
	D	2/88	*	13	<31	<9	<3	19	8	*	*	*	*	*	*	*
	D	7/88	*	<1	<2	<5	<1	12	<5	*	*	*	*	*	*	*
MW-3I	D	6/86	450	1	*	30	<5	61	90	*	*	*	*	*	*	*
(16' -	D	2/88	*	6	<31	<9	<3	8	19	*	*	*	*	*	*	*
21')	D	7/88	*	<1	<2	<5	<1	23	17	*	*	*	*	*	*	*
		2/89	*	*	*	7	*	30	17	*	*	*	*	*	*	*
Off-Site West/South																
OSP-6S	D	10/88	*	2	<2	11	<1	16	7	*	*	*	*	*	*	*
OSP-5S	D	10/88	*	3	<2	<5	<1	16	<5	*	*	*	*	*	*	*
OSP-4S	D	10/88	*	1	4	<5	<1	20	<5	*	*	*	*	*	*	*
MW-10	D	2/88	*	10	<31	<9	<3	10	25	*	*	*	*	*	*	*
	D	10/88	*	<1	<2	6	<1	18	27	*	*	*	*	*	*	*
	D	2/89	*	*	*	*	*	*	25,25	*	*	*	*	*	*	*
OSP-2S	D	10/88	*	<1	<2	<5	<1	50	<5	*	*	*	*	*	*	*

D - Dissolved concentrations
* - Not Analyzed
** - All units in micrograms per liter (ppb) except where noted with ** which are in milligrams per liter (ppm)

Table 6.7 - Summary of Dissolved Metals Data for Deep Wells**

Location		Date	SS**	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ba	Fe**	Al**	Ag
On-Site - East																
OSP-1D	D	10/88	*	1	<2	<5	<1	14	<5	*	*	*	*	*	*	*
LW-13D	D	2/88	*	6	31	<9	<3	10	8	*	*	*	*	*	*	*
	D	7/88	*	<1	<2	<5	<1	14	<5	*	*	*	*	*	*	*
	D	2/89	*	*	*	<5	*	33	<5	*	*	*	*	*	*	*
On-Site - Middle																
MW-2DR	D	10/88	*	<1	<2	<5	<1	21	<5	*	*	*	*	*	*	*
DM-2D	D	7/86	290	<1	<5	<10	<5	16	70	<1	*	*	*	*	*	*
	D	10/88	*	<1	<2	<1	<1	13	16	*	*	*	*	*	*	*
LW-5D	D	7/88	*	<1	2	6	<1	34	6	*	*	*	*	*	*	*
DM-3D	D	7/86	*	*	<2	<10	<1	14	110	2	*	*	*	*	*	*
	D	7/88	*	<1	3	<5	<1	21	70	*	*	*	*	*	*	*
LW-10D	D	7/88	*	<1	<2	5	2	11	8	*	*	*	*	*	*	*
OW-5D	D	7/88	*	<1	<2	<5	<1	390	<5	*	*	*	*	*	*	*
OW-4D	D	7/88	*	<1	<2	<5	<1	19	13	*	*	*	*	*	*	*
LW-3D	D	2/89	*	*	*	8	*	110	<5	*	*	*	*	*	*	*
On-Site - West and South																
OSP-7D	D	10/88	*	<1	<2	18	<1	19	11	*	*	*	*	*	*	*
	D	2/89	*	*	*	12	*	29	<5	*	*	*	*	*	*	*
LW-1D	D	7/88	*	<1	3	7	4	26	<5	*	*	*	*	*	*	*
LW-6D	D	7/88	*	1	<2	8	<1	24	12	*	*	*	*	*	*	*
	D	2/89	*	*	*	11	*	16	10	*	*	*	*	*	*	*
LW-9D	D	7/88	*	<1	<2	7	2	15	8	*	*	*	*	*	*	*
	D	2/89	*	*	*	6	*	17	8	*	*	*	*	*	*	*
LW-12D	D	7/88	*	<1	<2	5	<1	13	<5	*	*	*	*	*	*	*
	D	2/89	*	*	*	<5,7	*	28,68	<5,6	*	*	*	*	*	*	*
Off-Site - West and South																
OSP-6D	D	10/88	*	<1	5	<5	<1	21	10	*	*	*	*	*	*	*
OSP-5D	D	10/88	*	<1	2	<5	<1	16	<5	*	*	*	*	*	*	*
OSP-4D	D	10/88	*	2	<2	<5	<1	11	42	*	*	*	*	*	*	*
	D	2/89	*	*	*	*	*	*	42,45	*	*	*	*	*	*	*
OSP-3D	D	10/88	*	<1	<2	<5	<1	8	6	*	*	*	*	*	*	*
OSP-2D	D	10/88	*	<1	<2	<5	<1	10	<5	*	*	*	*	*	*	*
	D	2/89	*	*	*	<5	*	25	<5	*	*	*	*	*	*	*
MW-5	D	6/86**	*	4	9	<10	3	24	<5	2	<1	<5	*	*	*	3
		2/88	*	11	<31	<9	<3	<6	<7	*	*	*	*	*	*	*
MW-4	D	6/86**	*	3	4	<10	1	23	<5	<1	<1	<5	*	*	*	2
	D	2/88	*	11	48	<9	<3	12	<7	*	*	*	*	*	*	*

NOTES: ** - All units ug/L (ppb) unless indicated with **, ** - mg/L (ppm)
* - not analyzed

Table 6.8 - Summary of Total Metals Data for Shallow Wells**

Location (Screen Depth)		Date	SS**	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ba	Fe**	Al**	Ag
MW-1	T	6/84	*	8	11	6	<2	4	12	1	<1	<5	*	*	*	<1
(18' -	T	12/84	*	<20	40	<5	10	180	8	<1	*	*	*	*	*	<50
23')	T	6/85	*	<20	<10	<2	<10	30	7	<4	*	*	*	*	*	<250
MW-2I	T	6/84	*	2	19	<5	<2	7	5	1	<1	<5	*	*	*	<1
(18' -	T	12/84	*	40	30	<5	10	150	7	<1	*	*	*	*	*	<50
23')	T	6/85	*	<20	<10	<2	<10	10	15	<4	*	*	*	*	*	<250
MW-3I	T	6/84	*	42	29	12	16	130	25	2	<1	<5	*	*	*	<1
(16' -	T	12/84	*	20	30	<5	<10	140	15	<1	*	*	*	*	*	<50
21')	T	6/85	*	<20	<10	<2	<10	40	17	<4	*	*	*	*	*	<250
	T	2/86	*	38	40	22	38	174	100	<5	<0.3	<50	220	17	14	11
MW-4S	T	2/86	*	21	20	19	16	46	<10	<5	<0.2	<5	<200	23	4	10
(2-3)	R															
Off-Site																
LMW-1S (6'- 16')	T	7/89		<1	<2	<5	<1	16	10	<1	<1	<5	*	*	*	*
LMW-2S (6'- 15.5')	T	7/89		<1	4	<5	<1	14	9	<1	<1	<5	*	*	*	*
LMW-4 (4.5'- 9.0')	T	7/89		<1	<2	<5	<1	4	8	<1	<1	<5	*	*	*	*

NOTES: ** - All units in micrograms per gram (ppb) except if noted with **, which are in milligrams per liter (ppm).
* - Not analyzed.

Table 6.9 - Summary of Total Metals Data for Deep Wells**

Location		Date	SS**	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ba	Fe**	Al**	Ag
East Site																
LW-7D	T	6/86	260	12	8	20	10	23	50	<1	<1	*	*	32	31	*
LW-13D	T	6/86	340	*	12	<10	19	39	<200	<1	*	*	*	*	*	*
Middle Site																
MW-2D	T	12/84	*	50	30	15	10	90	36	<1	*	*	*	*	*	<50
(35-40)	T	6/85	*	<20	<10	<2	<10	30	4	<4	*	*	*	*	*	<250
	T	7/86	600	6	<5	<10	<5	24	50	<1	*	*	*	*	*	*
LW-2D	T	6/86	300	18	15	50	14	28	80	<1	<1	*	*	36	36	*
LW-3D	T	6/86	320	13	12	10	10	26	20	<1	<1	*	*	18	17	*
LW-5D	T	6/86	140	5	5	40	<5	17	60	<1	<1	*	*	28	28	*
LW-8D	T	6/86	92	NA	<5	<5	6	270	30	<1	<1	*	*	*	*	*
LW-10D	T	7/86	620	NA	22	<10	31	60	100	<1	<1	*	*	*	*	*
LW-11D	T	6/86	2,700	81	65	<10	80	130	80	<1	4	*	*	74	72	*
West and South Site																
LW-1D	T	6/86	370	14	11	10	12	27	100	<1	<1	*	*	52	52	<10
LW-6D	T	6/86	370	5	6	50	<5	14	90	<1	<1	*	20@	49	50	2@
LW-9D	T	6/86	360	35	16	<5	22	45	<200	<1	<1	<200	60	*	*	*
MW-4	T	2/88	*	5	<20	<5	<5	17	<10	<5	<0.2	<5	<200	6	2	6
MW-5	T	2/88	*	36	40	5	36	48	12	<5	<0.2	<5	<200	31	19	6
Off-Site																
LMW-1D (31' - 39')	T	7/89		<1	2	5	<1	15	5	<1	<1	<5	*	*	*	*
LMW-2D (29'- 39.5')	T	7/89		<1	<2	<5	<1	28	<5	<1	<1	<5	*	*	*	*

NOTES: ** - All units ug/L (ppb) except ** which are in milligrams per liter (ppm).
@ - Matrix interference from high iron and aluminum concentrations.

Table 6.10 - Comparison of Selected Total and Dissolved Metals**

Location		Date	SS**	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ba	Fe**	Al**	Ag
LW-9S	D	7/88	*	1	<2	9	1	15	15	*	*	*	*	*	*	*
	T	7/88	*	6	<2	9	5	24	27	*	*	*	*	*	*	*
MW-3I	D	7/88	*	<1	<2	<5	1	23	17	*	*	*	*	*	*	*
(16' - 21')	T	7/88	*	22	10	16	14	88	28	*	*	*	*	*	*	*
OSP-2S	D	10/88	*	<1	<2	<5	<1	50	<5	*	*	*	*	28	*	*
	T	10/88	*	15	80	14	120	230	<5	*	*	*	*	*	*	*

NOTES: ** - All units in micrograms per liter (ppb) except if noted with ** which are in millirgrams per liter (ppm).

- o The proposed Washington State Groundwater Quality Standards (WAC 173-290) use dissolved concentrations for most metals.

The contribution of particulate sources of soil-derived metals to water withdrawn from the PACCAR monitoring wells was evaluated as the product of background soil concentrations (METRO, 1985a) and total suspended solids (TSS) data collected previously at the PACCAR facility. These calculations were based on the realistic assumption that all of the TSS concentration observed in water samples withdrawn from the monitoring wells was derived from particulate migration of aquifer materials into the wells, largely as a result of sampling activities. As stated previously, the observed TSS levels in on-site monitoring wells were relatively high (mean = 466 mg/L), which is reflective of the rather fine-grained texture of many of the aquifer materials.

The calculated "natural" particulate metal inputs are summarized in Table 6.11. For some of the metals such as chromium, lead, and nickel, the calculated natural inputs are considerably greater than dissolved metal concentrations measured at the PACCAR site. These results suggest that natural soil inputs resulting from monitoring well sampling activities may be sufficient to substantially increase the apparent total metals concentration. In situations such as this where TSS levels can not be easily reduced to low levels by the use of alternative sampling techniques, sample filtering is necessary in order to obtain a representative sample of groundwater transported through the aquifer. For all samples collected in 1988, great care was taken during the field filtering activity to prevent sample oxidation which could potentially alter the sample matrix. Only dissolved metal data collected with appropriate field techniques are discussed in the remaining sections of this report.

Table 6.11 - Evaluation of Particulates Present in On-Site Monitoring Wells

	Background Soil Conc. in mg/kg (dry weight) (a)		Predicted "Natural" Particulate Conc. in ug/L (b)		Measured Dissolved Conc. in ug/L (c)	
Parameter	Mean	Upper 95 Percent(d)	Mean	Upper 95 Percent	Mean	Upper 95 Percent
Arsenic	13.43	38.85	6.3	21.3	22.1	76.3
Cadmium	0.55	1.83	0.3	0.9	<1.0	3.5
Chromium	42.60	61.50	19.8	58.8	<3.0	10.3
Copper	14.01	21.63	6.5	19.1	5.7	22.8
Lead	31.60	63.83	14.7	45.1	<5.0	18.6
Nickel	40.65	67.67	18.9	56.7	<5.0	16.6
Silver	0.50	0.93	0.2	0.9	<5.0	9.0
Zinc	56.77	82.48	26.4	79.1	35.9	136.1

(a) Background soil data based on METRO, 1985a.
(b) Based on a measured average total suspended solids concentration of 466 mg/L, and an upper 95th percentile value of 1,950 mg/L, with variance propagated using first-order uncertainty techniques (Cornell, 1973).
(c) On-site dissolved metal concentration measured at the PACCAR facility, 1986 to 1988.
(d) Concentrations which fall within the upper 95 percent confidence interval.

Shallow Groundwater Samples
(less than 25 feet in depth)

Dissolved lead, zinc, and arsenic were the only metals consistently detected in groundwater samples from depths less than about 25 feet (Table 6.6). Copper, nickel, chromium, cadmium, mercury, selenium, barium, and silver were generally not detected. Figures 6.76, 6.77, and

6.78 show the distribution of arsenic, lead, and zinc concentrations in shallow groundwater.

Dissolved arsenic concentrations ranged between <5 ug/L to about 130 ug/L, although an arsenic concentration of 0.160 mg/L (160 ug/L) of one sample from well LW-11S was reported based on a sample analyzed by Landau Associates in 1986. If the latest sampling round at each location is considered, a narrower and lower concentration range was detected; <5 to 73 ug/L. Much lower arsenic concentrations were detected adjacent to well LW-11S as compared with the 1986 analysis.

Arsenic was detected between <5 ug/L to about 27 ug/L in off-site wells. The highest off-site arsenic concentration was detected in well MW-10 located to the southwest of the site.

Dissolved lead concentrations ranged between <5 ug/L to 40 ug/L although most concentrations were measured to be below 10 ug/L. The highest off-site concentration was detected at OSP-7S at 22 ug/L. Other off-site concentrations were measured to be 11 ug/L or less. The water quality data for shallow groundwater indicate that the high lead concentrations measured in soils have not had a substantial impact on groundwater quality beneath the site.

Dissolved zinc concentrations ranged between 10 and 61 ug/L. Off-site concentrations were measured in the range of 10 to 50 ug/L.

Deep Groundwater Samples
(greater than 25 feet in depth)

Similar to the shallow groundwater samples, dissolved lead, zinc, and arsenic were the only metals consistently detected in groundwater samples from depths greater than about 25 feet (Table 6.7). Copper, nickel, chromium, cadmium, mercury, selenium, barium, and silver were generally not detected. Figures 6.79, 6.80, and 6.81 show the distribution of arsenic, lead, and zinc concentrations in deep groundwater samples.

Dissolved arsenic concentrations ranged between <5 ug/L to 110 ug/L. The highest concentrations were measured within the northern portion of the site. Off-site arsenic concentrations ranged from <5 ug/L to 45 ug/L. The highest concentrations were measured at OSP-4D.

Dissolved lead concentrations ranged between <5 ug/L to 30 ug/L with most concentrations being below the detection limits. No lead was detected at off-site sampling locations (detection limit of 5 ug/L or 5 ppb) except for OSP-7D (12 ppb) and LMW-1D (5 ppb).

Dissolved zinc concentrations ranged between 8 ug/L and 110 ug/L. One sample from OW-5D had a concentration of 390 ug/L, although concentrations of 11 and 19 ug/L were detected in nearby adjacent wells OW-4D and LW-10D, respectively. Off-site zinc concentrations ranged between 3 ug/L and 29 ug/L.

Wet Weather Sampling

With the approval of Ecology a wet weather sampling program was conducted during the week of February 6, 1989. Selected wells were sampled and analyzed for various chemical constituents including volatile and semivolatile organic compounds, and dissolved arsenic, lead, and zinc (see Tables 6.6 and 6.7). The purpose of the sampling was to obtain additional data to assess whether water quality varied between wet and dry weather conditions.

The water quality results from the wet weather sampling event are in close agreement with the results of previous sampling events. For example, at LW-3D we measured vinyl chloride concentrations of 0.041 ppm in July 1988 and 0.038 ppm in February 1989. Dissolved arsenic concentrations measured at OSP-4D in February 1989 (42 ppb and 45 ppb) were similar to concentrations detected in the October 1988 sampling event (42 ppb).

Vinyl chloride and Cis-1,2-dichlorethene were detected in LW-3S during the February 1989 sampling program at concentrations of 10 and 2 ppb, respectively. These volatile chemicals were not detected in previous sampling events. However this variability is consistent with the results of previous sampling results on the site.

Comparison of Arsenic Analytical Methods

During the sampling and analysis a question arose concerning the reliability of the analytical method for arsenic in groundwater. Several methods are available including SW 7060-inductively coupled plasma atomic emission spectroscopy and SW 7061- atomic absorption gaseous hydridge. Dissolved arsenic was determined by Method SW 7061 per the RI/FS work plan dated May 27, 1988.

To resolve the question of analytical reliability, groundwater samples from OSP-4D, LW-12S, and MW-10 were analyzed for arsenic using the two methods listed above. A Zeman graphite furnace was used with Method 7060. As shown in Tables 6.6 and 6.7 the analytical results are similar and we consider the data obtained using Method 7061 to be reliable for use in this RI.

6.4 SURFACE WATER AND SEDIMENTS

6.4.1 Surface Water Quality

On-Site - Water samples have been obtained from the two (2) major surface drainage channels (SW-3 and SW-4 located on Figure 1.5) which exist on the north side of the site and in Johns Creek and the Cedar River. Selected data are listed in Table 6.12.

Volatile and pesticide compounds were not detected and only very low concentrations of two (2) phthalate compounds (diethylphthalate - 15 ppb and bis(2-ethylhexyl)phthalate - 2 to 21 ppb) were detected in the June 1984 sampling. The phthalate compounds were not detected in three (3) successive sampling rounds during December 1984, July 1985 (AGI), and October 1988 (Hart Crowser).

Low concentrations of dissolved and total metals were detected in surface water samples from the ditches. The highest arsenic concentration (total) was 5 ppb detected at SW-4 in June 1984 while the highest lead concentration was 24 ppb also detected in June 1984. Lower concentrations of these metals was measured in later sampling rounds. Copper ranged from 1 ppb to 30 ppb while zinc concentrations ranged between 4 and 370 ppb. While not listed in Table 6.12 cyanide, antimony, beryllium, and thallium were also analyzed at SW-3 and SW-4 and were not detected (detection limits of 5, 5, 2, and 2 ppb, respectively, were reported for these metals).

The results listed in Table 6.12 represent a variety of conditions of both low and high runoff periods. The first sample was taken on June 18, 1984, during a period of relatively low rainfall. Only a trace amount of precipitation has fallen during the previous week. The second sample taken on June 20, 1984, was obtained during a stormwater runoff event. On this date, 1.14 inches of rain were recorded at the SeaTac Airport. This represents 40 percent of the total of 2.81 inches which fell in June 1984.

A comparison of the surface water quality on the PACCAR site is compared with typical urban runoff (Table 6.13). As shown, the quality of the surface water migrating off-site is similar to or of better quality than that of runoff in urban residential neighborhoods.

Off-Site - Water samples were obtained from the Cedar River and Johns Creek (HNTB, 1984) which were analyzed for selected metals (Table 6.12). Generally, metals were not measured above the reported detection limits. These results are consistent with other water quality analyses of Cedar River water (METRO, 1982; Seattle Water Department unpublished data).

Table 6.12 - Summary of Selected Surface Water Quality Data Concentrations in ug/L (ppb)

Location		Date	Cu	Ni	Pb	Cr	Zn	As	Cd	Hg	Se	Ag	VOC	Semi VOC	Pest/ PCB
SW-3	T	6/84	1	<5	24	3	4	<5	1	<1	<5	<1	ND	a	ND
(SW-1)	T	12/84	30	20	<5	<10	70	<5	<1	*	*	<50	*	ND	ND
	T	7/85	<20	<10	4	<10	40	<2	<4	*	*	<250	*	ND	ND
	D	10/88	11	<2	<5	1	370	<5	*	*	*	*	ND	ND	*
Replicate	D	10/88	8	<2	<5	<1	360	<5	*	*	*	*	ND	ND	*
SW-4	T	6/84	19	<5	<5	<2	11	5	<1	<1	<5	<1	ND	b	ND
(SE-1)	T	12/84	30	20	<5	<10	80	<5	<1	*	*	<50	*	ND	ND
	T	7/85	<20	<10	<2	<10	<10	3	<4	*	*	<250	*	ND	ND
	D	10/88	5	<2	<5	1	40	<5	*	*	*	*	ND	ND	*
Johns Creek		6/84	7	*	<10	<5	*	<5	<2	<1	<5	<5	*	*	*
Cedar River (upstream)		6/84	<5	*	<10	<5	*	<5	<2	<1	<5	<5	*	*	*
Cedar River (downstream)		6/84	<5	*	<10	<5	*	<5	<2	<1	<5	<5	*	*	*

NOTES:
* - Not analyzed
ND - Not detected
a - Diethylphthalate @ 15 ppb
Bis(2-ethylhexyl)phthalate @ 2 ppb
b - Bis(2-ethylhexyl)phthalate @ 21 ppb
T - Total
D - Dissolved

Table 6.13 - Summary of Surface Water Quality at the PACCAR Site and in Local Runoff (b)

On-Site Chemical Data:	On-Site Water Concentration in ug/L Detection(c)	Mean	Upper 95 Percent	Regional Runoff Concentration in ug/L (a) Detection(c)	Mean	Upper 95 Percent
Metals:						
Arsenic	2/14	2	7	21/21	13	37
Cadmium						
Chromium	3/14	2	8	21/21	7	19
Copper	11/14	19	43	19/19	20	46
Lead	3/14	4	15	21/21	210	460
Nickel	2/13	8	22	12/21	12	32
Silver	0/12	<1	<5	1/20	<0.2	<1
Zinc	11/13	77	234	21/21	120	250
Volatiles:						
Benzene	0/10	<1	<5	2/21	1	13
1,2-Dichloroethane	0/10	<1	<5	0/21	<1	<1
Eth+Tol+Xyl(ETX)	1/10	<2	5	0/21	<1	<1
Vinyl Chloride	0/10	<1	<5	0/21	<1	<1
Semi-volatiles:						
Total PAHs	0/6	<4	<10	4/21	3	28
1,2-Dichlorobenzene	0/10	<1	<2	0/21	<1	<1
Hexachlorobenzene	0/10	<2	<4	0/21	<1	<1
Total PCBs	0/12	<0.1	<1	0/21	<1	<1

(a) Regional runoff concentrations based on data collected in residential areas of Bellevue (Galvin and Moore, 1982).
(b) Includes data not listed in Table 6.12.
(c) Number of detections versus number of samples analyzed.

6.4.2 Sediments

Samples were obtained at locations shown on Figure 1.3 from the bottom of the drainage ditches located on the north property line during July 1986. Sediment sample LSD-1, LSD-3, and LSD-4 were analyzed for metals, semivolatiles, and pesticides/PCBs as indicated in Table 6.14.

Low concentrations of volatiles and semivolatile organic chemicals were detected in sediments from LSD-1 and LSD-4. No semivolatile organic chemicals were detected at LSD-3. No pesticides were detected in LSD-1; however 3.1 mg/kg of the PCB, Aroclor- 1254 were detected at this location.

Lead, chromium, nickel, and zinc were detected at LSD-1 and LSD-4. These concentrations are within the range detected in soil samples on the site. EP Tox analyses for extractable lead, chromium, nickel, zinc, arsenic, copper, and cadmium were made. Only zinc was extracted above the limits of detection at 0.2 to 0.8 mg/L.

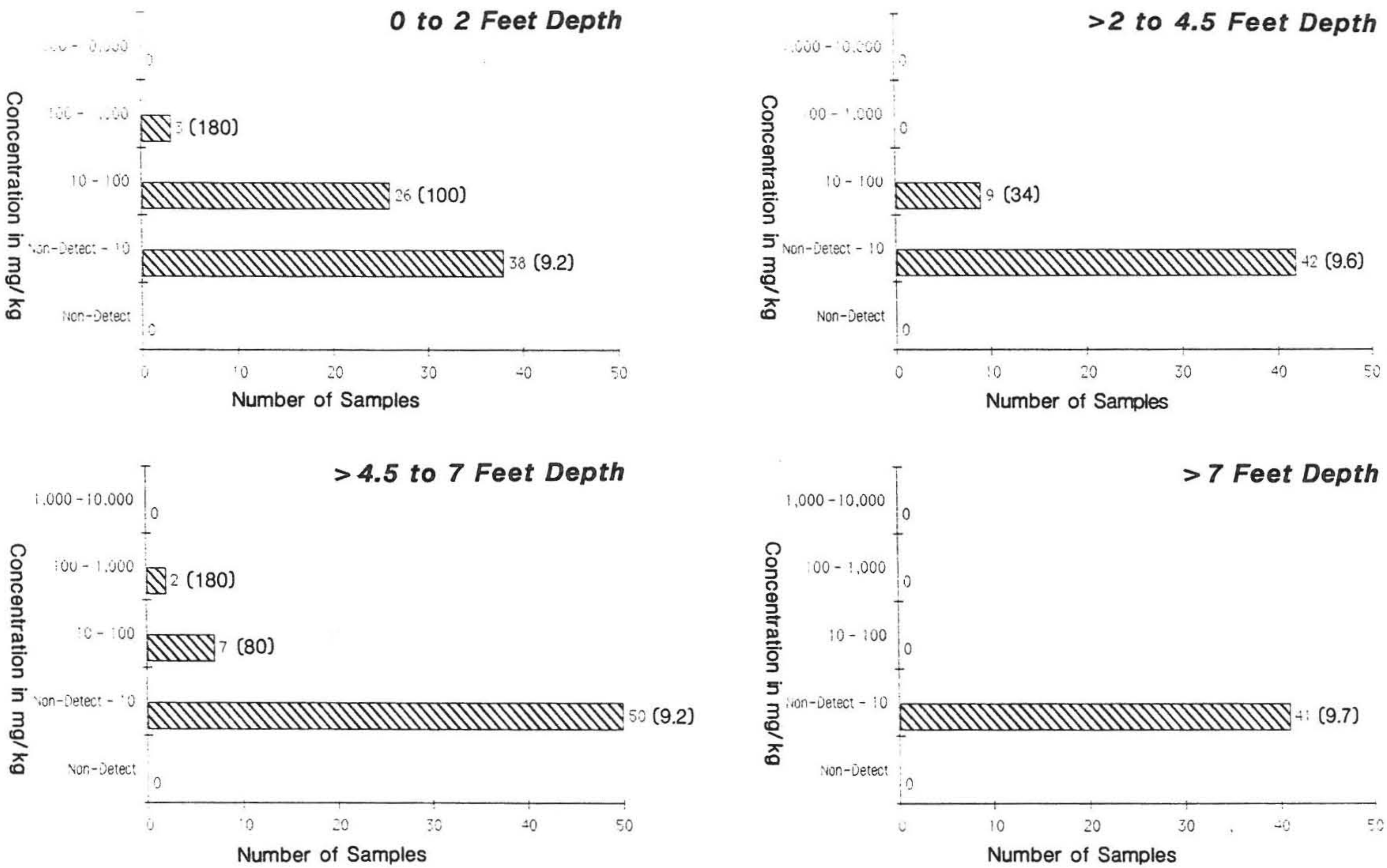
Table 6.14 - Summary of Sediment Data

Sample Location	LSD-1	LSD-3	LSD-4
Volatiles in mg/kg			
Total xylenes	0.020	*	none detected
Semivolatiles in mg/kg			
Phenanthrene	1.20		none detected
Benzo(a)Anthracene	0.65	none detected	none detected
Bis(2-ethylhexyl) Phthalate	9.0		0.710J
Di-n-Octyl Phthalate	11.0		none detected
Pesticides/PCBs in mg/kg			
Aroclor 1254	3.1	*	*
Metals**			
Lead	560/<0.5	*	110/<0.5
Chromium	200/<0.1	*	38/<0.1
Nickel	44/<0.1	*	49/<0.1
Zinc	1,200/0.8	*	270/0.2
Arsenic	*/<0.5	*	*/<0.5
Copper	*/<0.5	*	*/<0.1
Cadmium	*/<0.1	*	0.7/<0.1

* Not Analyzed
** Total Metal Concentration in mg/kg/EP Tox Concentration in mg/L
< Less than

Distribution of Total Arsenic Concentration Data

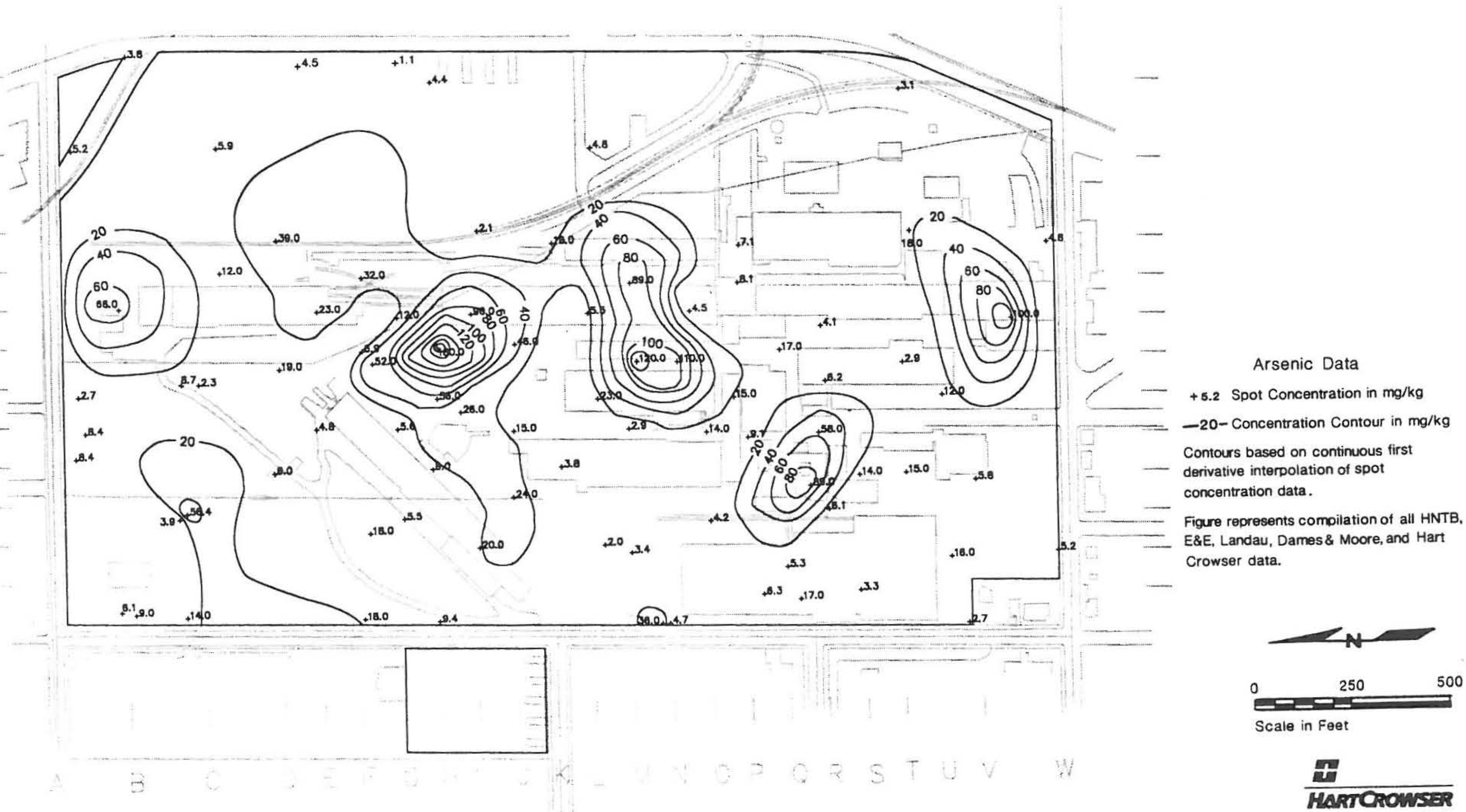
Regional background concentrations
for Arsenic - 5 to 30 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

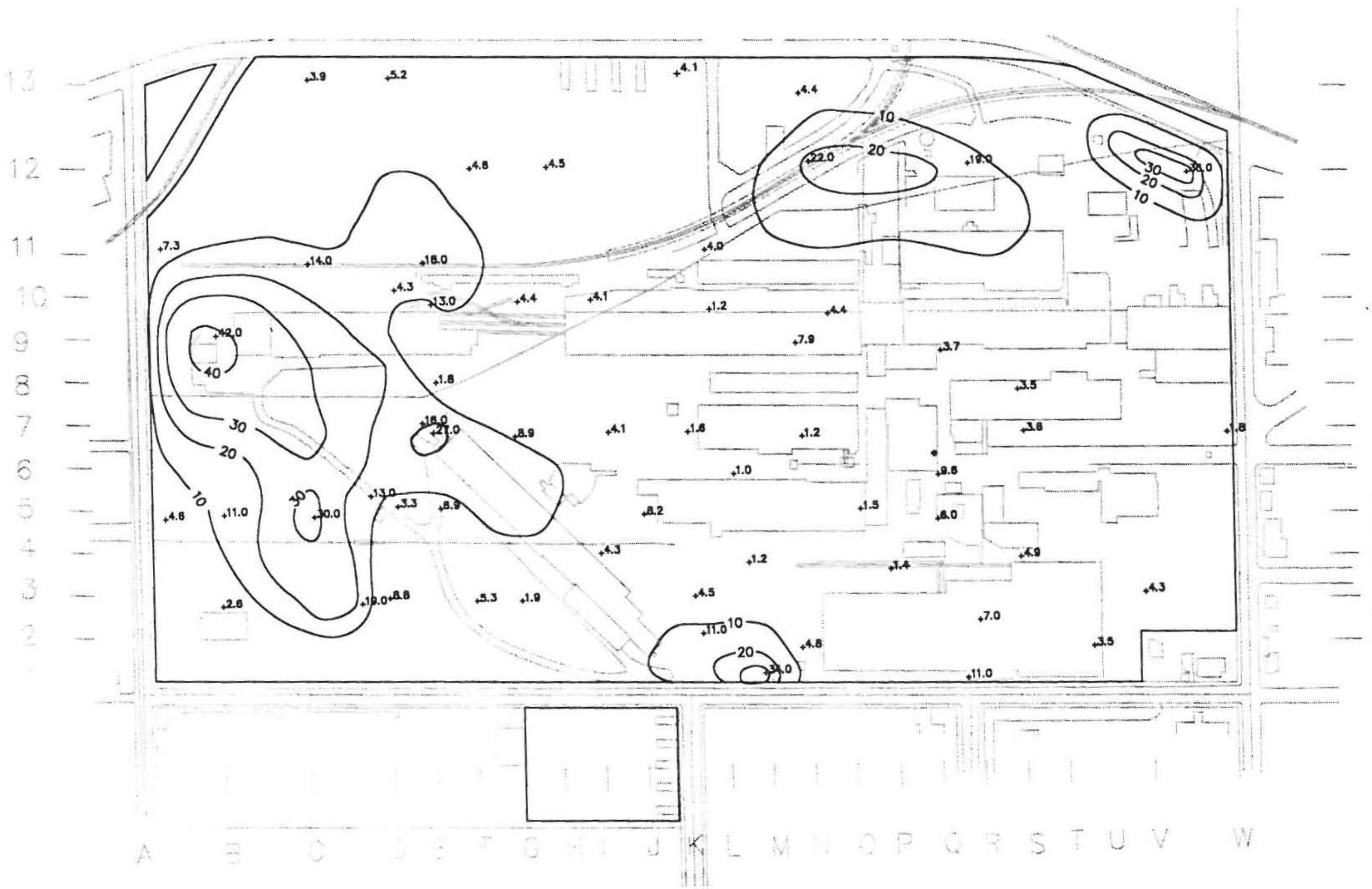
HARTCROWSER
J-1639-09 1/89
Figure 6.1

Distribution of Arsenic in Soil
(0 to 2 Feet Depth)



HARTCROWSER
J-1639-09 1/89
Figure 6.2

Distribution of Arsenic in Soil
(>2 to 4.5 Feet Depth)



Arsenic Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

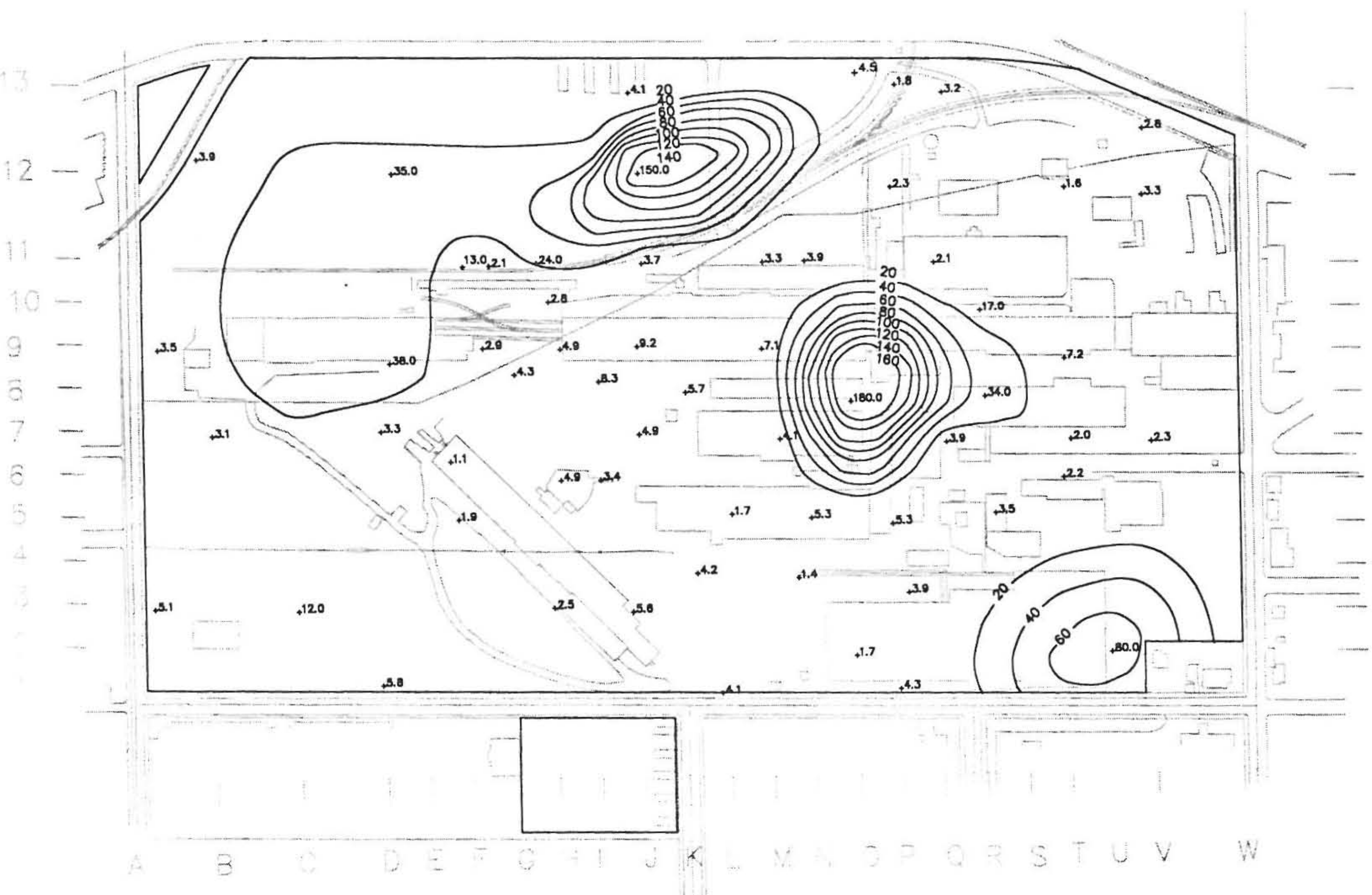
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.3

Distribution of Arsenic in Soil
(>4.5 to 7 Feet Depth)



Arsenic Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

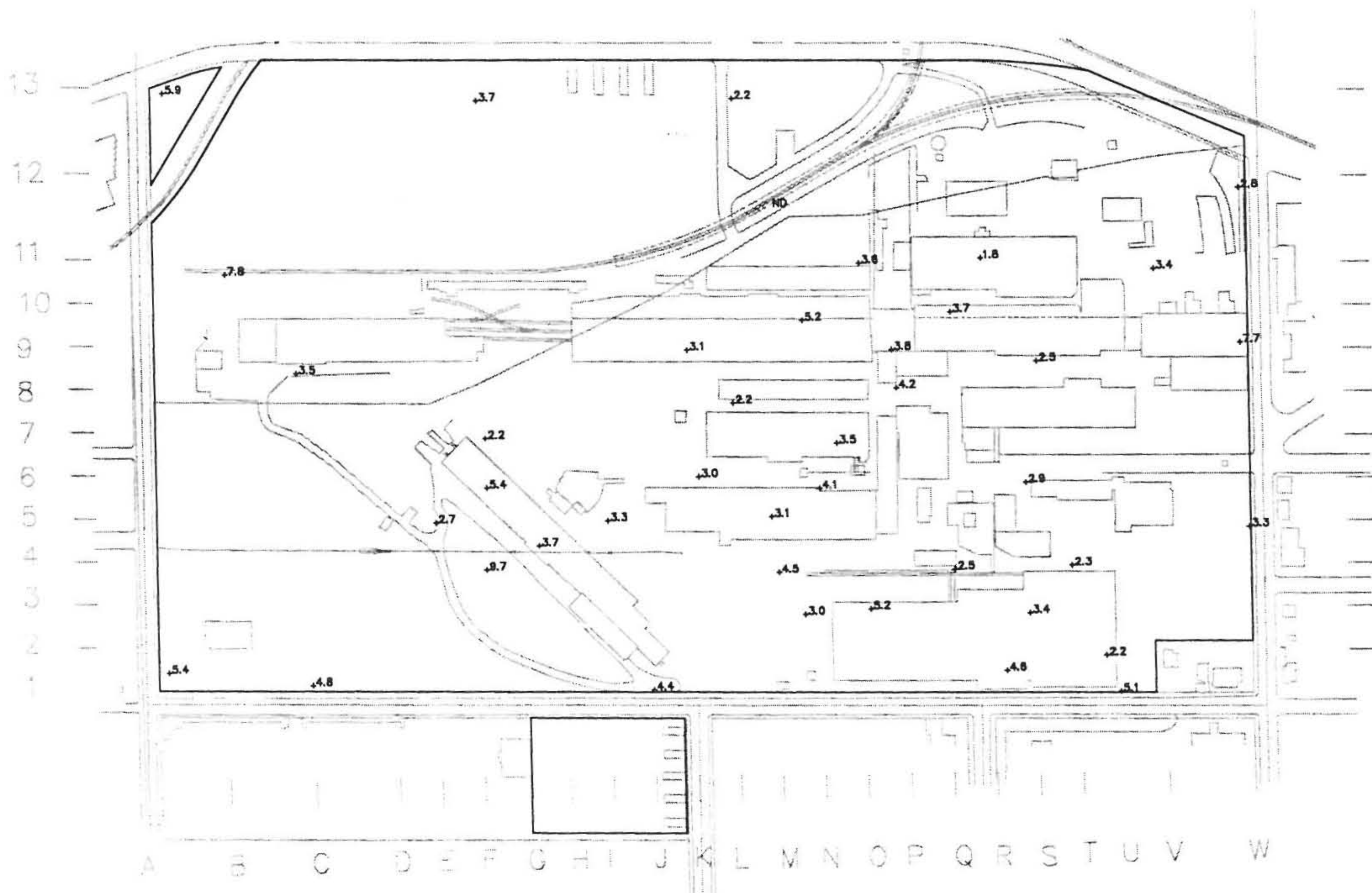
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.4

Distribution of Arsenic in Soil
(>7 Feet Depth)



Arsenic Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

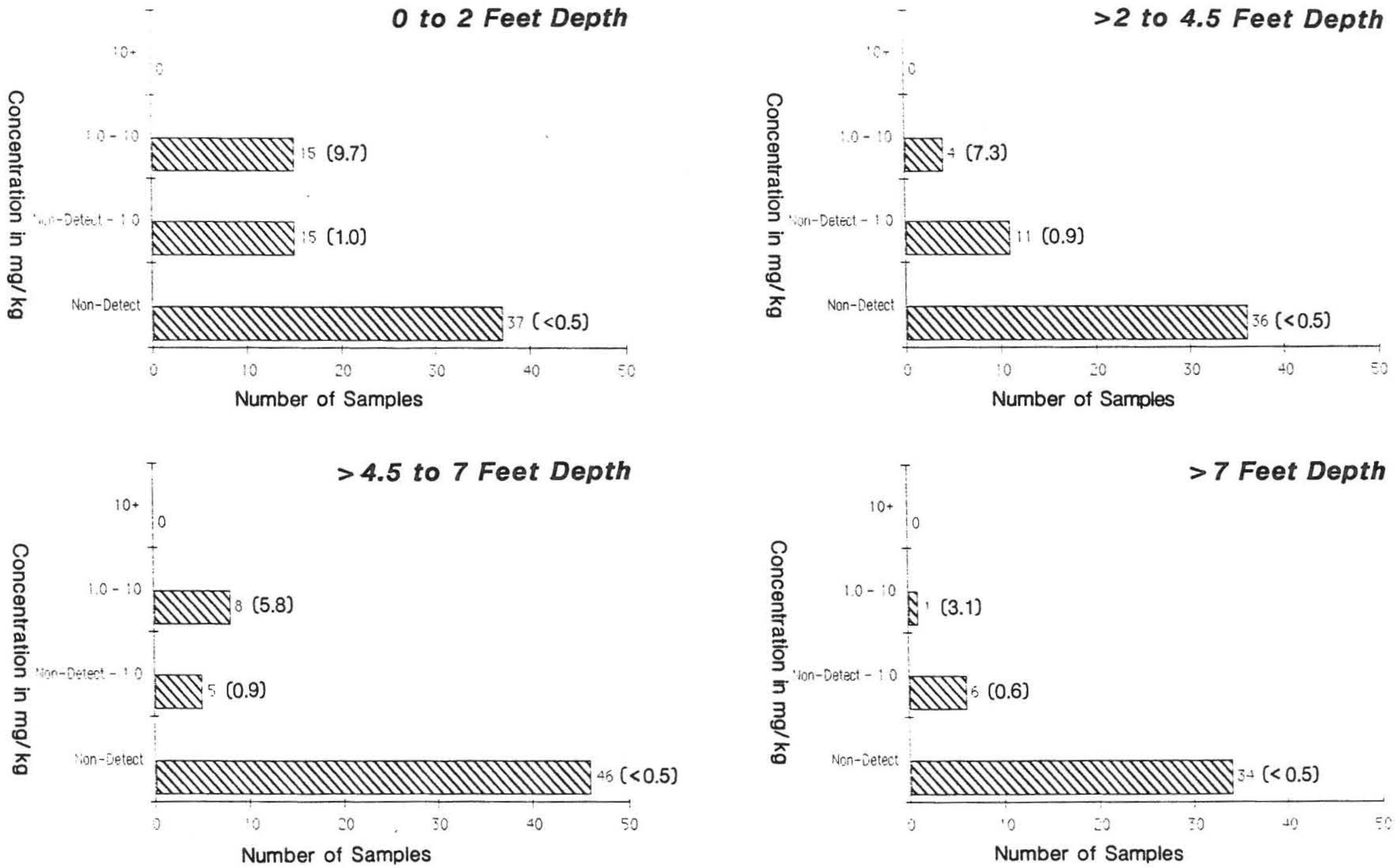
HARTCROWSER

J-1639-09 1/89

Figure 6.5

Distribution of Total Cadmium Concentration Data

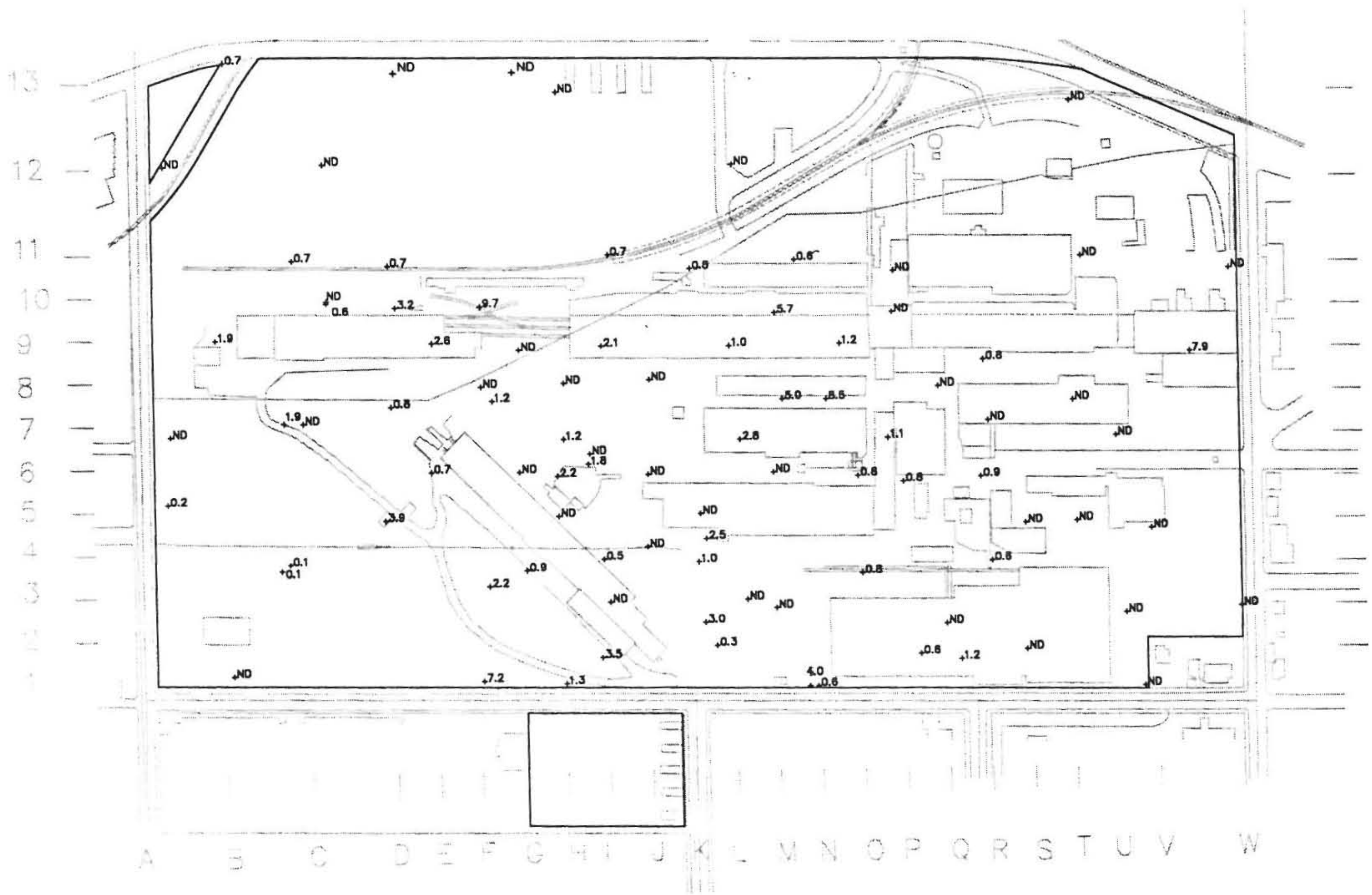
Regional background concentrations
for Cadmium - 0 to 1.4 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.6

Distribution of Cadmium in Soil
(0 to 2 Feet Depth)



Cadmium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

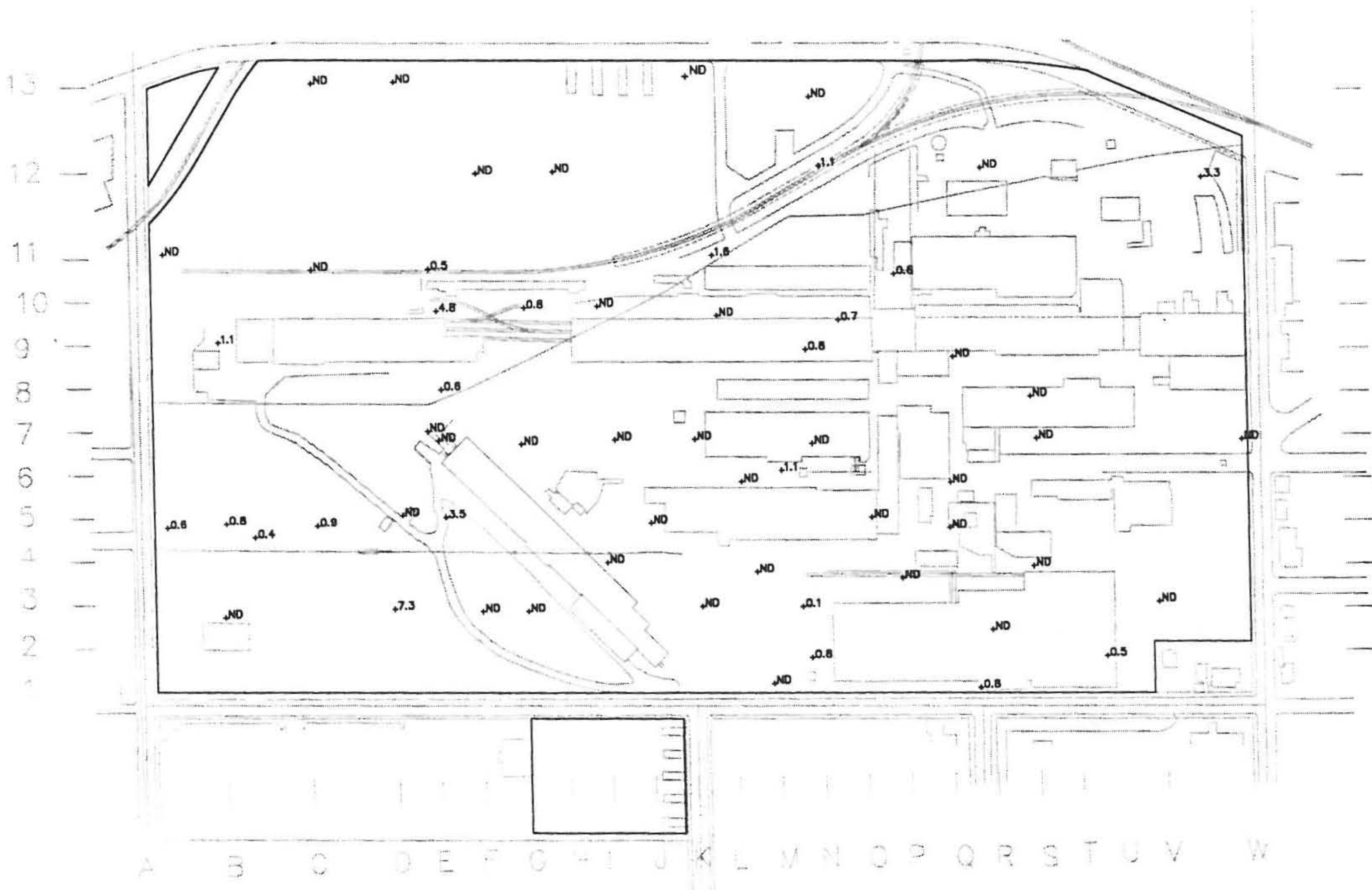
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.7

Distribution of Cadmium in Soil
(>2 to 4.5 Feet Depth)



Cadmium Data

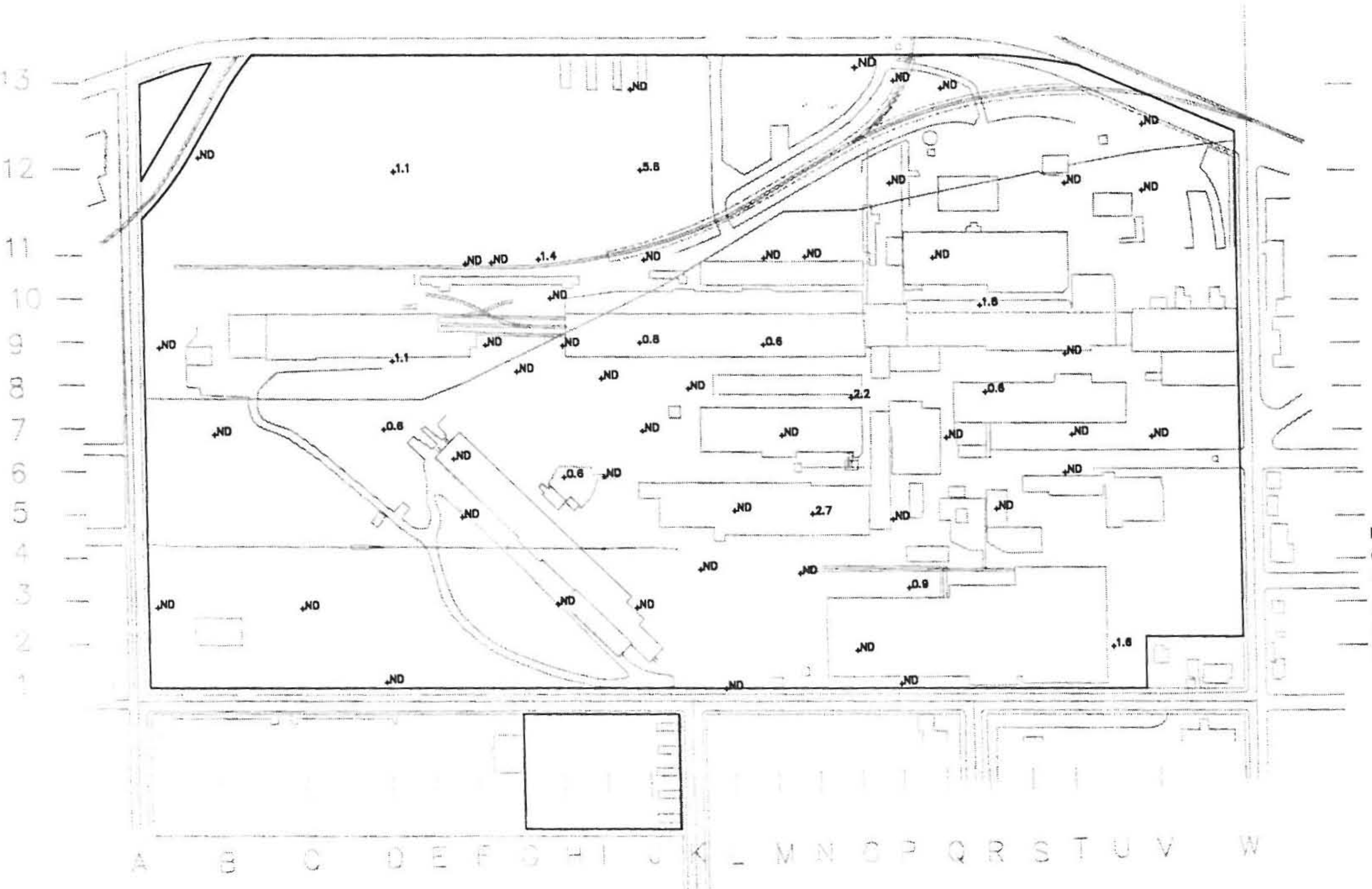
+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

HARTCROWSER
J-1639-09 1/89
Figure 6.8

Distribution of Cadmium in Soil
(>4.5 to 7 Feet Depth)



Cadmium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

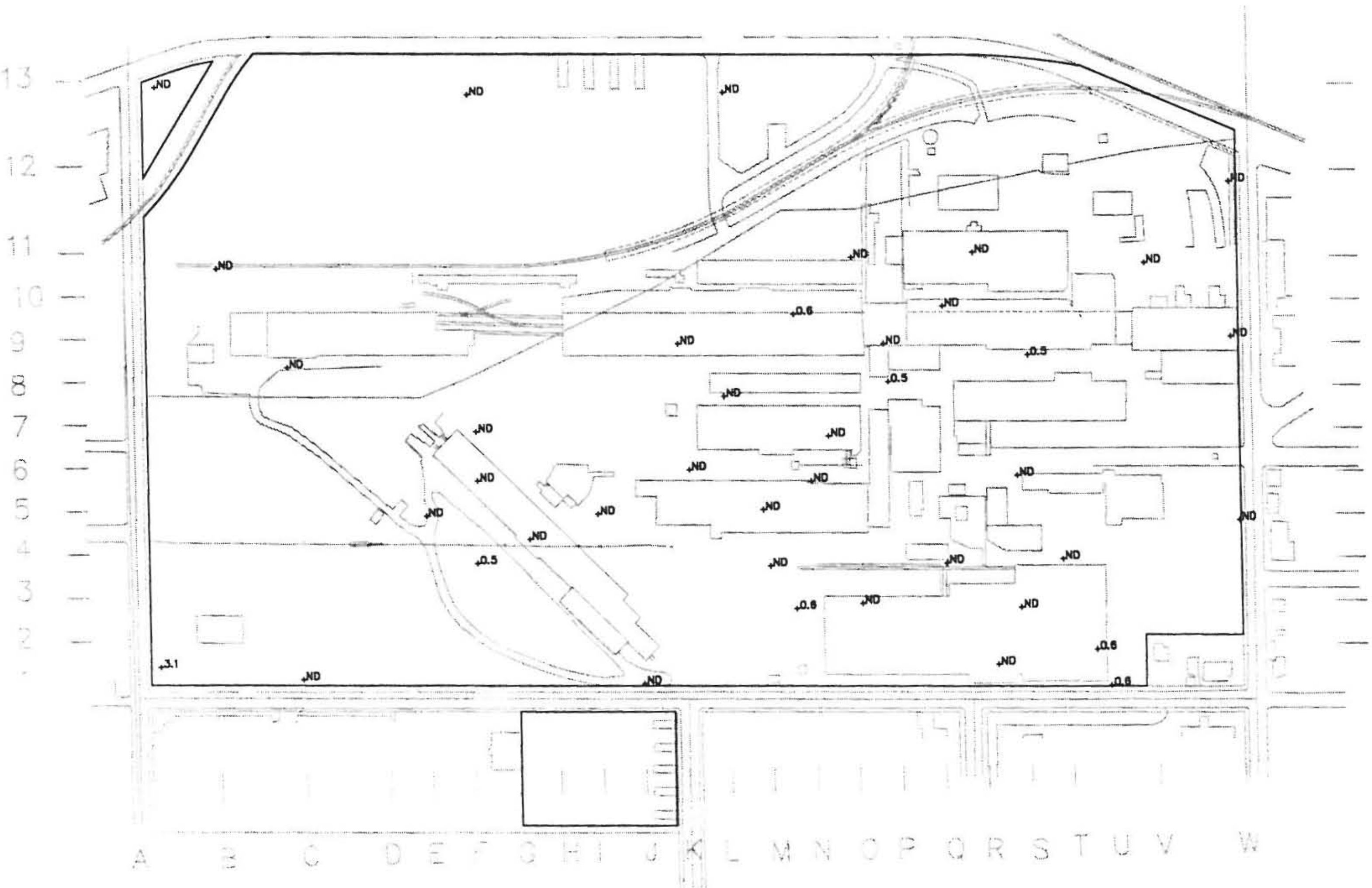
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.9

Distribution of Cadmium in Soil
(> 7 Feet Depth)



Camdium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

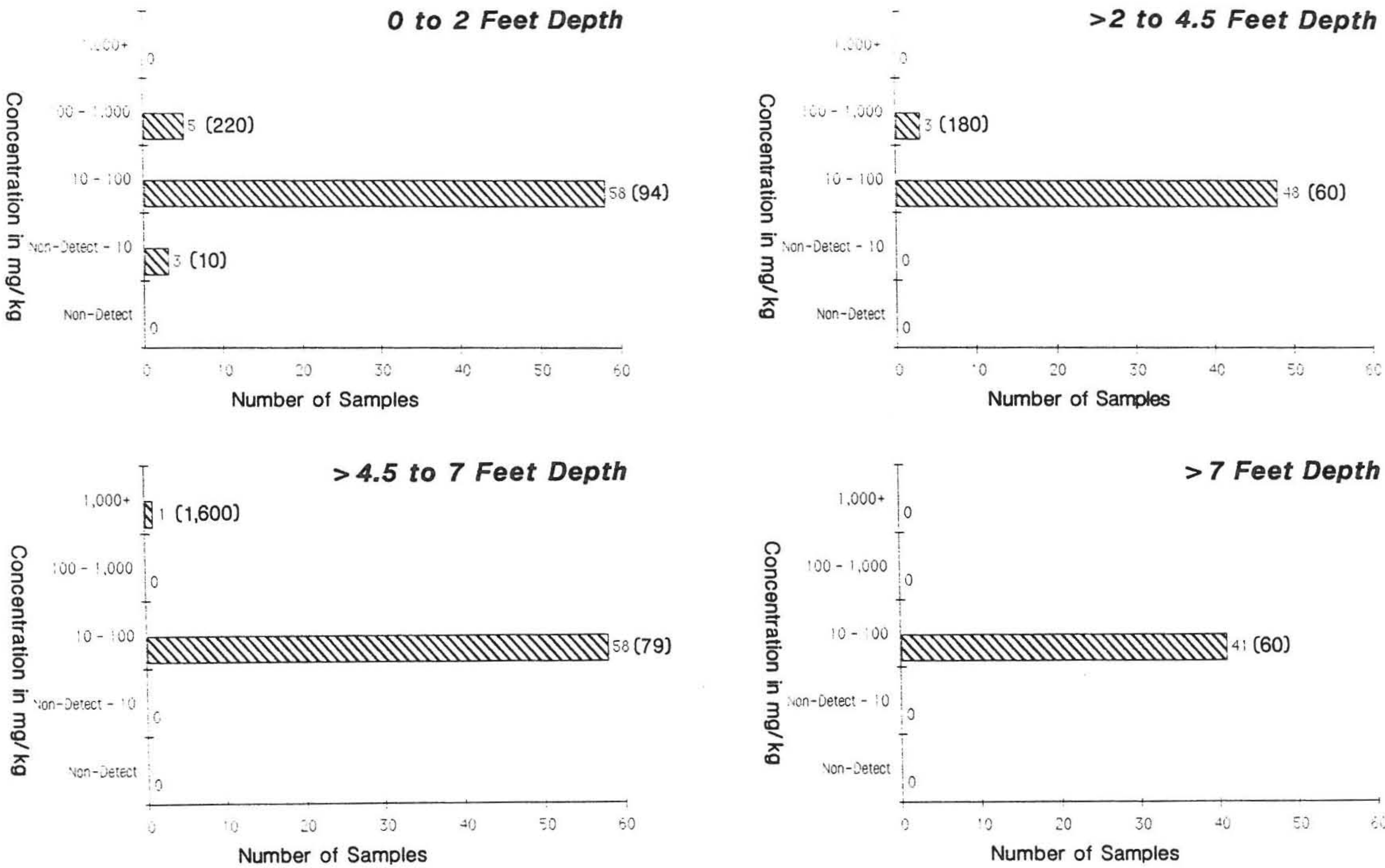
HARTCROWSER

J-1639-09 1/89

Figure 6.10

Distribution of Total Chromium Concentration Data

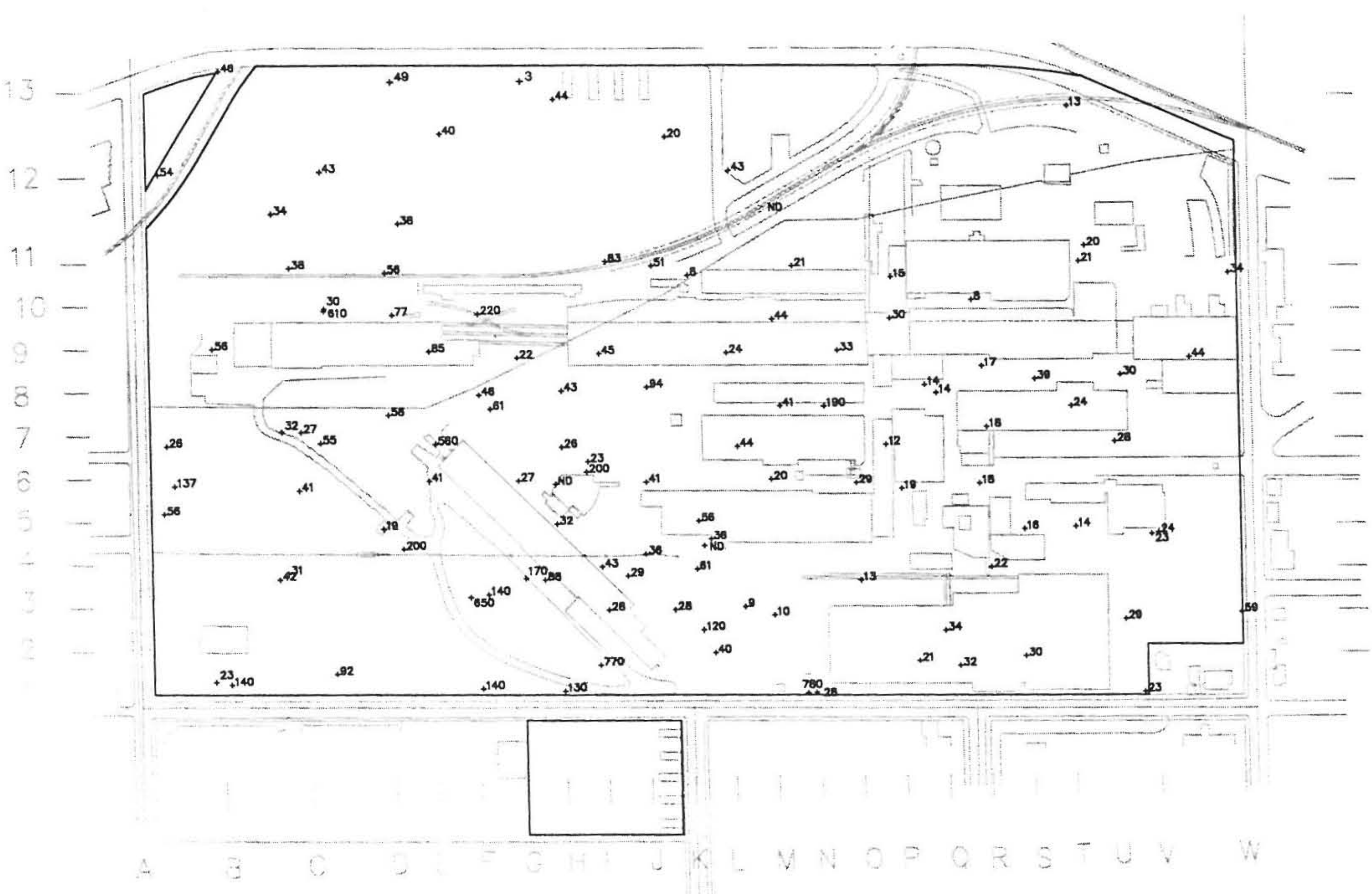
Regional background concentrations for Chromium - 10 to 70 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.11

Distribution of Chromium in Soil
(0 to 2 Feet Depth)



Chromium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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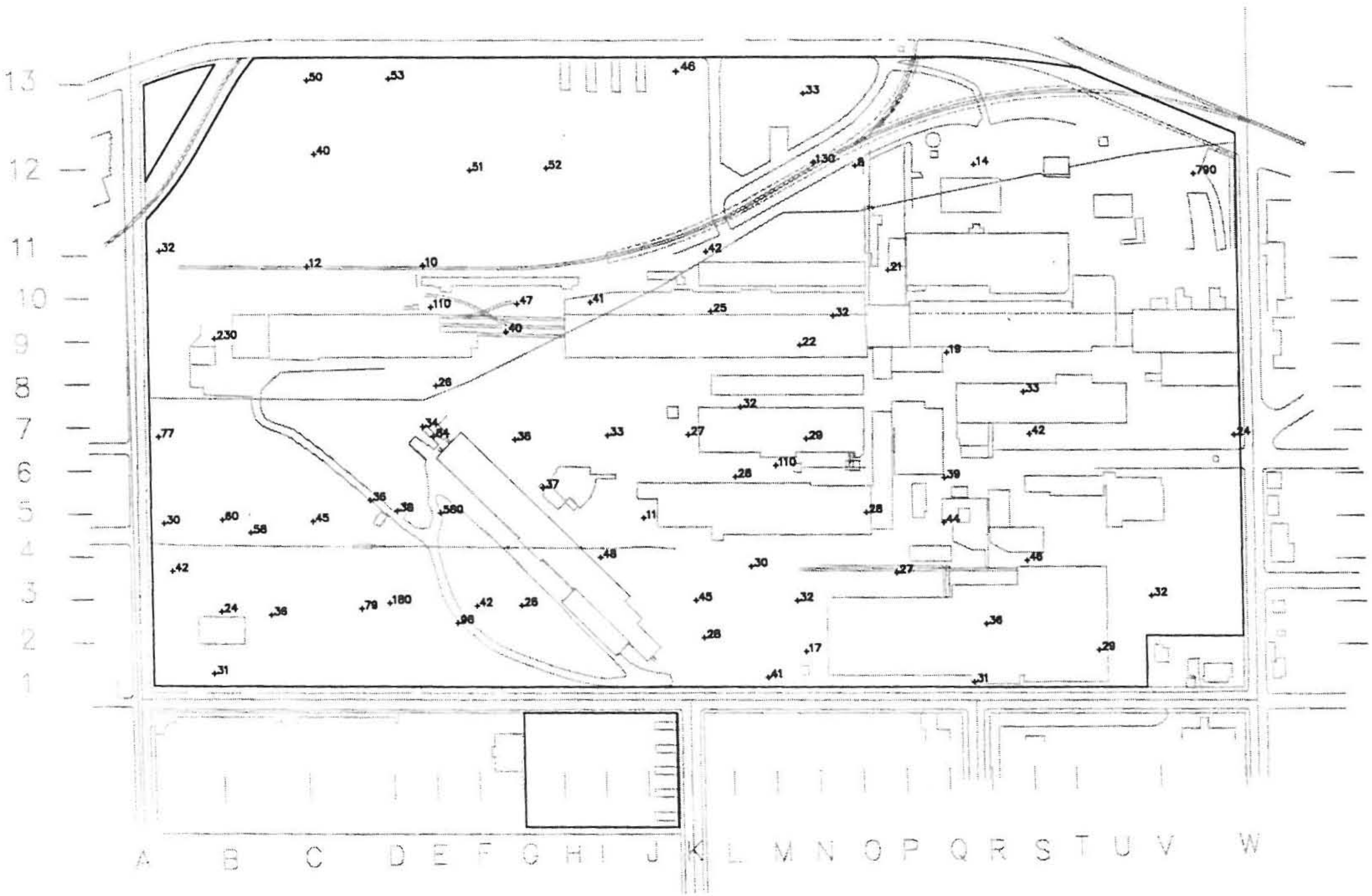
Figure 6.12

Distribution of Chromium in Soil
(> 2 to 4.5 Feet Depth)



Chromium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER
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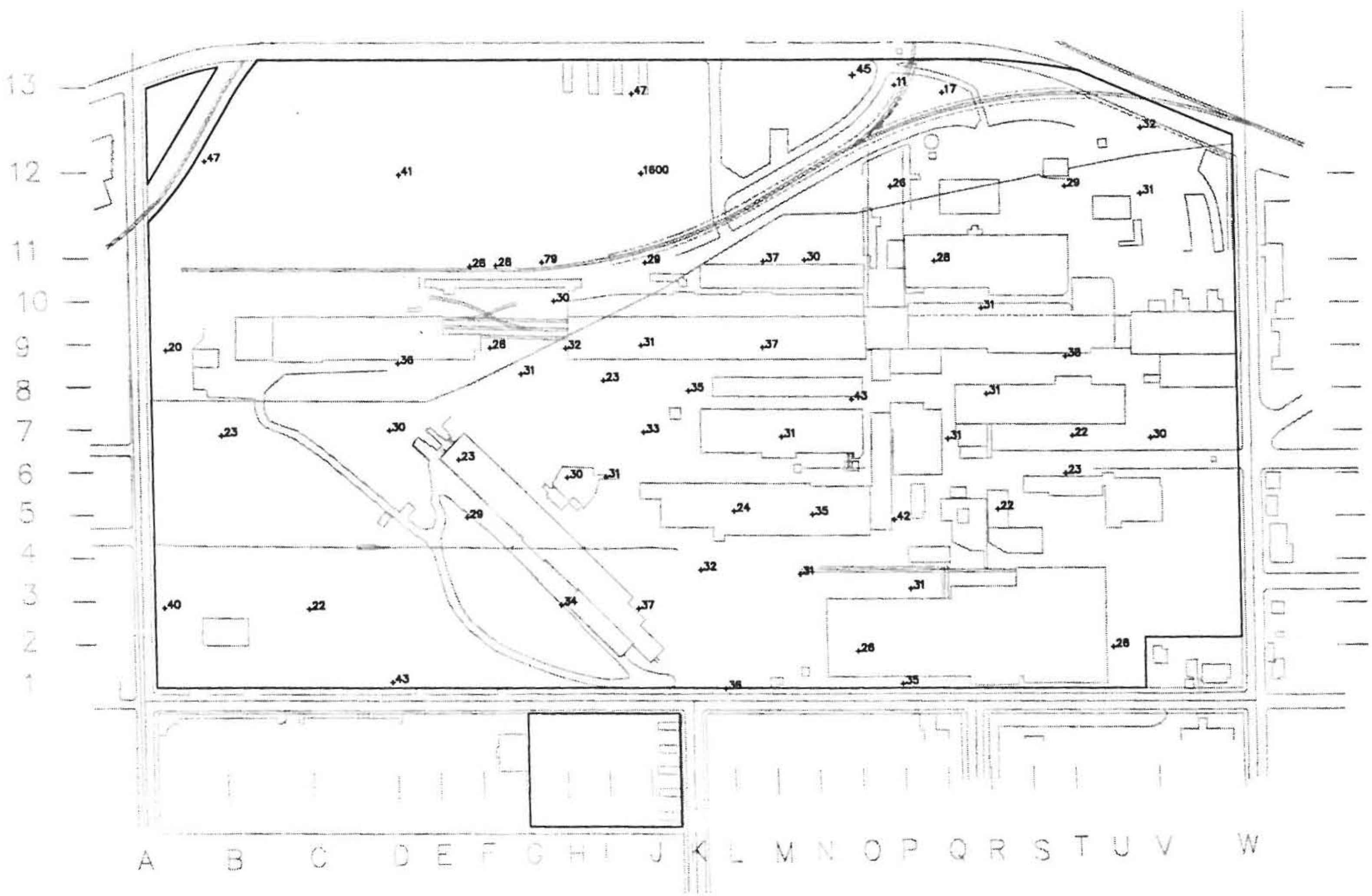
Figure 6.13

Distribution of Chromium in Soil
(> 4.5 to 7 Feet Depth)



Chromium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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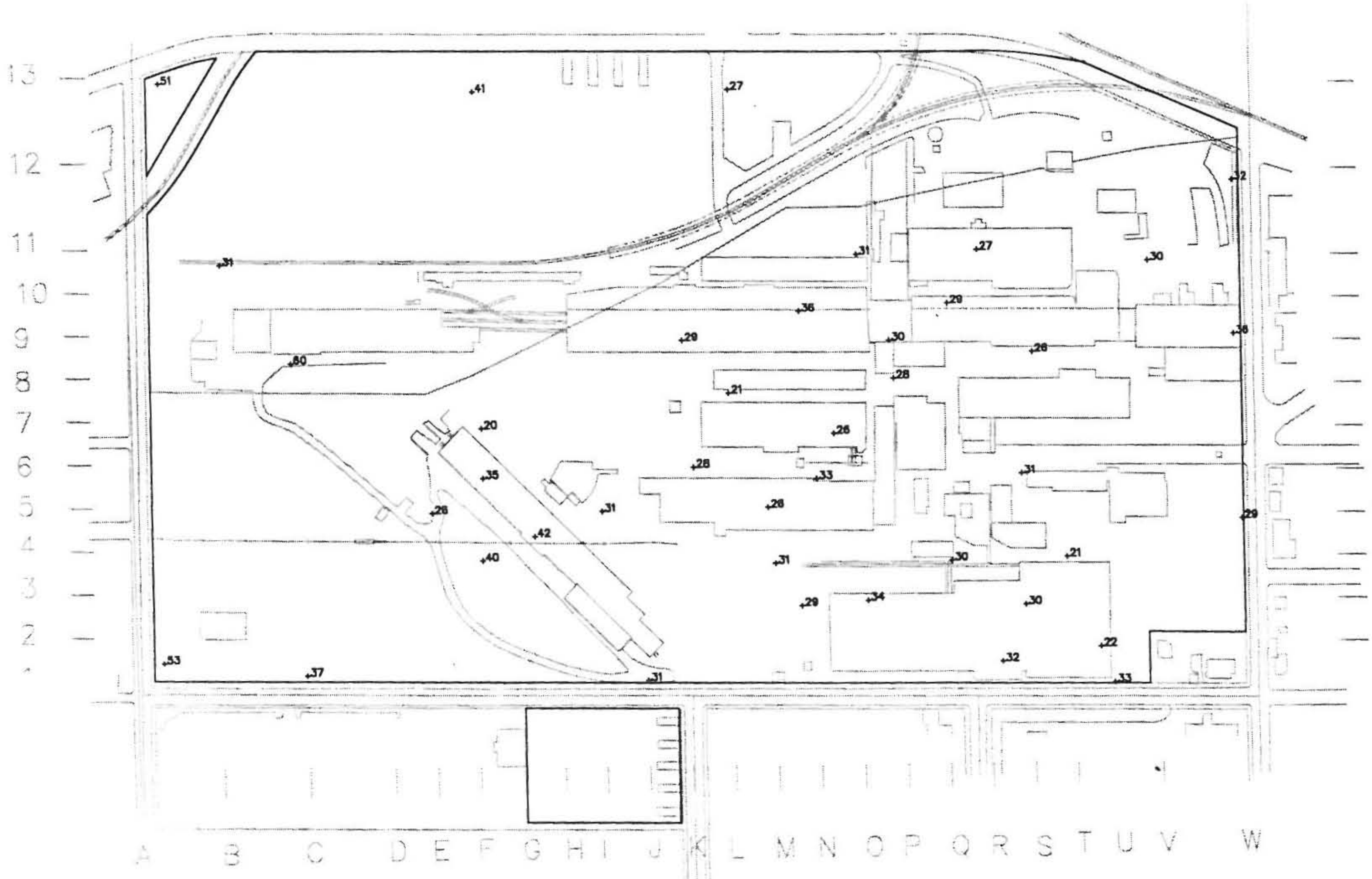
Figure 6.14

Distribution of Chromium in Soil
(> 7 Feet Depth)



Chromium Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER
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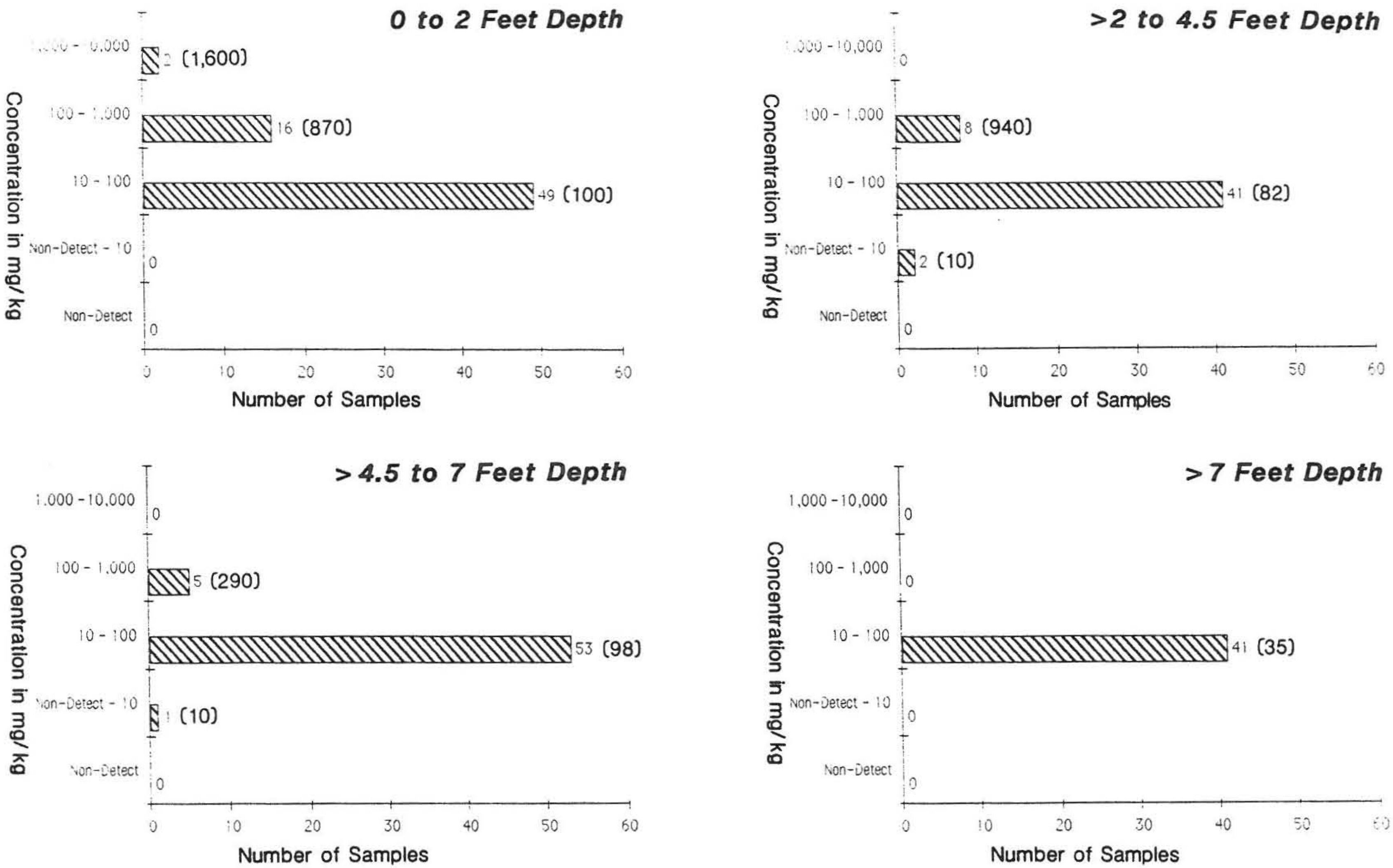
Figure 6.15

Distribution of Total Copper Concentration Data

Regional background concentrations
for Copper - 5 to 20 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

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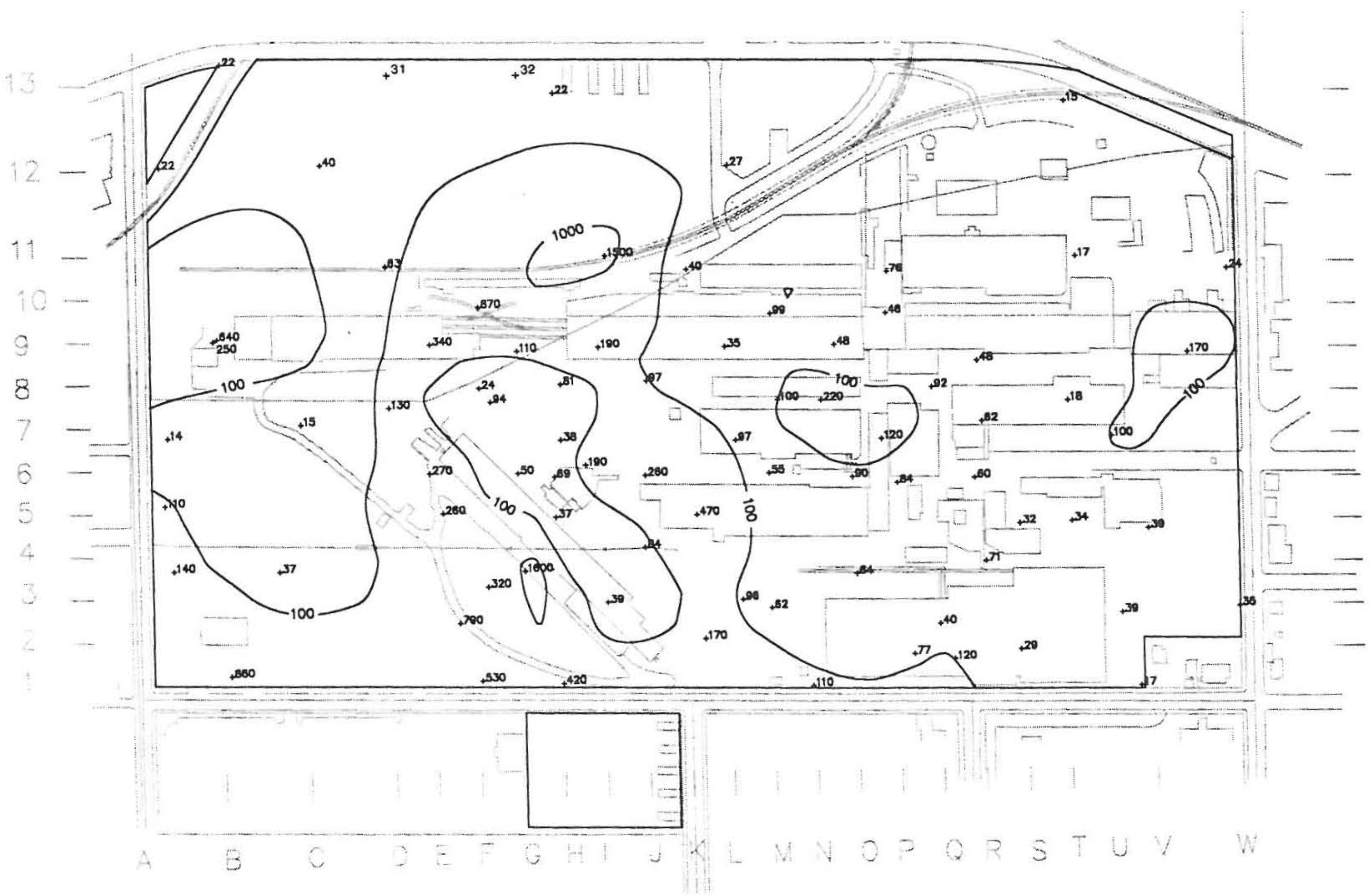
Figure 6.16

Distribution of Copper in Soil
(0 to 2 Feet Depth)



Copper Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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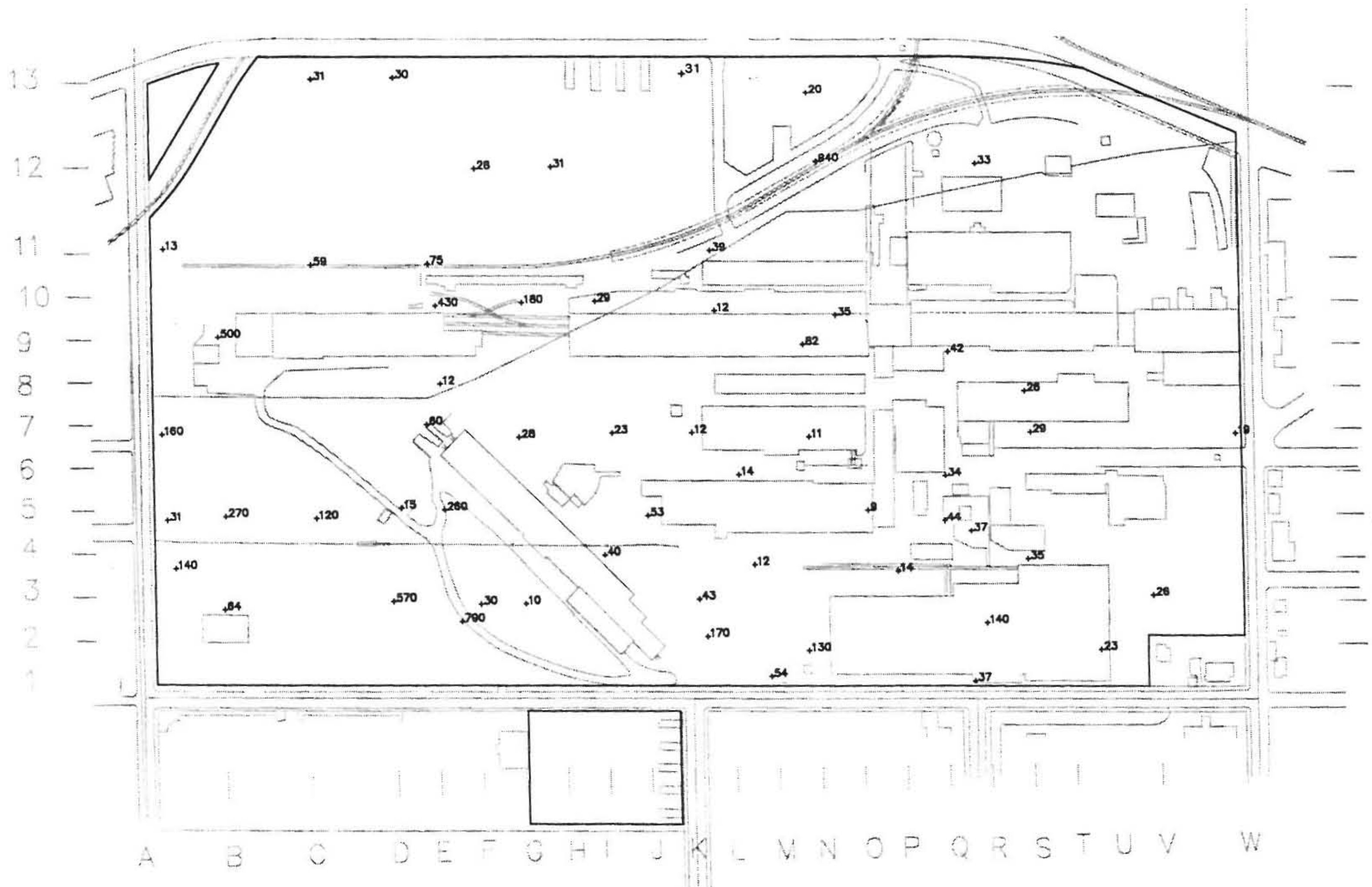
Figure 6.17

Distribution of Copper in Soil
(>2 to 4.5 Feet Depth)



Copper Data

+6.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER
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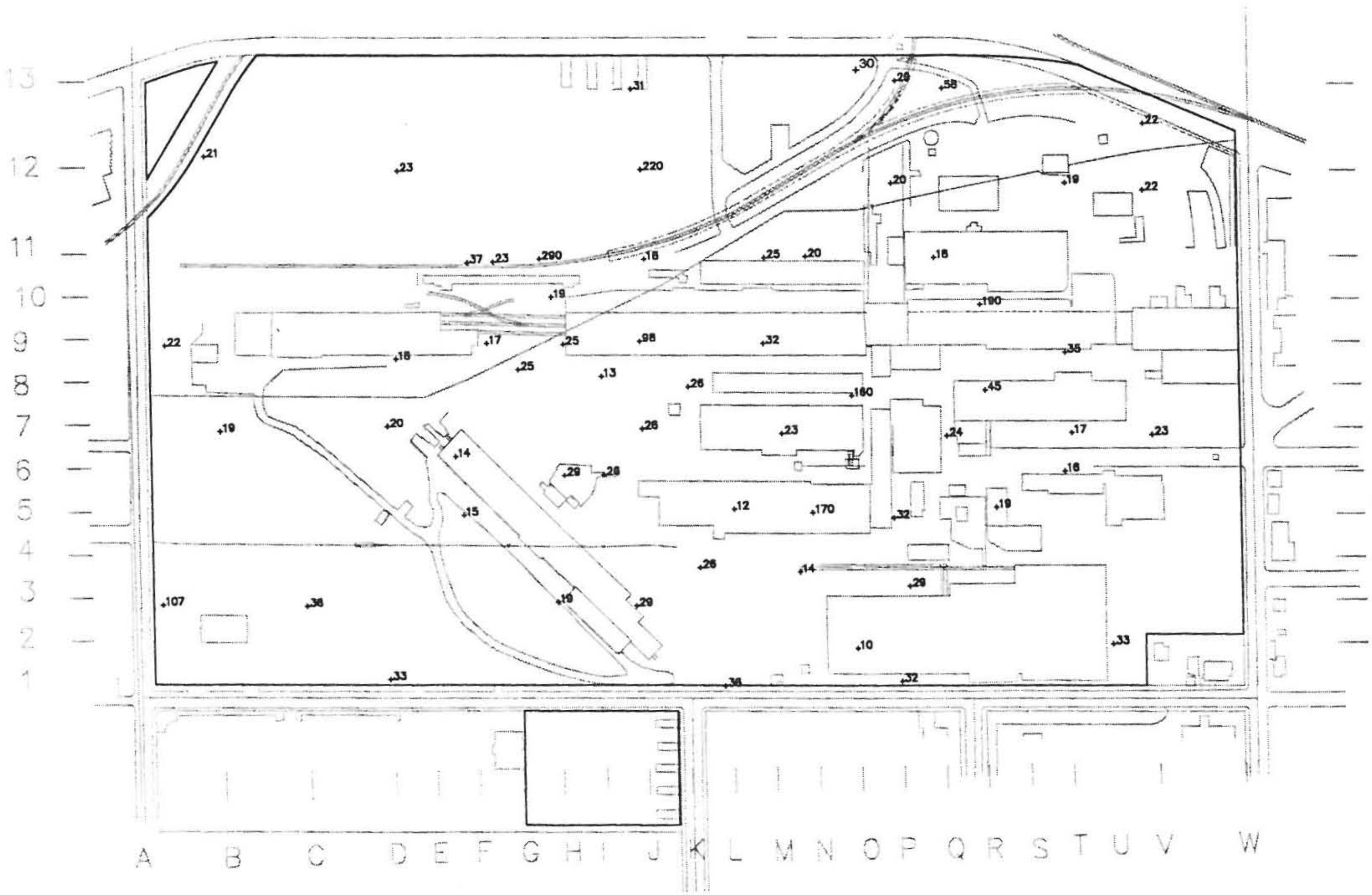
Figure 6.18

Distribution of Copper in Soil
(>4.5 to 7 Feet Depth)



Copper Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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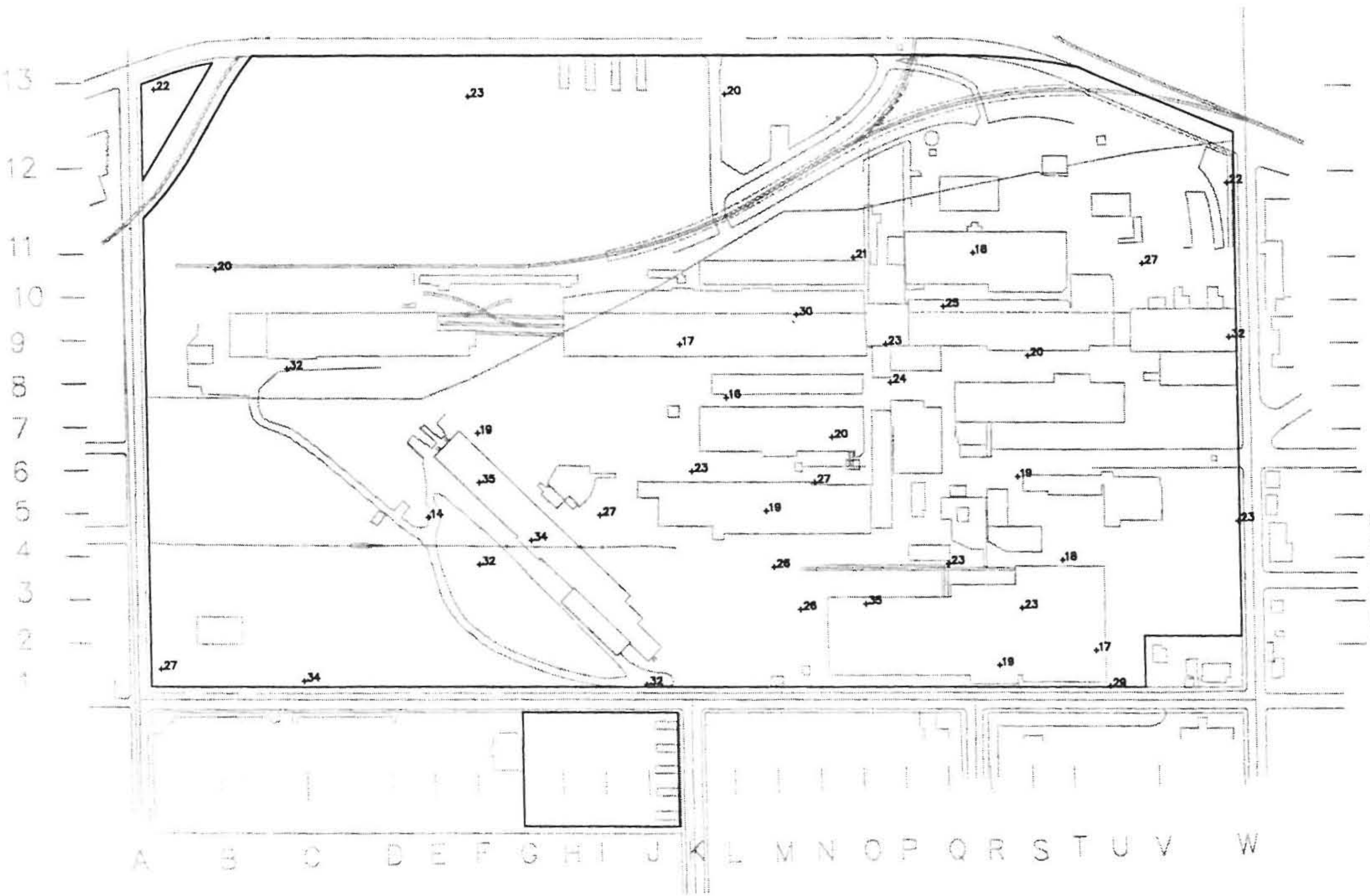
Figure 6.19

Distribution of Copper in Soil
(>7 Feet Depth)



Copper Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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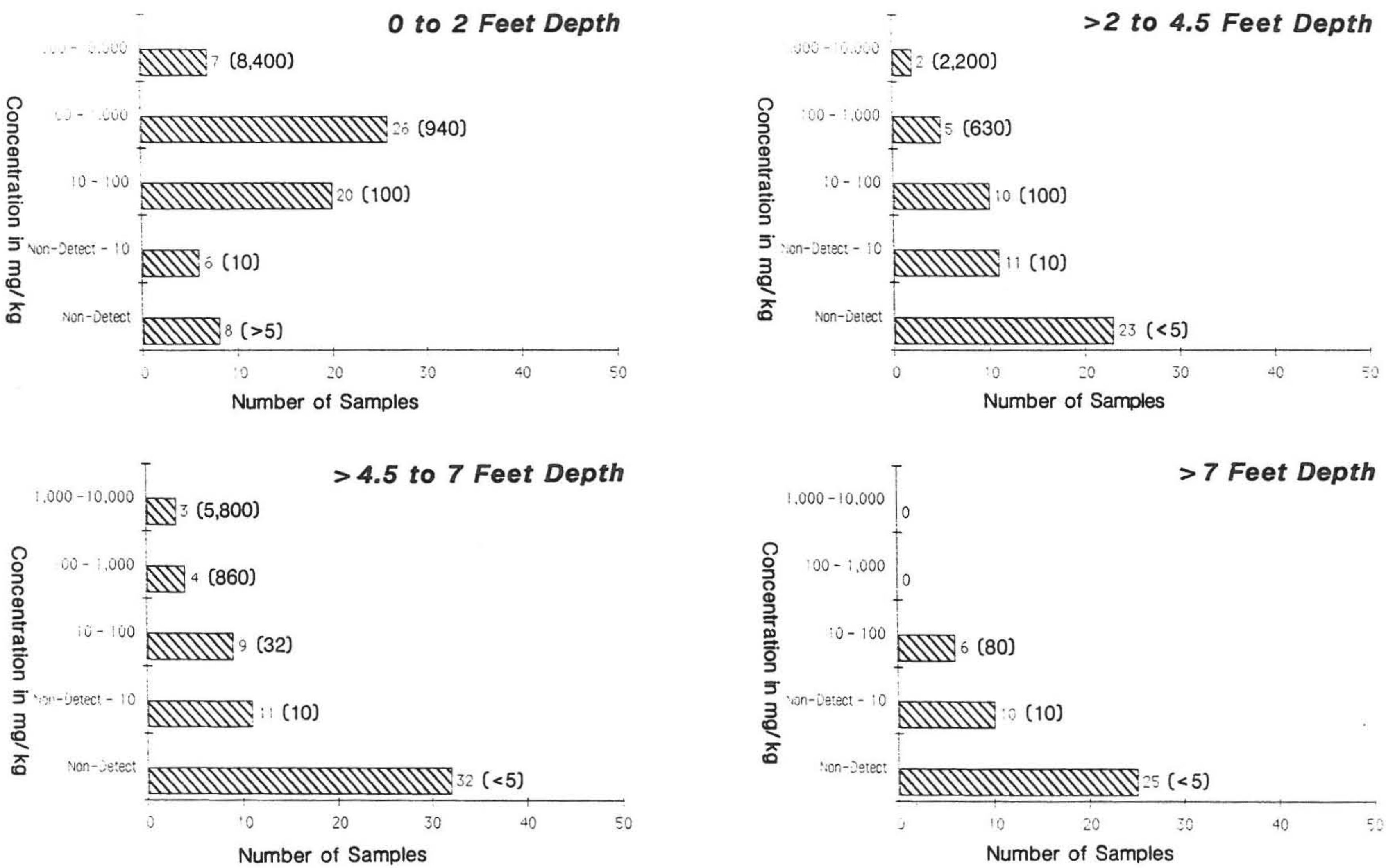
Figure 6.20

Distribution of Total Lead Concentration Data

Regional background concentrations for Lead - 10 to 60 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

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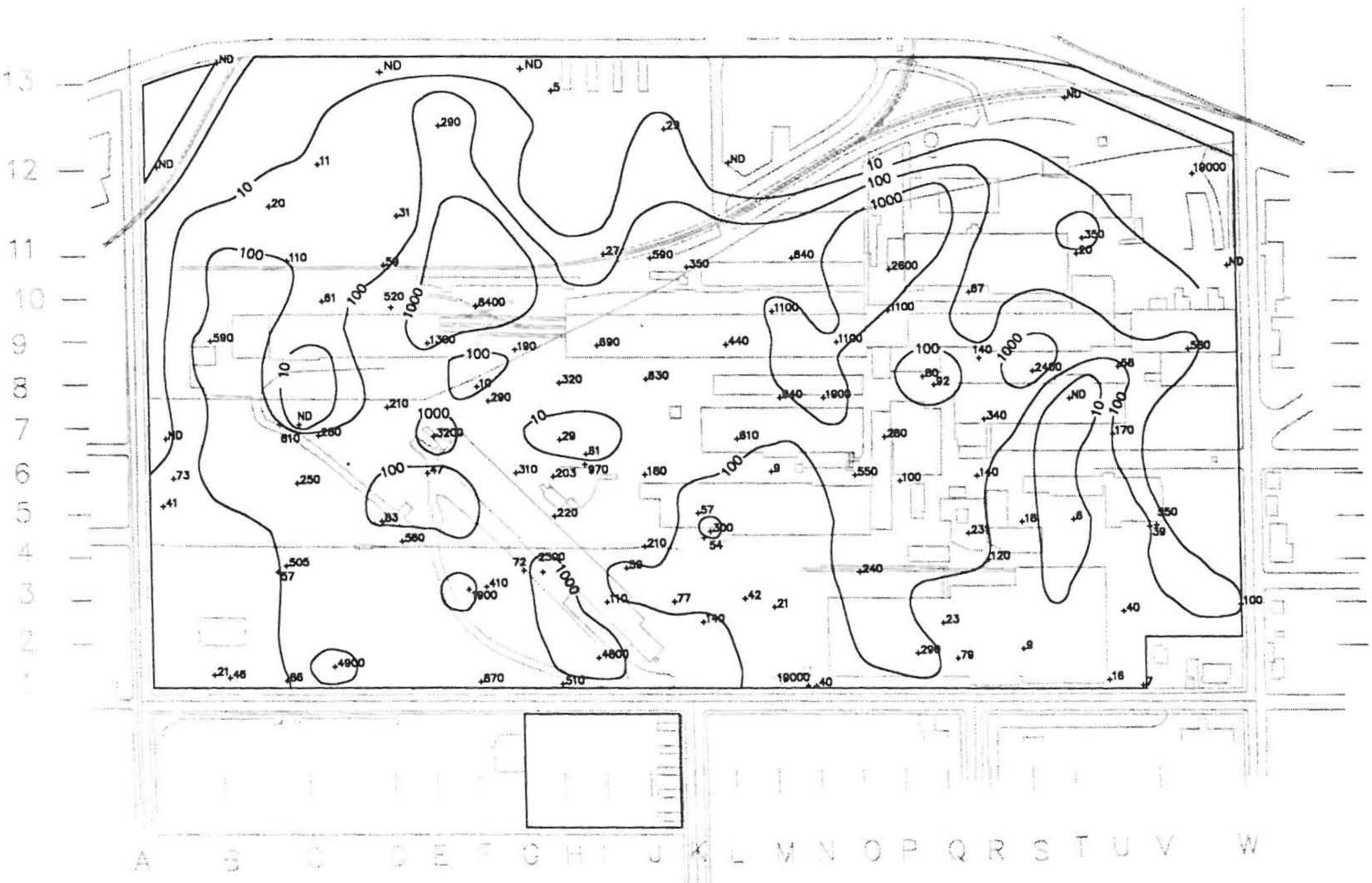
Figure 6.21

Distribution of Lead in Soil
(0 to 2 Feet Depth)



Lead Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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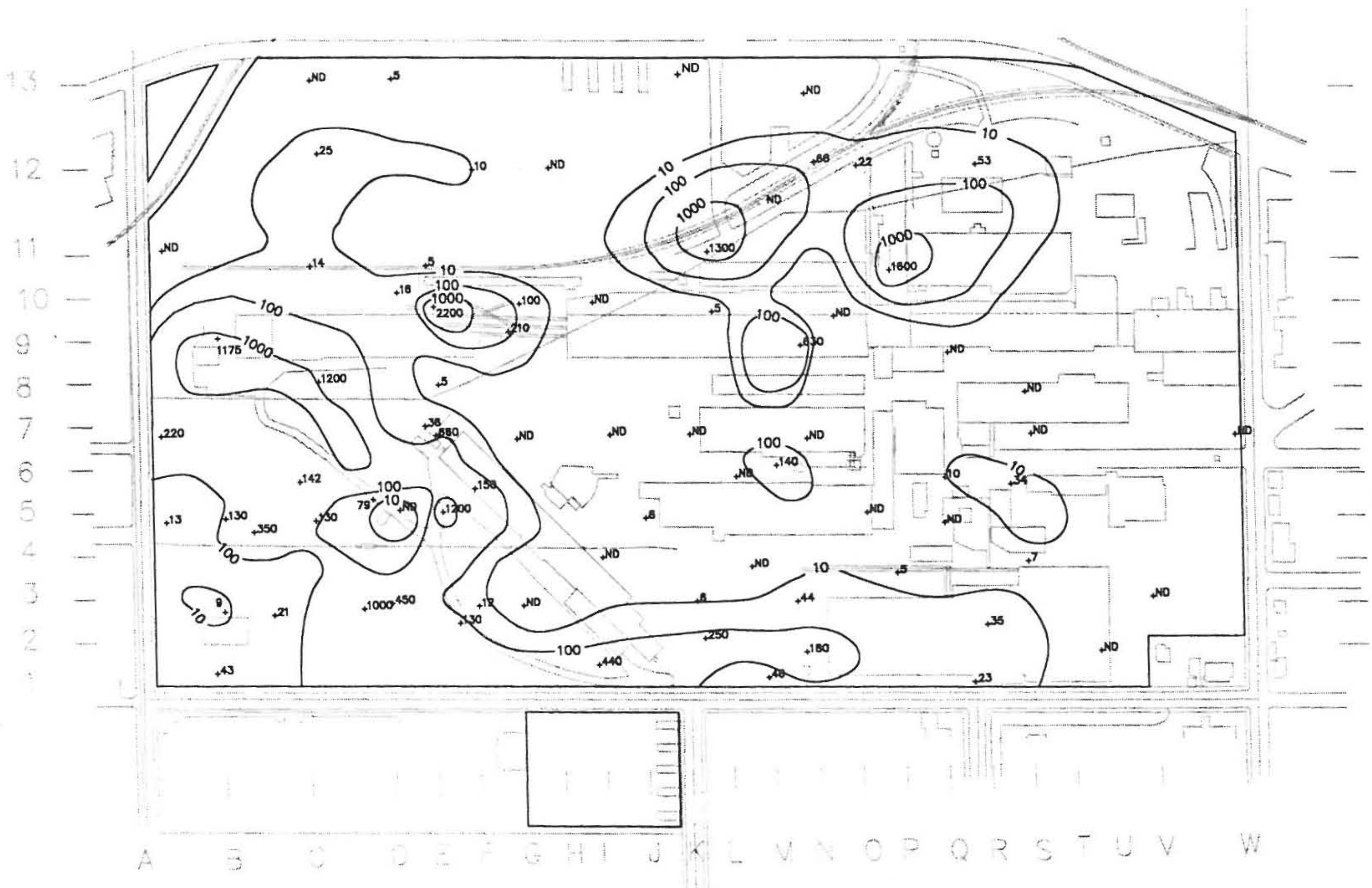
Figure 6.22

Distribution of Lead in Soil
(>2 to 4.5 Feet Depth)



Lead Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

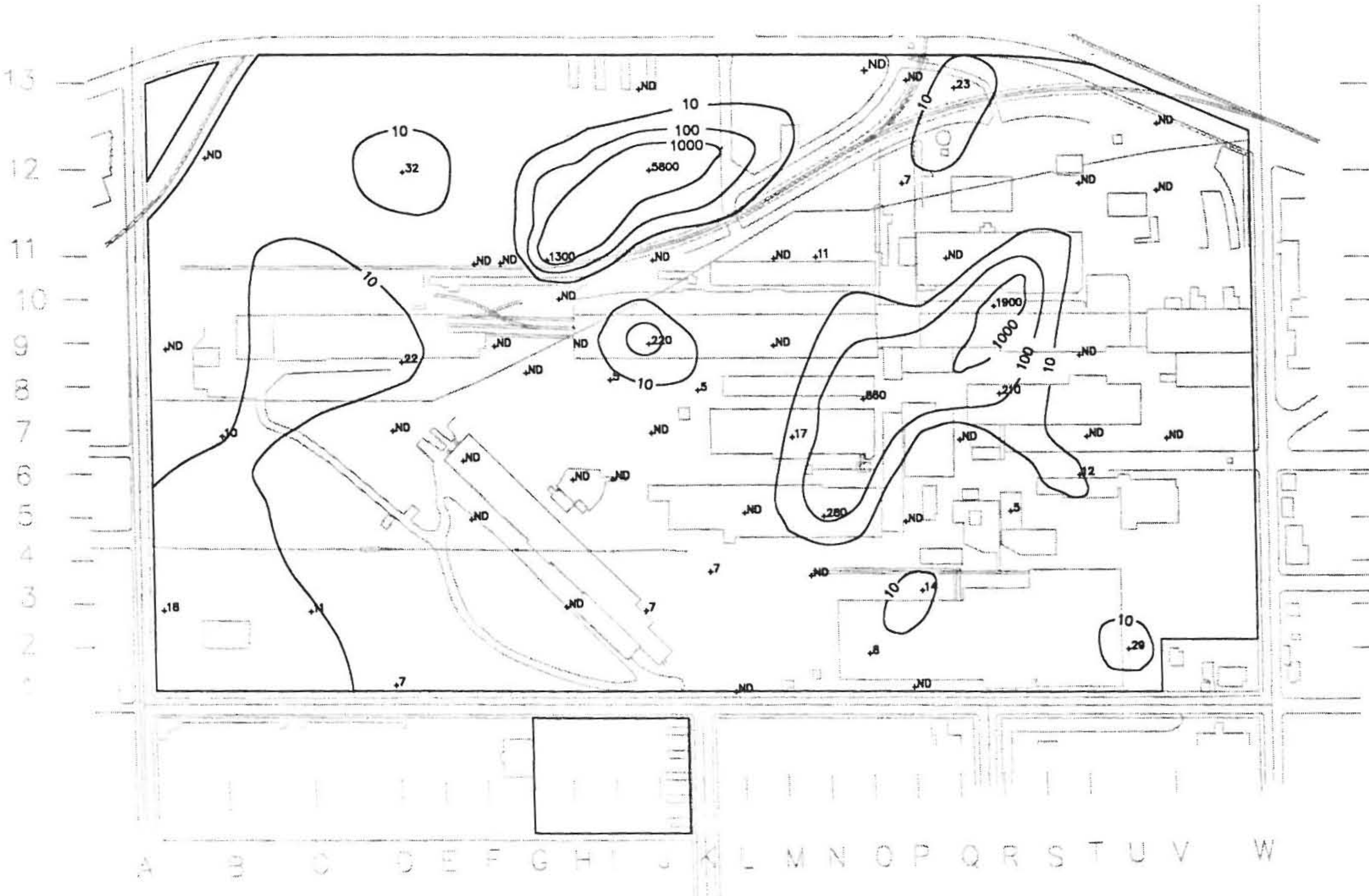
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.23

Distribution of Lead in Soil
(>4.5 to 7 Feet Depth)



Lead Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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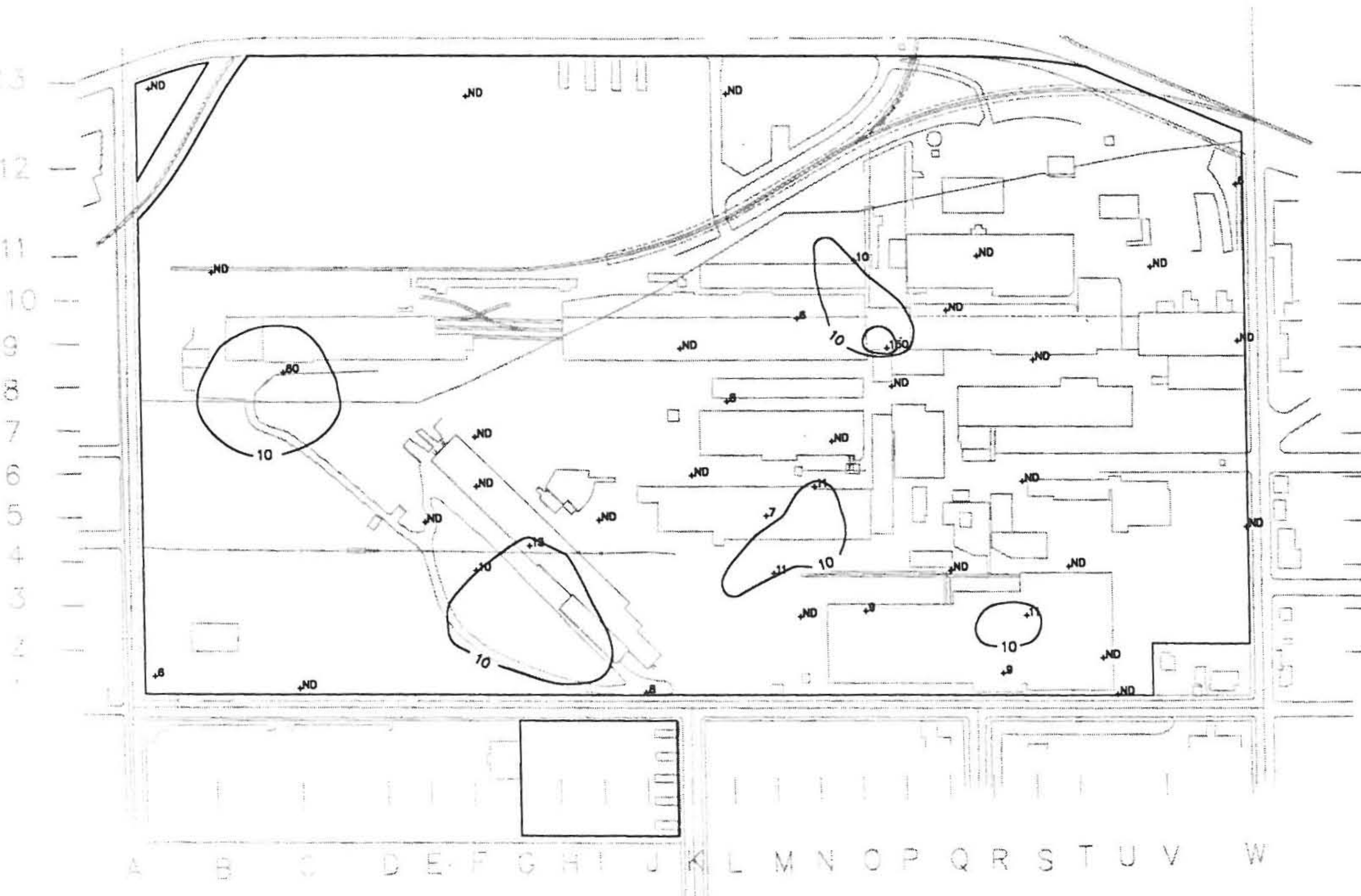
Figure 6.24

Distribution of Lead in Soil
(> 7 Feet Depth)



Lead Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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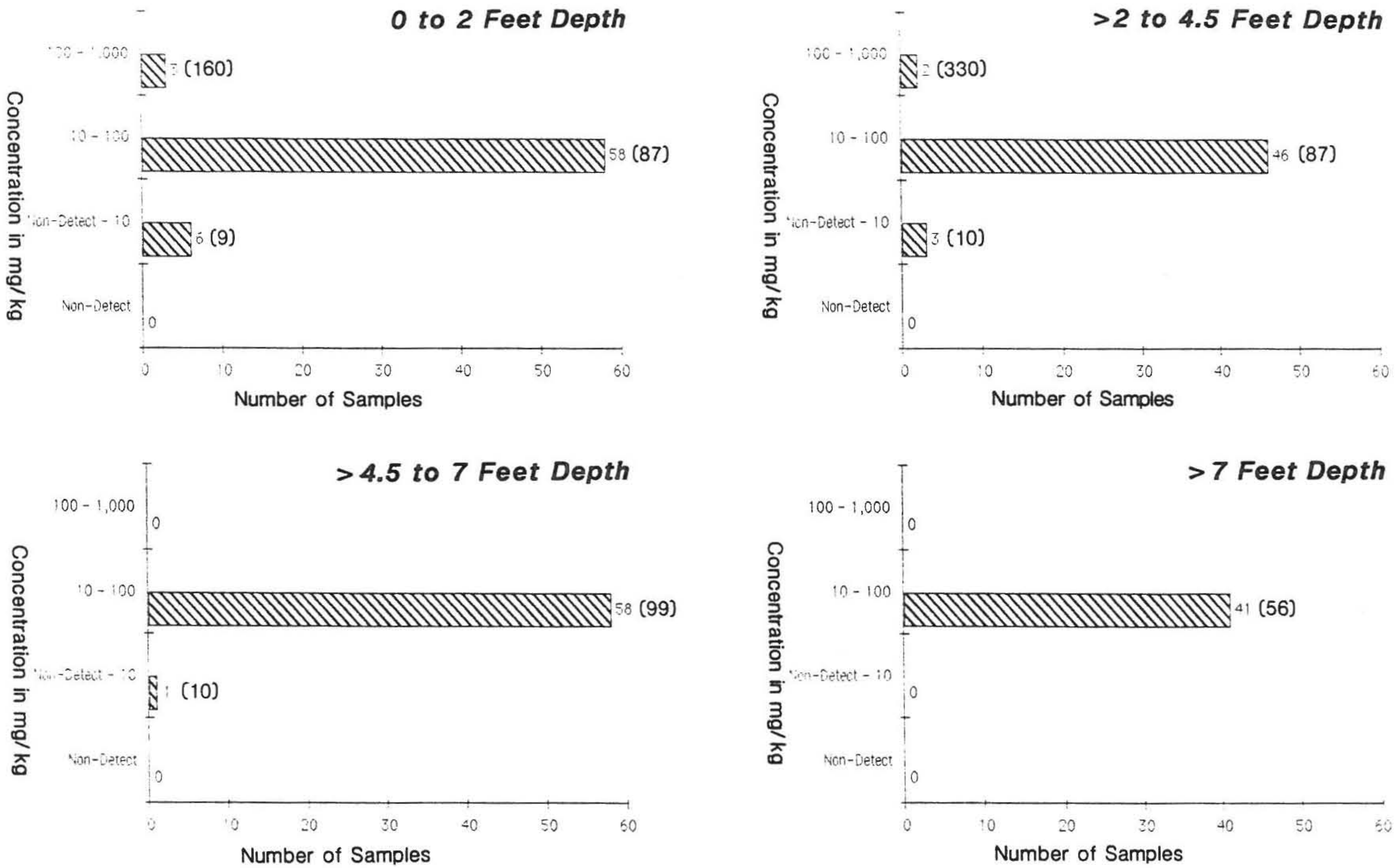
Figure 6.25

Distribution of Total Nickel Concentration Data

Regional background concentrations
for Nickel - 10 to 70 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
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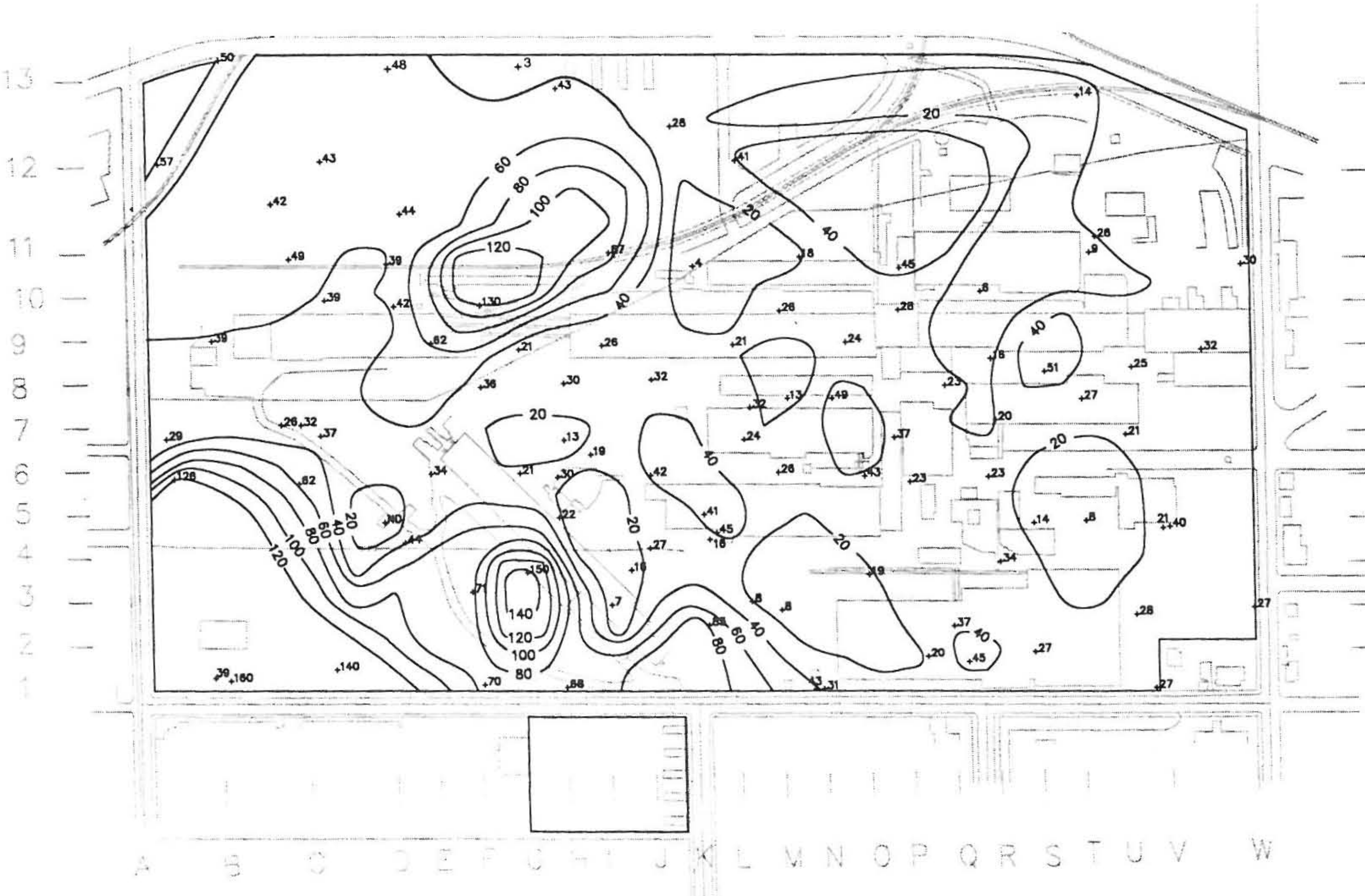
Figure 6.26

Distribution of Nickel in Soil
(0 to 2 Feet Depth)



Nickel Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

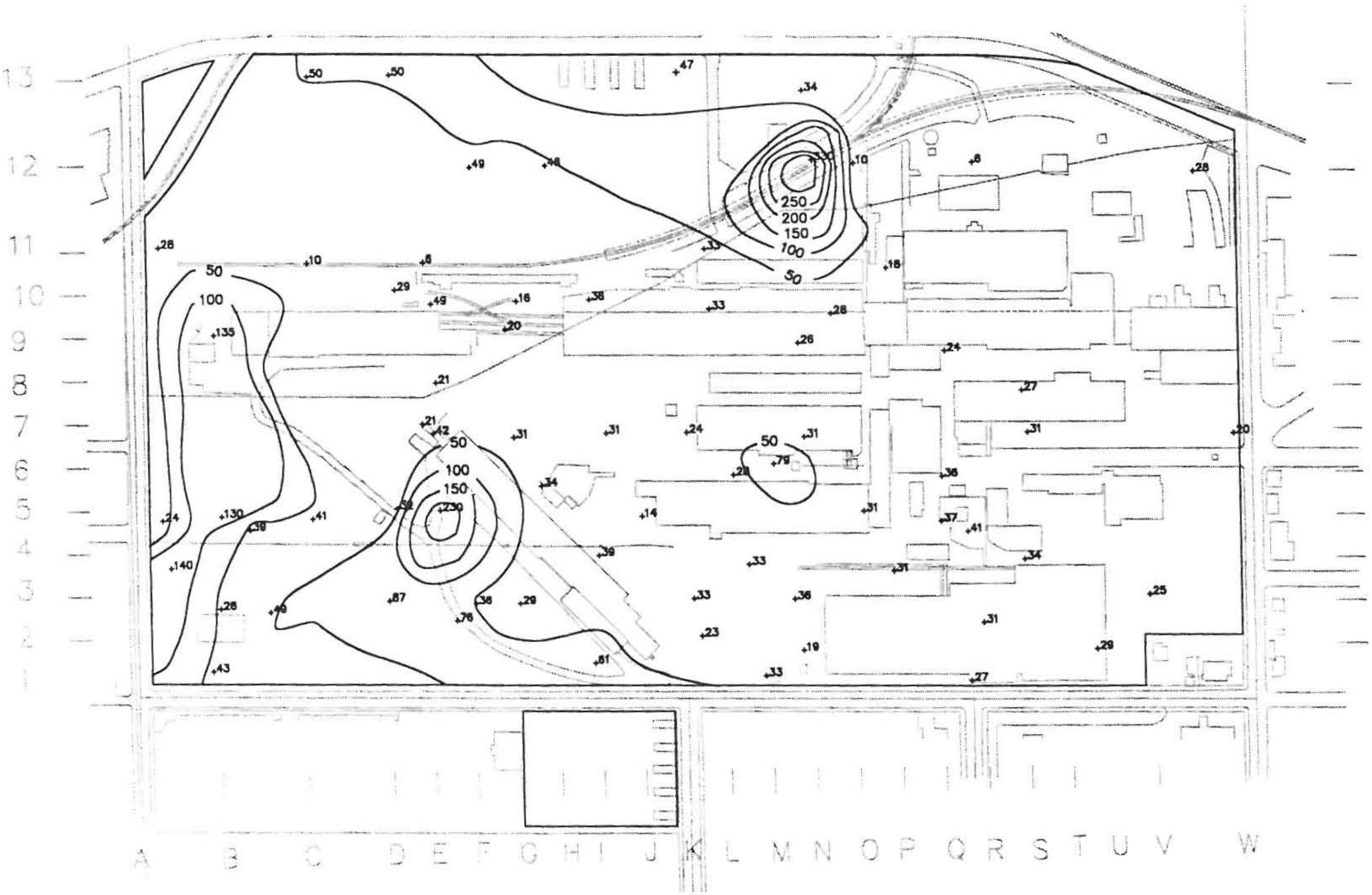
Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500
Scale in Feet

HARTCROWSER
J-1639-09 1/89
Figure 6.27

Distribution of Nickel in Soil
(> 2 to 4.5 Feet Depth)



Nickel Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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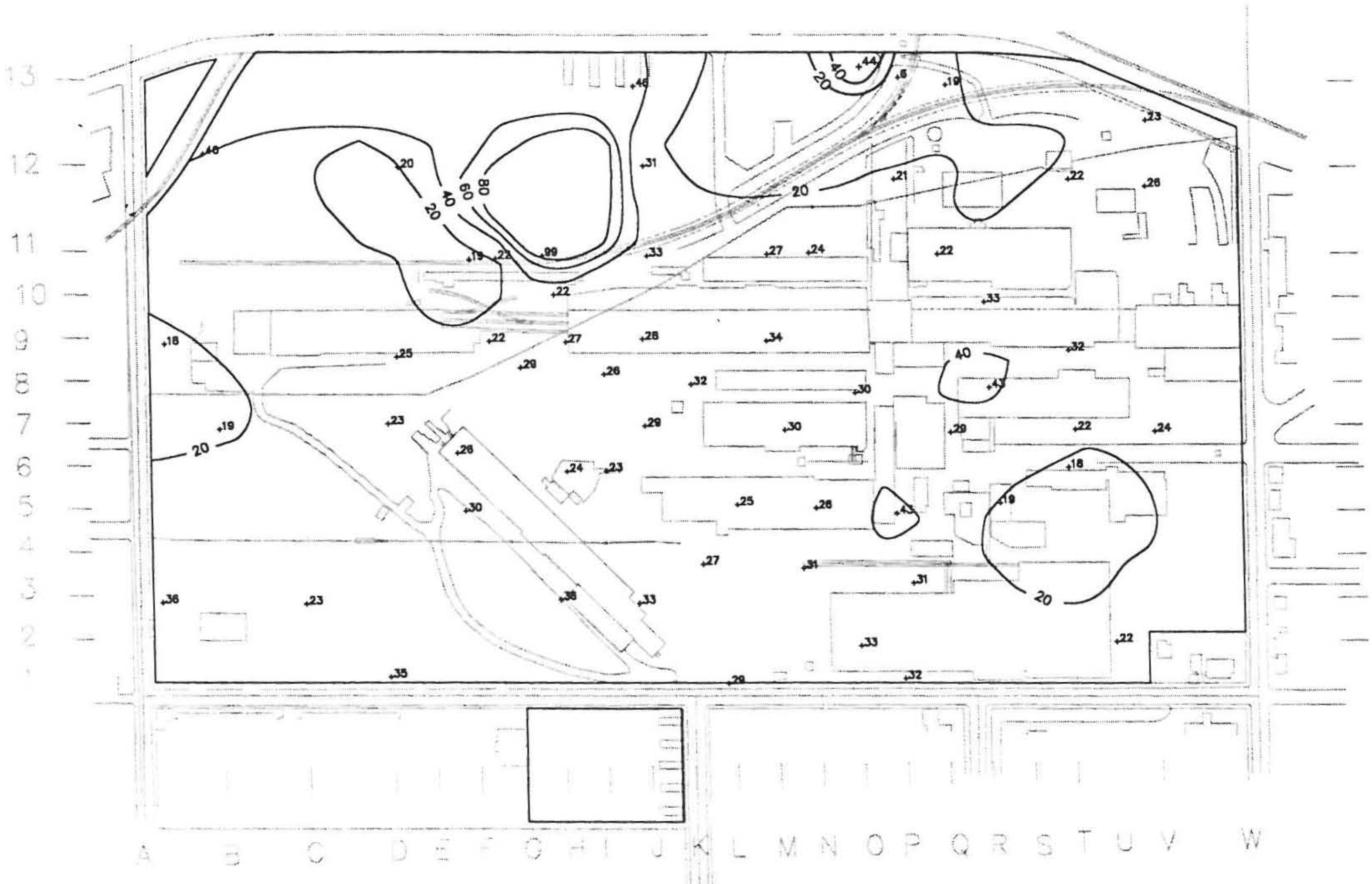
Figure 6.28

Distribution of Nickel in Soil
(>4.5 to 7 Feet Depth)



Nickel Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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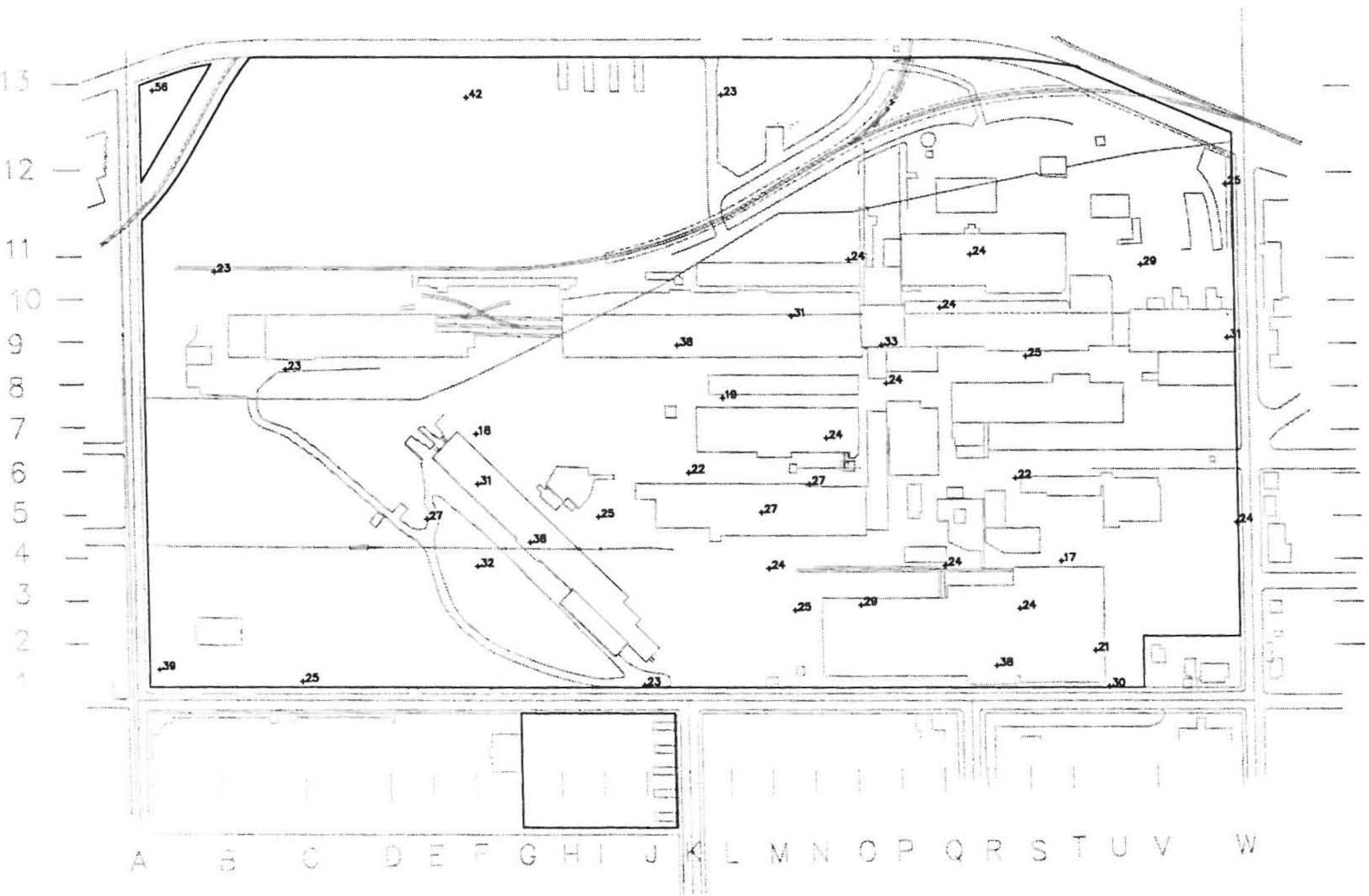
Figure 6.29

Distribution of Nickel in Soil
(> 7 Feet Depth)



Nickel Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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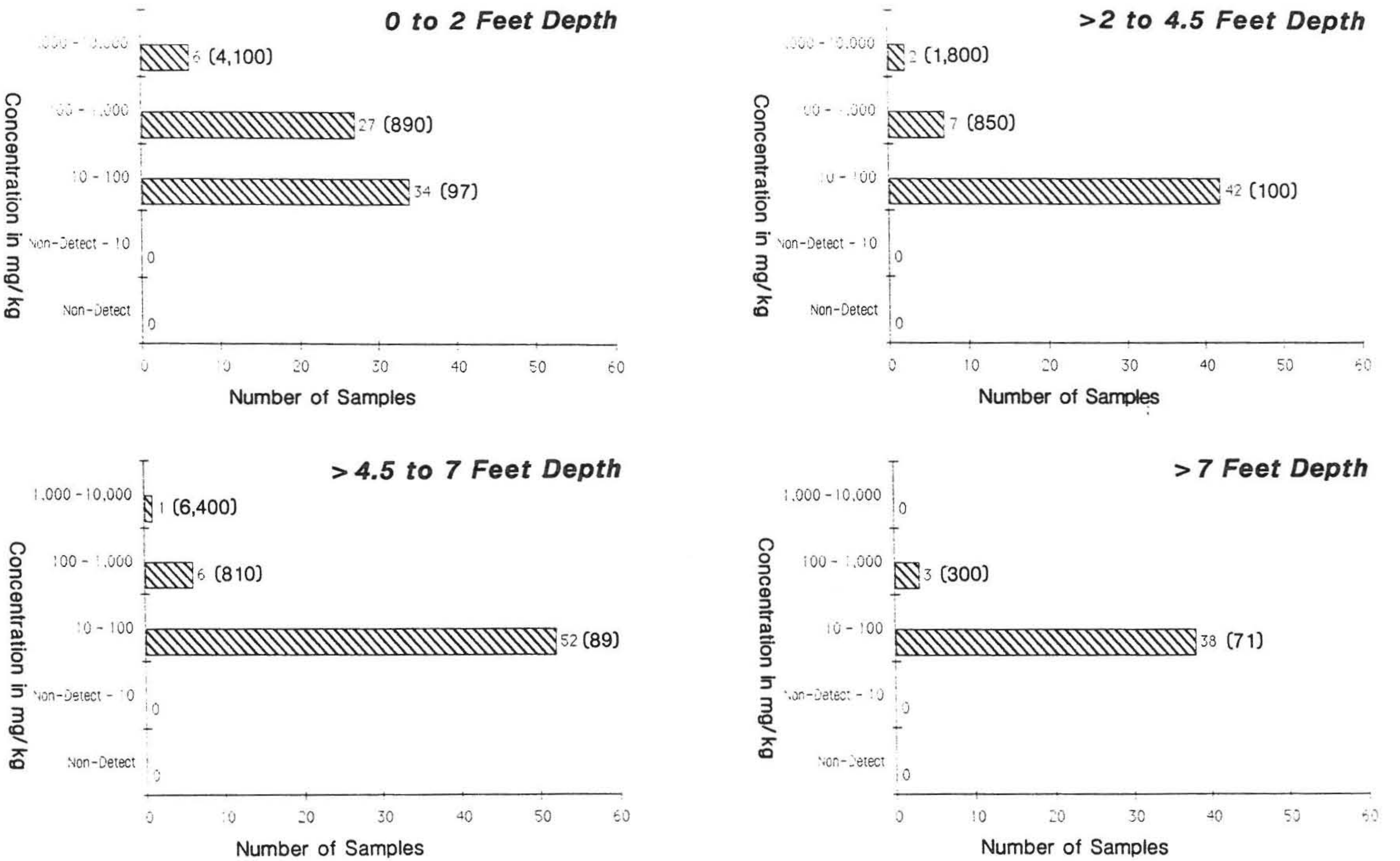
Figure 6.30

Distribution of Total Zinc Concentration Data

Regional background concentrations
for Zinc - 20 to 80 mg/kg



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

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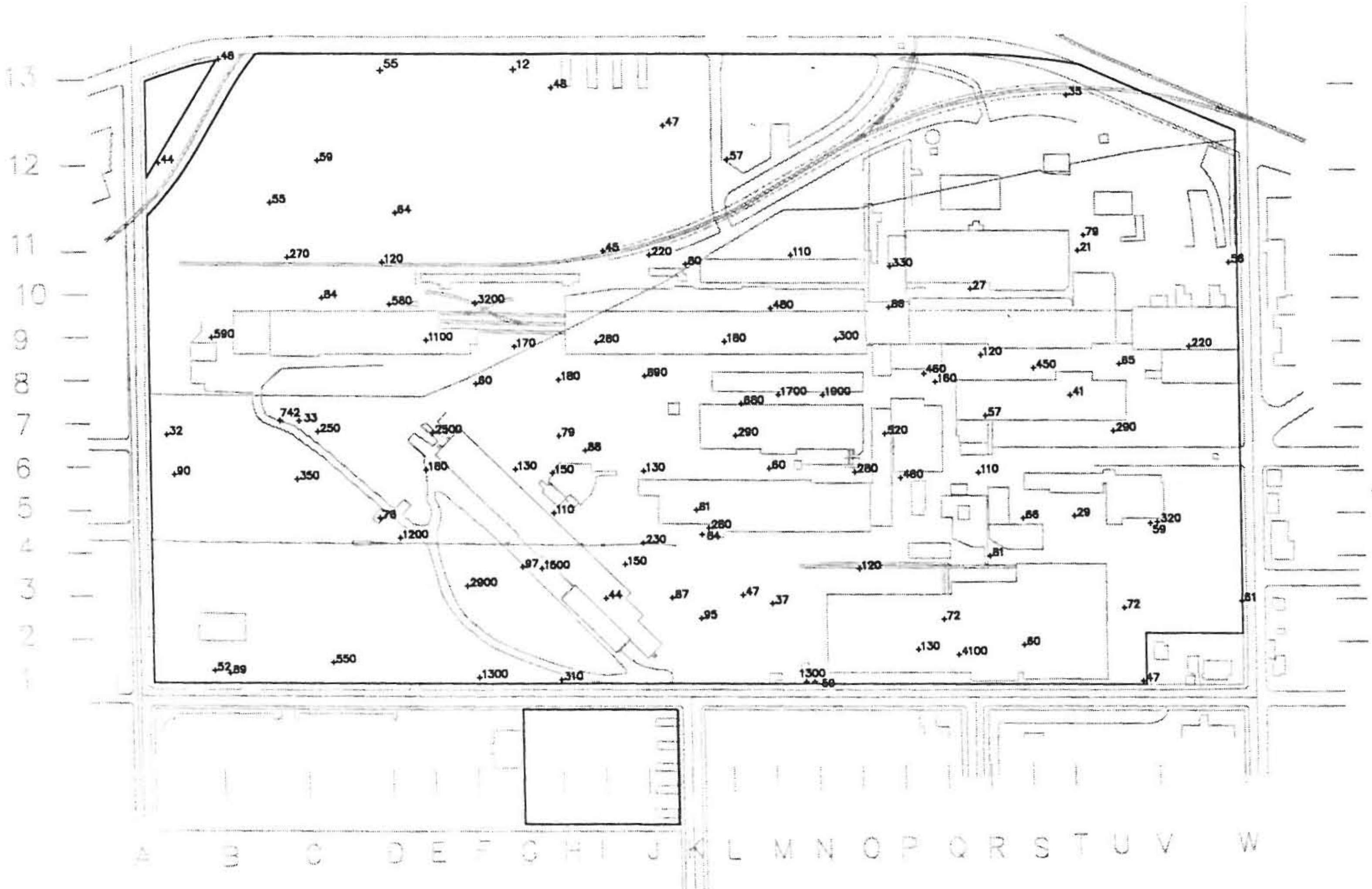
Figure 6.31

Distribution of Zinc in Soil
(0 to 2 Feet Depth)



Zinc Data

+6.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500
Scale in Feet

HARTCROWSER
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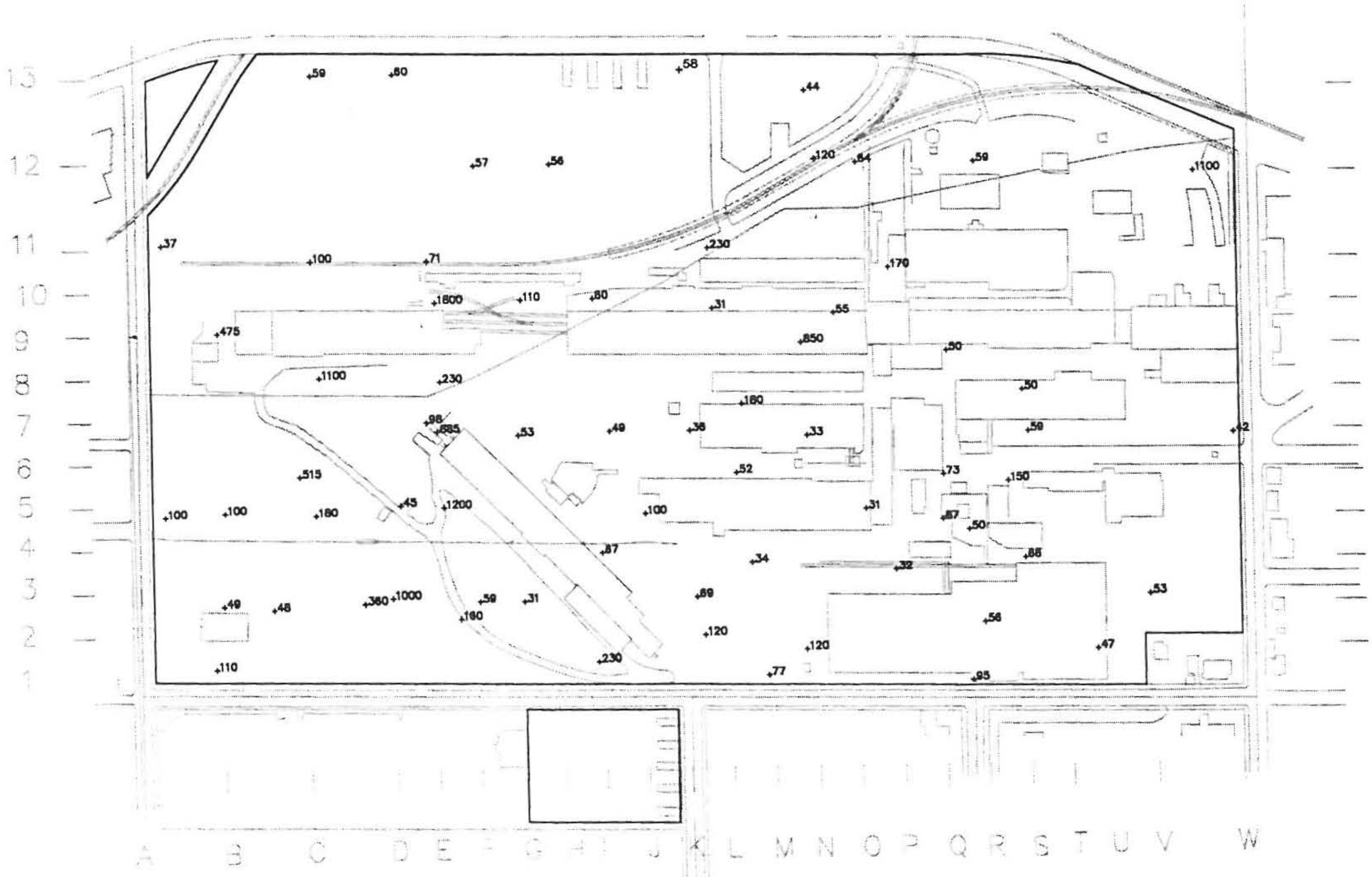
Figure 6.32

Distribution of Zinc in Soil
(>2 to 4.5 Feet Depth)



Zinc Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

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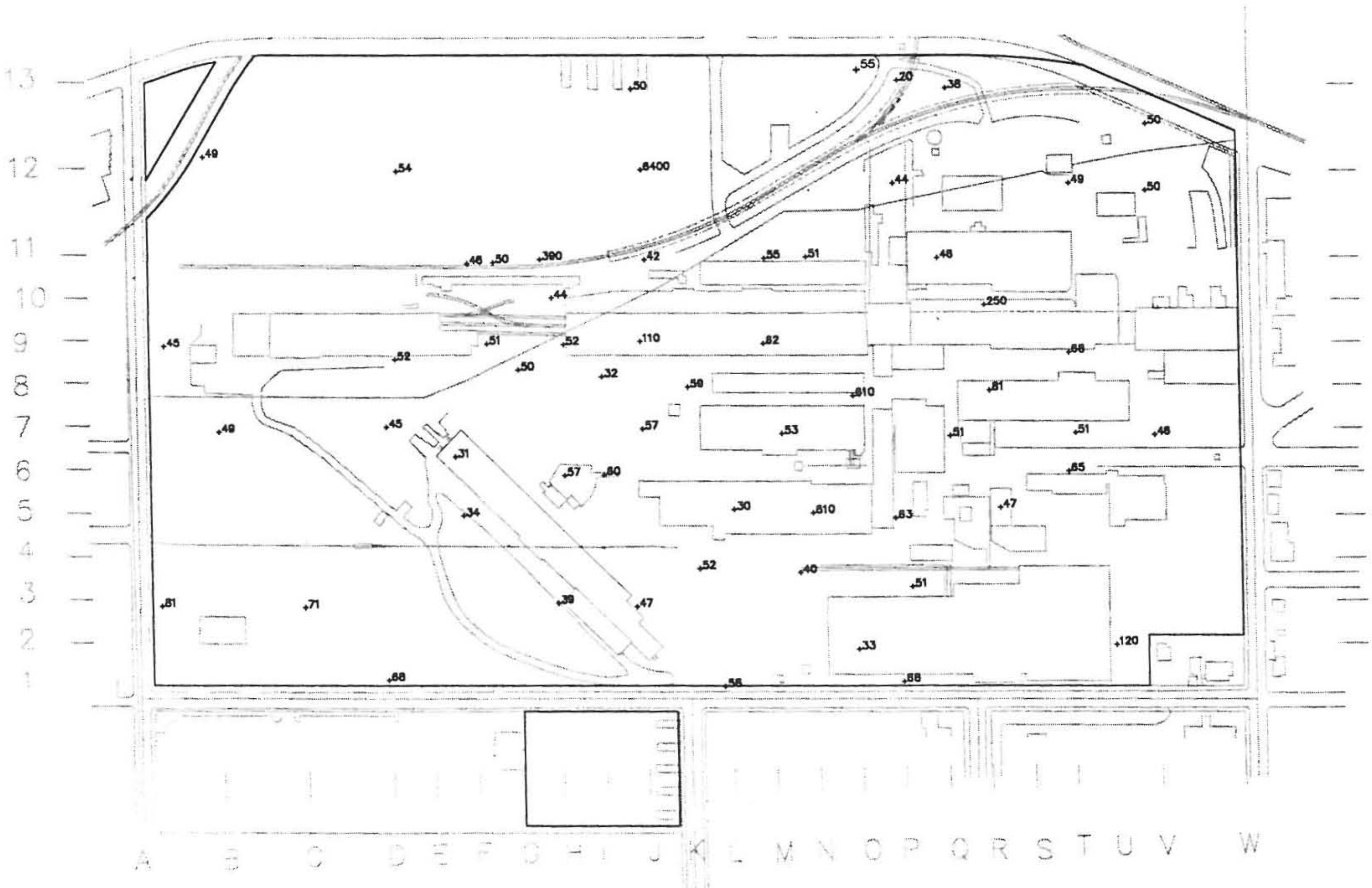
Figure 6.33

Distribution of Zinc in Soil
(>4.5 to 7 Feet Depth)



Zinc Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

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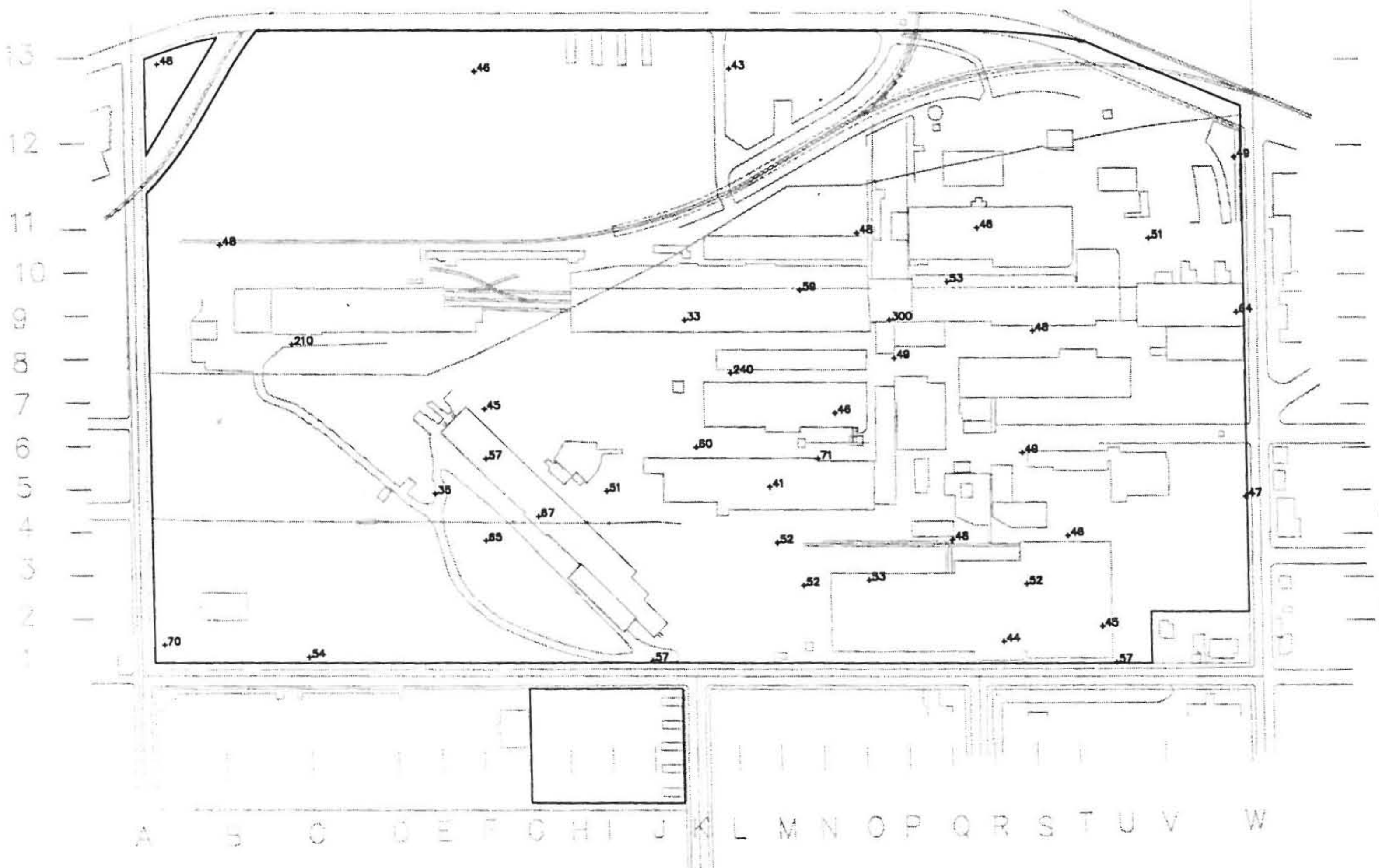
Figure 6.34

Distribution of Zinc in Soil
(>7 Feet Depth)



Zinc Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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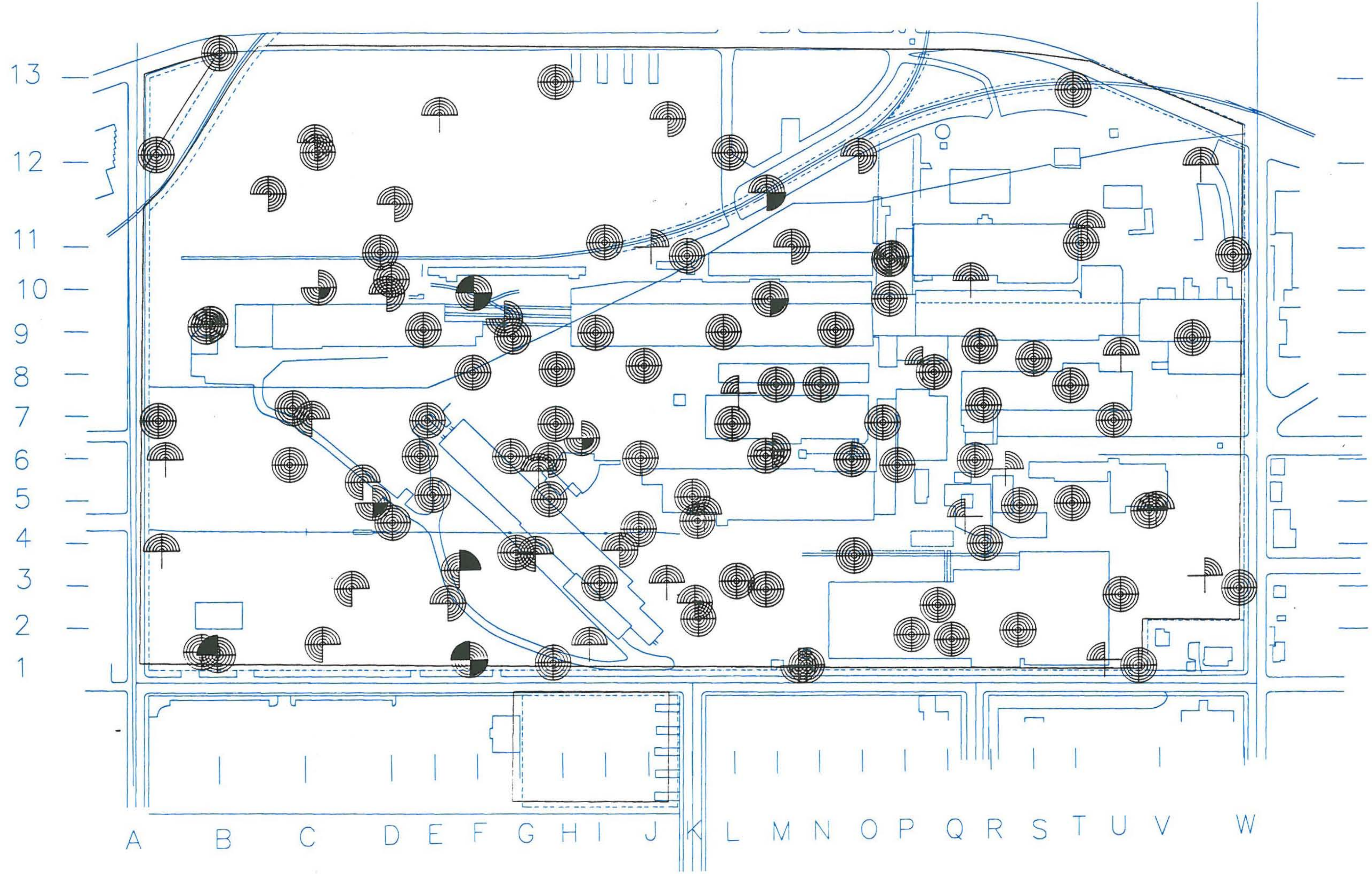
Figure 6.35

Distribution of EP Toxicity Metals

(As, Cd, Cr, Cu) in Soil
(0 to 2 Feet Depth)



Concentration in ppm

- 0.1
- 0.01
- 0.001
- Not Detected

Missing Segment Denotes Not Tested

EP Toxicity Metals

- Sample Location
- Copper
- Chromium
- Arsenic
- Cadmium

Note: Figure represents all data collected to date including HNTB, 1984; Dames and Moore, 1984; E&E, 1986; Hart Crowser/Landau and Associates, 1986; and Hart Crowser, 1988.

N

0 250 500
Scale in Feet

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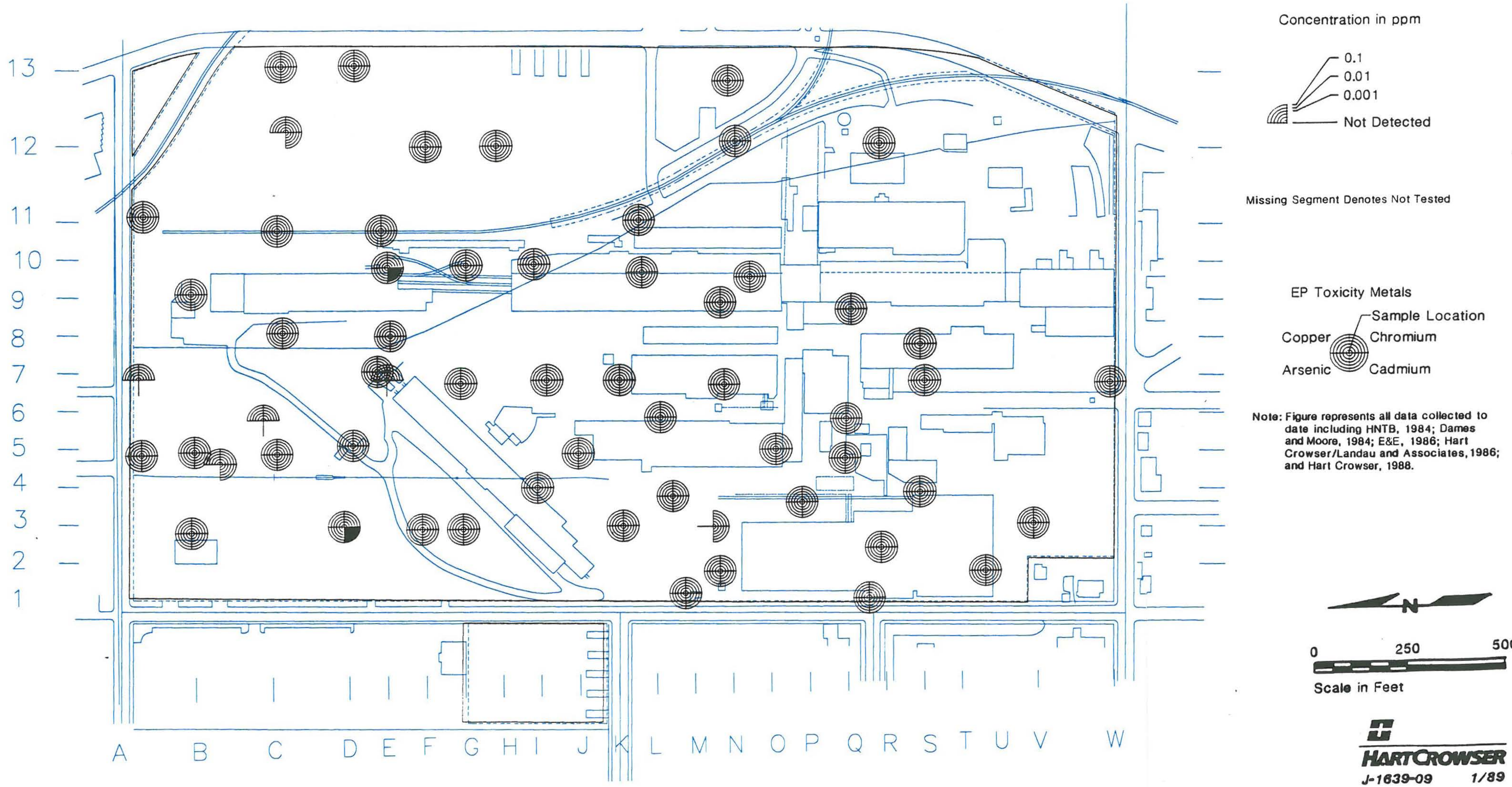
Figure 6.36

Distribution of EP Toxicity Metals
(As, Cd, Cr, Cu) in Soil
(>2 to 4.5 Feet Depth)



Note: Figure represents all data collected to date including HNTB, 1984; Dames and Moore, 1984; E&E, 1986; Hart Crowser/Landau and Associates, 1986; and Hart Crowser, 1988.

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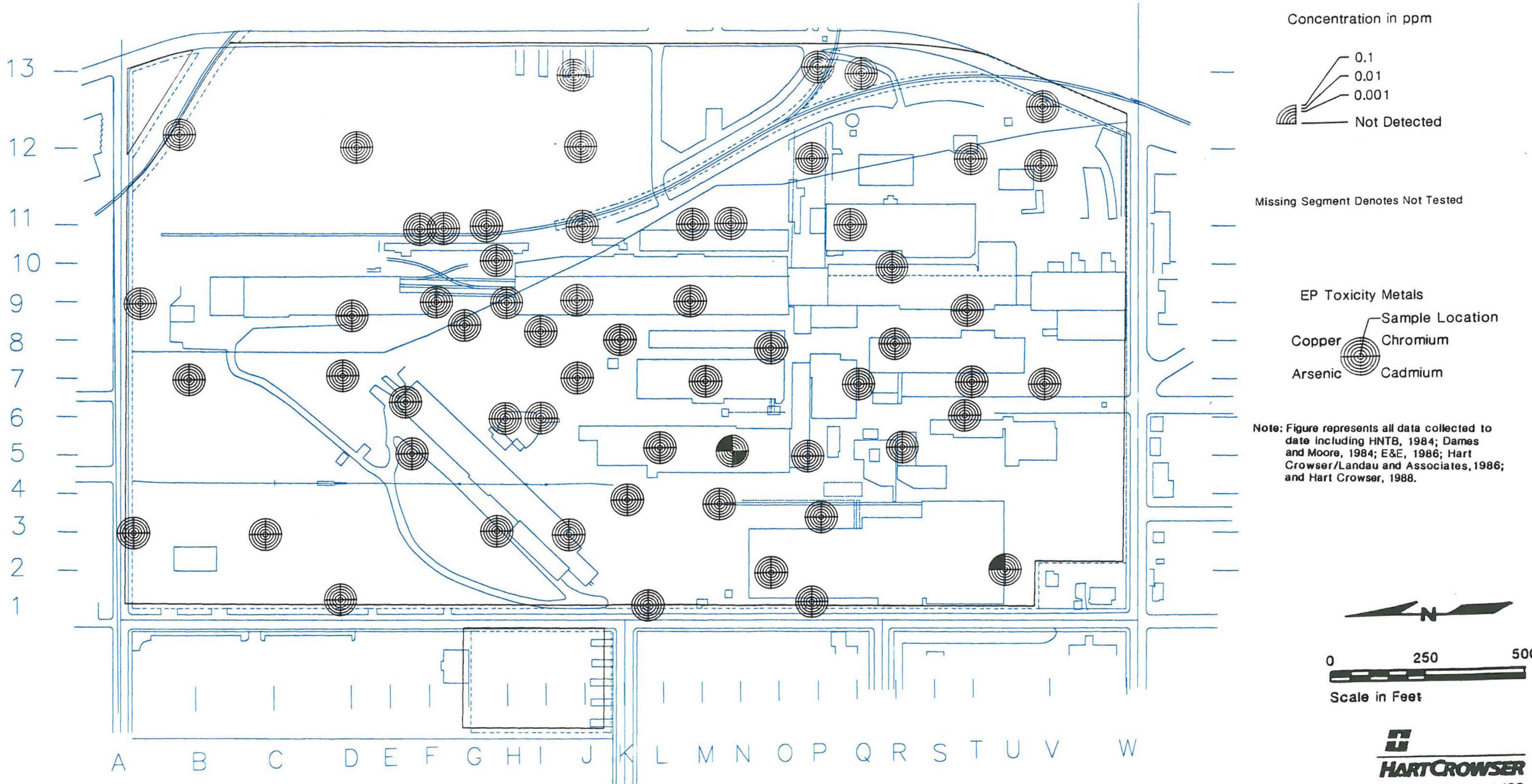
Figure 6.37

Distribution of EP Toxicity Metals
(As, Cd, Cr, Cu) in Soil
(>4.5 to 7 Feet Depth)



Note: Figure represents all data collected to date including HNTB, 1984; Dames and Moore, 1984; E&E, 1986; Hart Crowser/Landau and Associates, 1986; and Hart Crowser, 1988.

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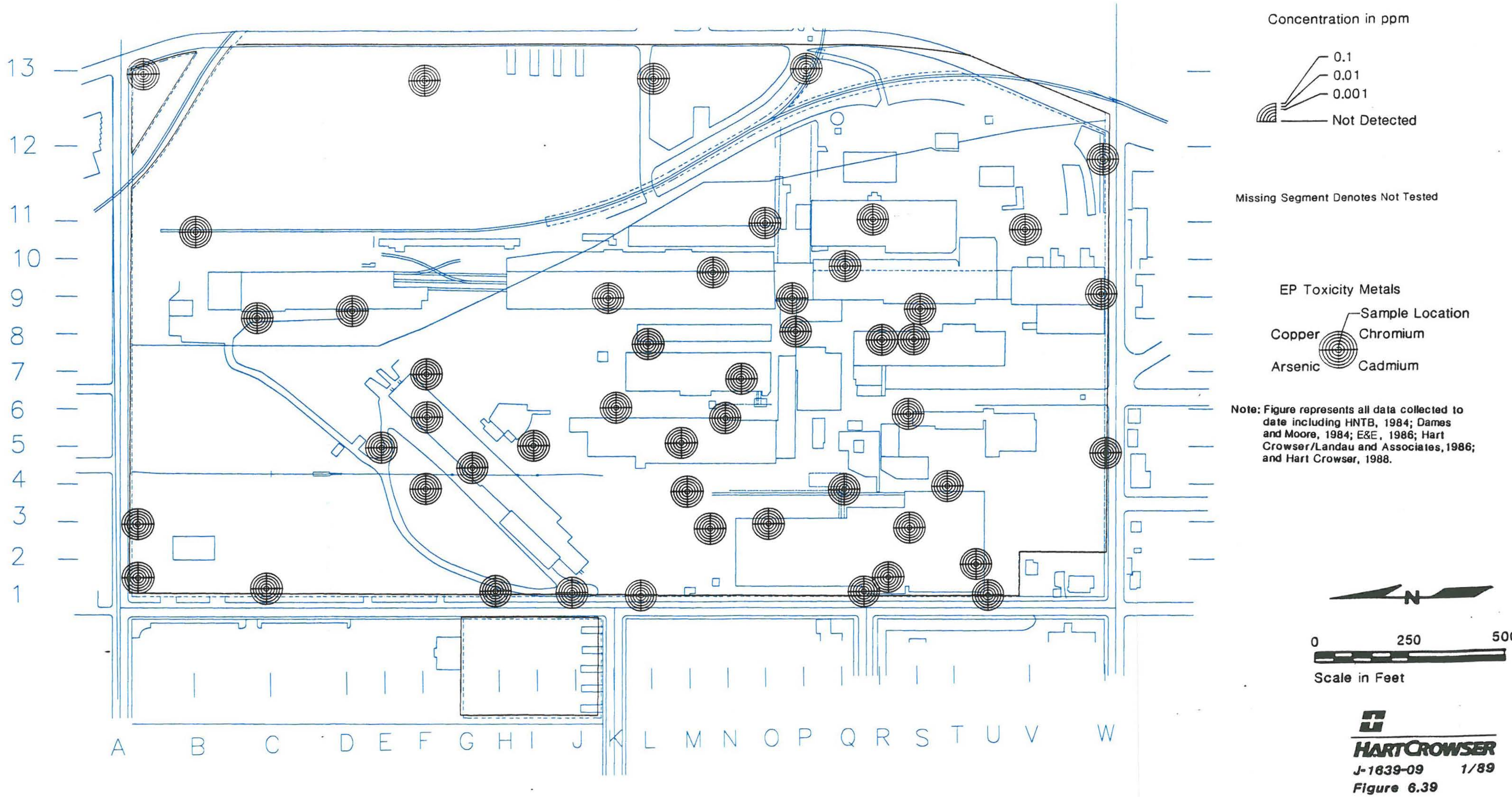
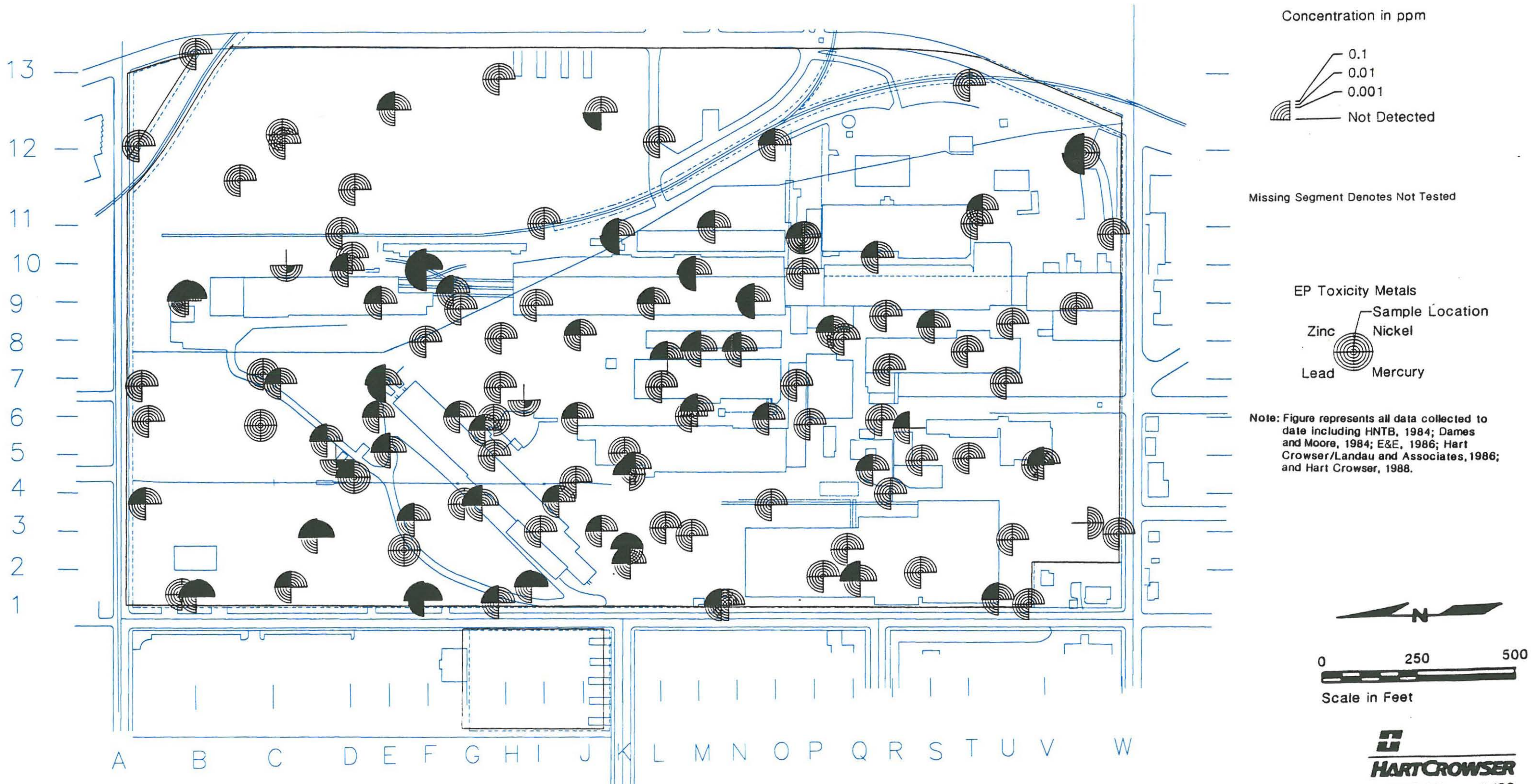
Figure 6.38

Distribution of EP Toxicity Metals
(As, Cd, Cr, Cu) in Soil
(>7 Feet Depth)

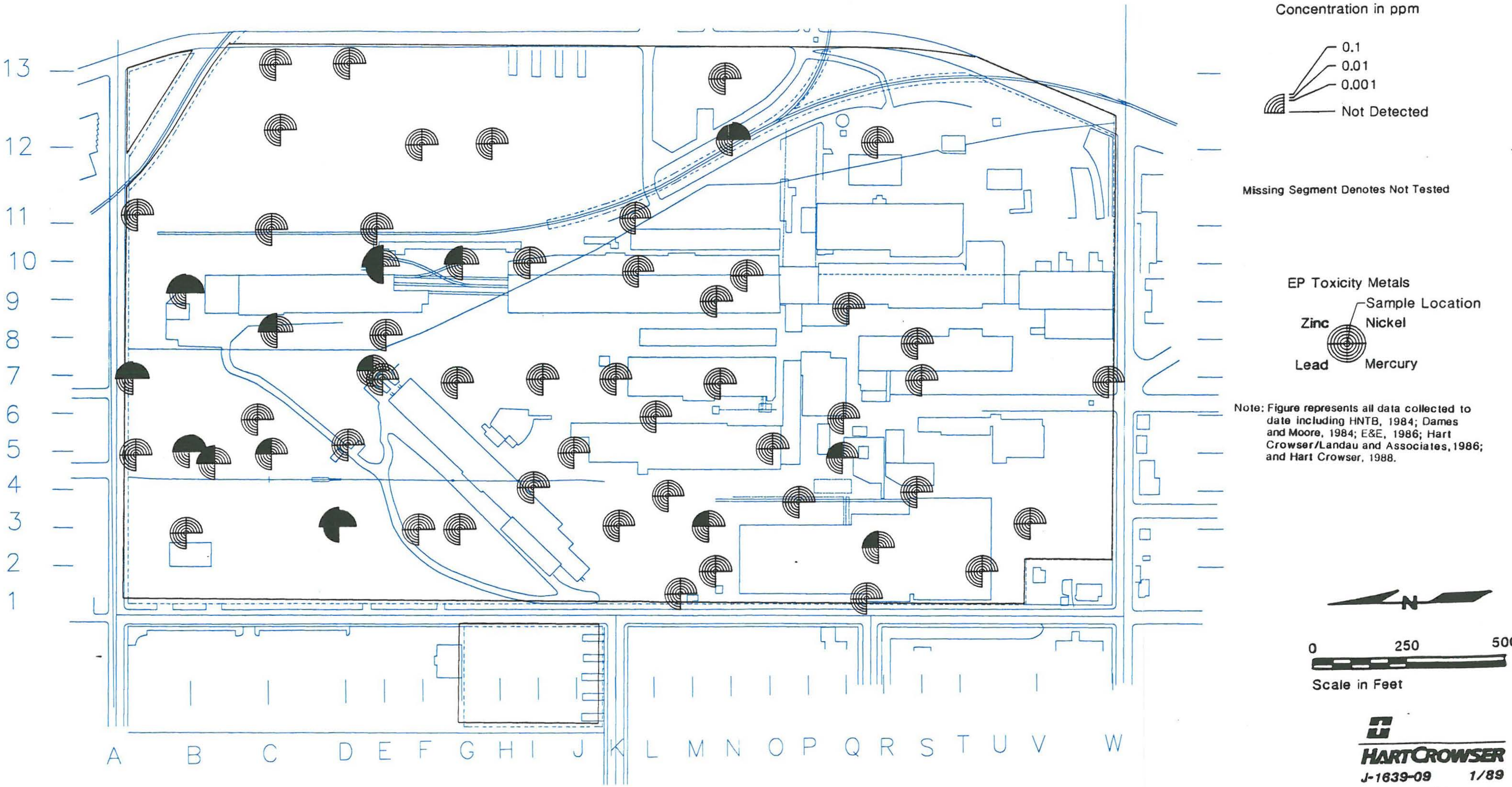


Distribution of EP Toxicity Metals
(Pb, Hg, Ni, Zn) in Soil
(0 to 2 Feet Depth)



HARTCROWSER
J-1639-09 1/89
Figure 6.40

Distribution of EP Toxicity Metals
(Pb, Hg, Ni, Zn) in Soil
(>2 to 4.5 Feet Depth)



HARTCROWSER
J-1639-09 1/89
Figure 6.41

Distribution of EP Toxicity Metals
(Pb, Hg, Ni, Zn) in Soil
(>4.5 to 7 Feet Depth)

HARTCROWSER
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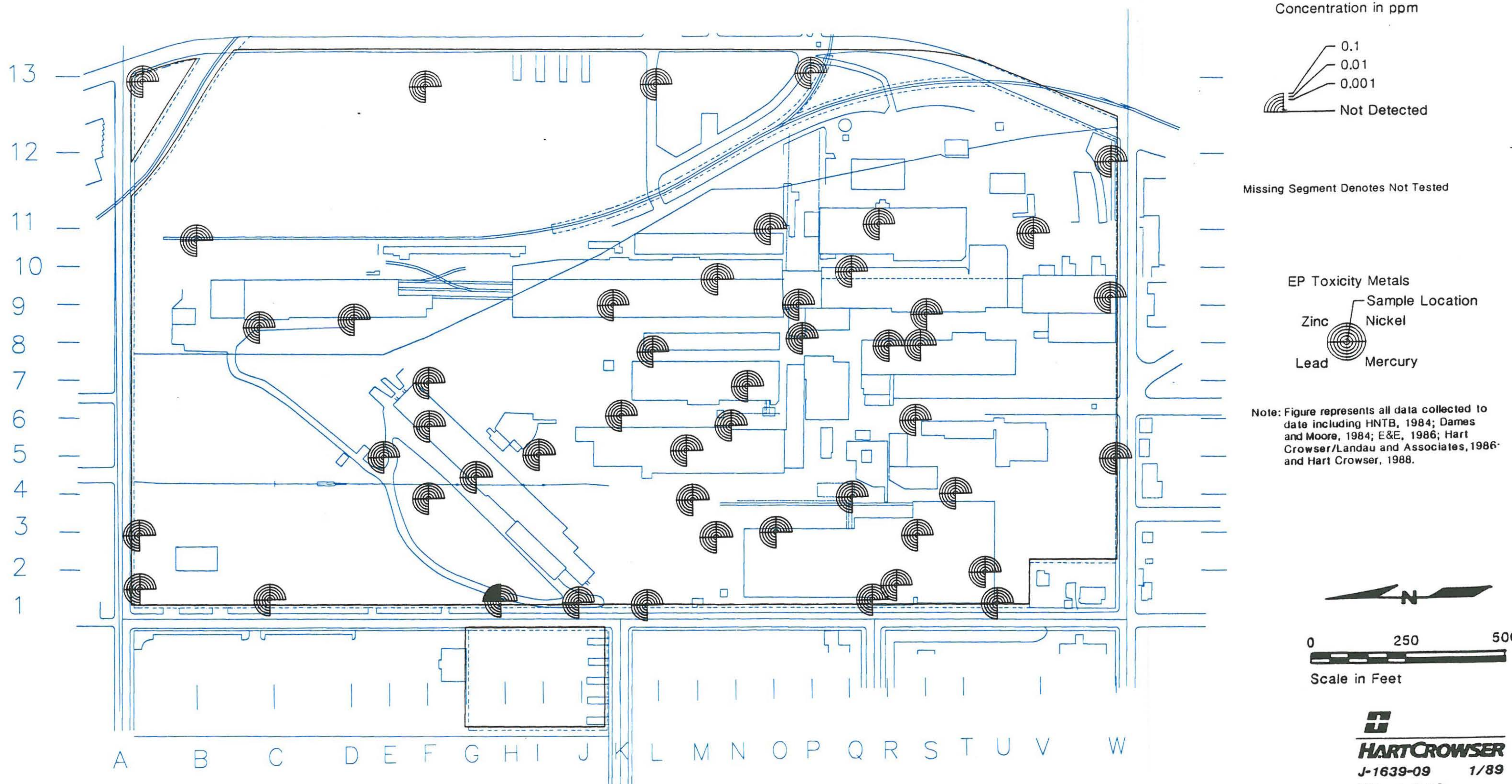
Figure 6.42

Distribution of EP Toxicity Metals

(Pb, Hg, Ni, Zn) in Soil
(>7 Feet Depth)



Note: Figure represents all data collected to date including HNTB, 1984; Dames and Moore, 1984; E&E, 1986; Hart Crowser/Landau and Associates, 1986 and Hart Crowser, 1988.

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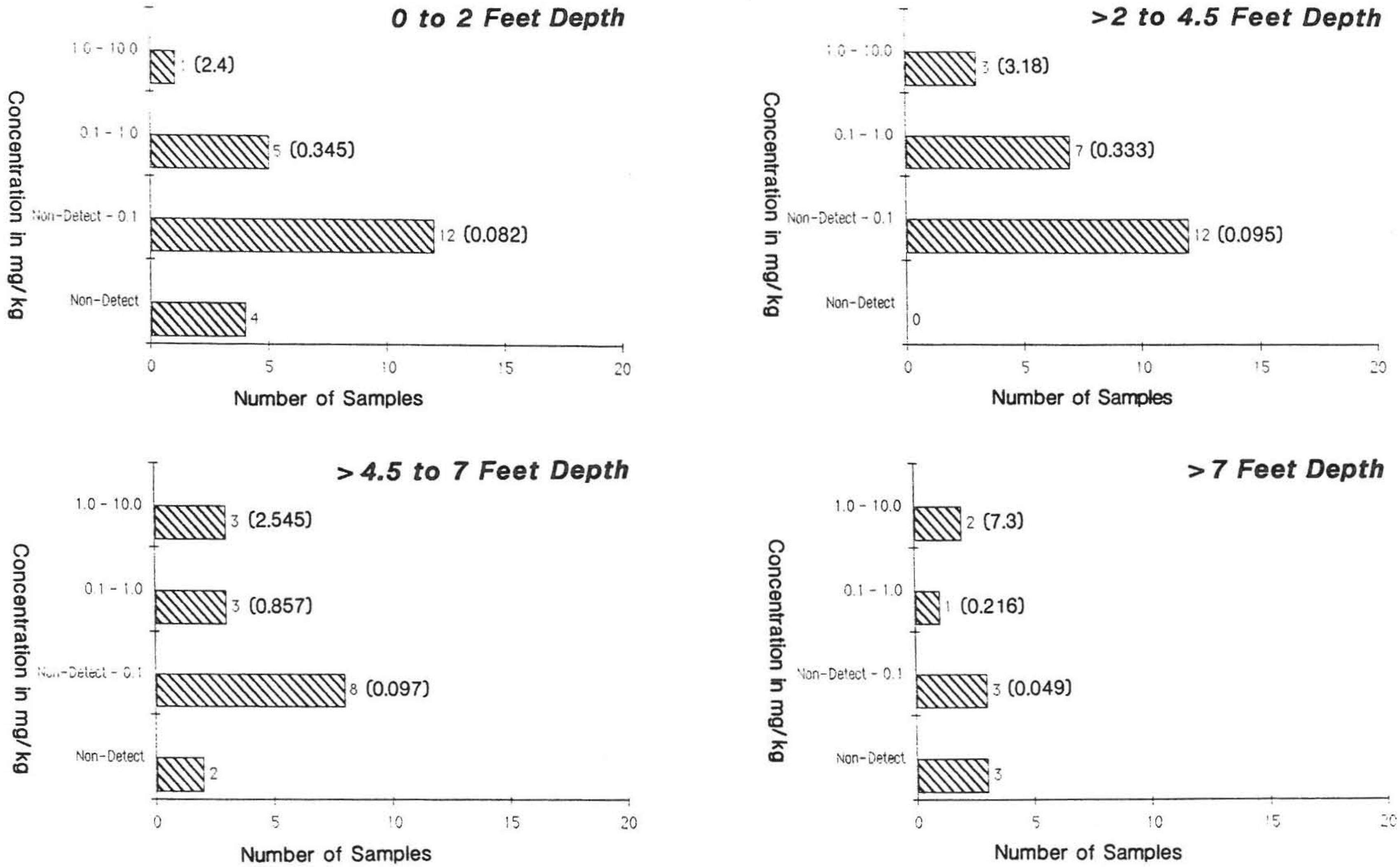
Figure 6.43

Distribution of Total Volatiles Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

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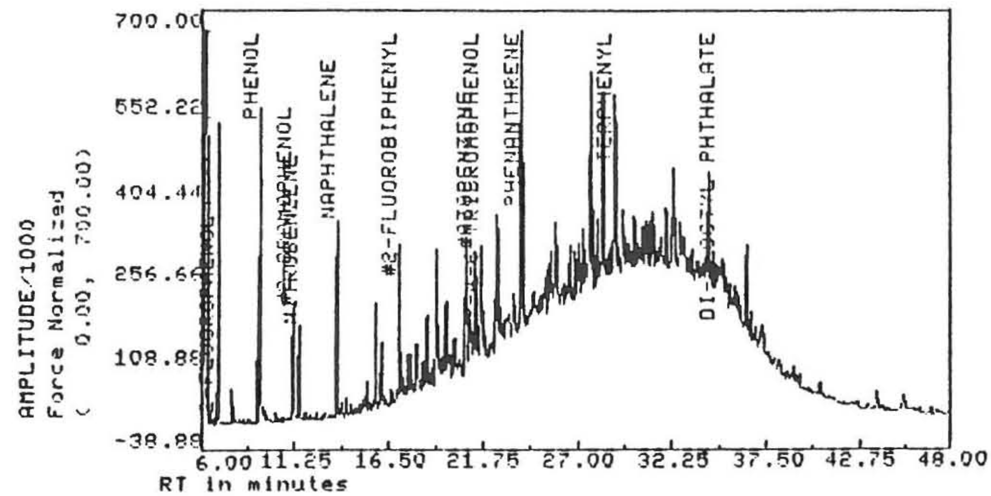
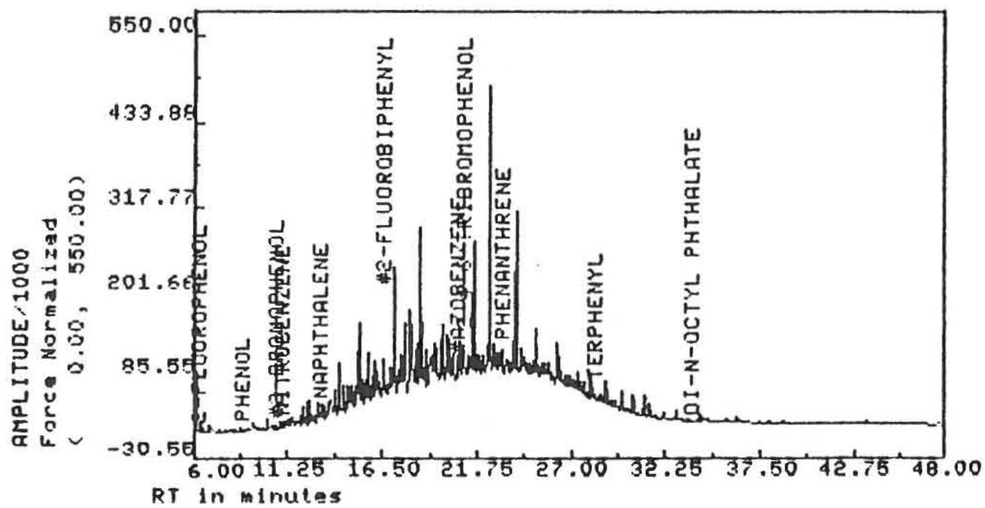
Figure 6.44

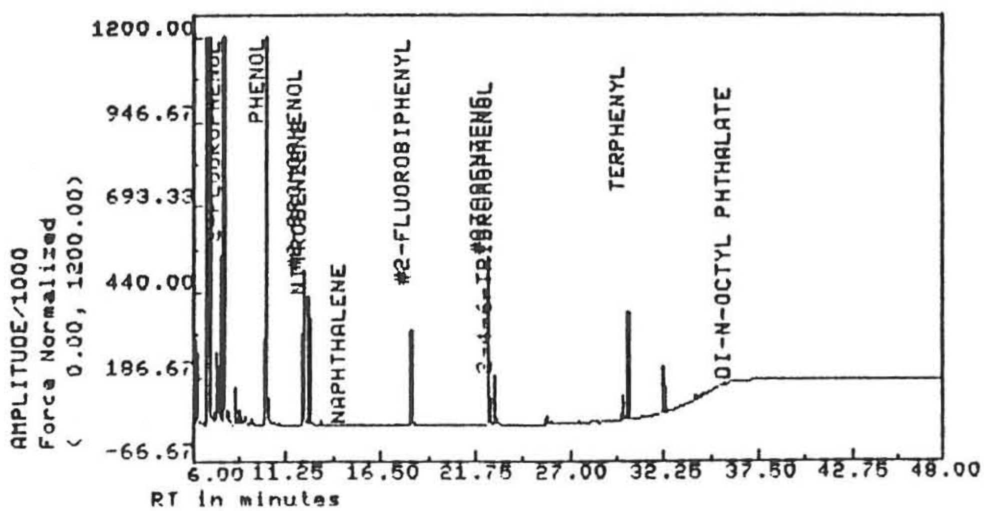
GC-FID Signatures



Polynulear Aromatic Hydrocarbons (PAH's)



Diesel Fuel



Gasoline

HARTCROWSER

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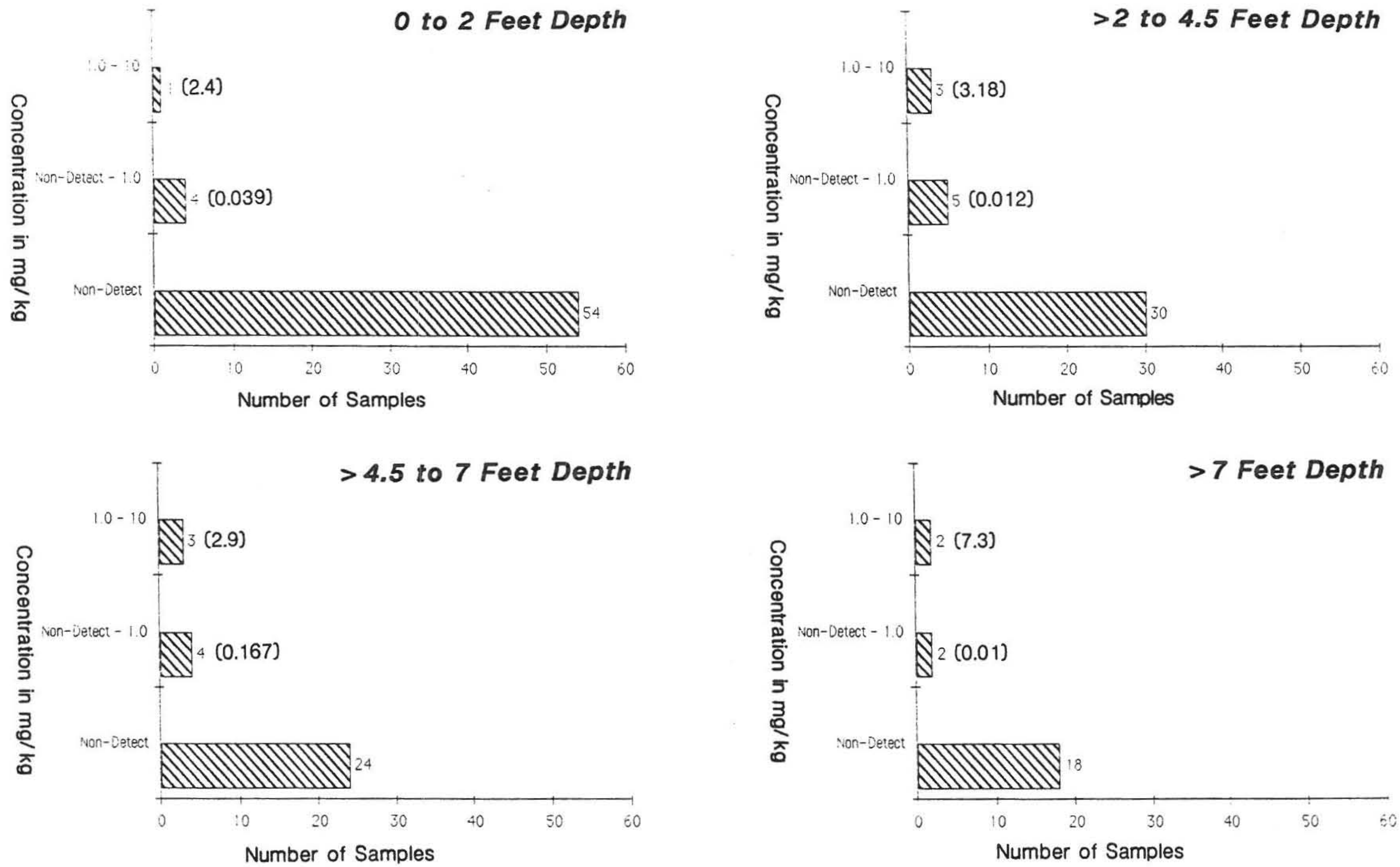
Figure 6.45

Distribution of BTEX Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

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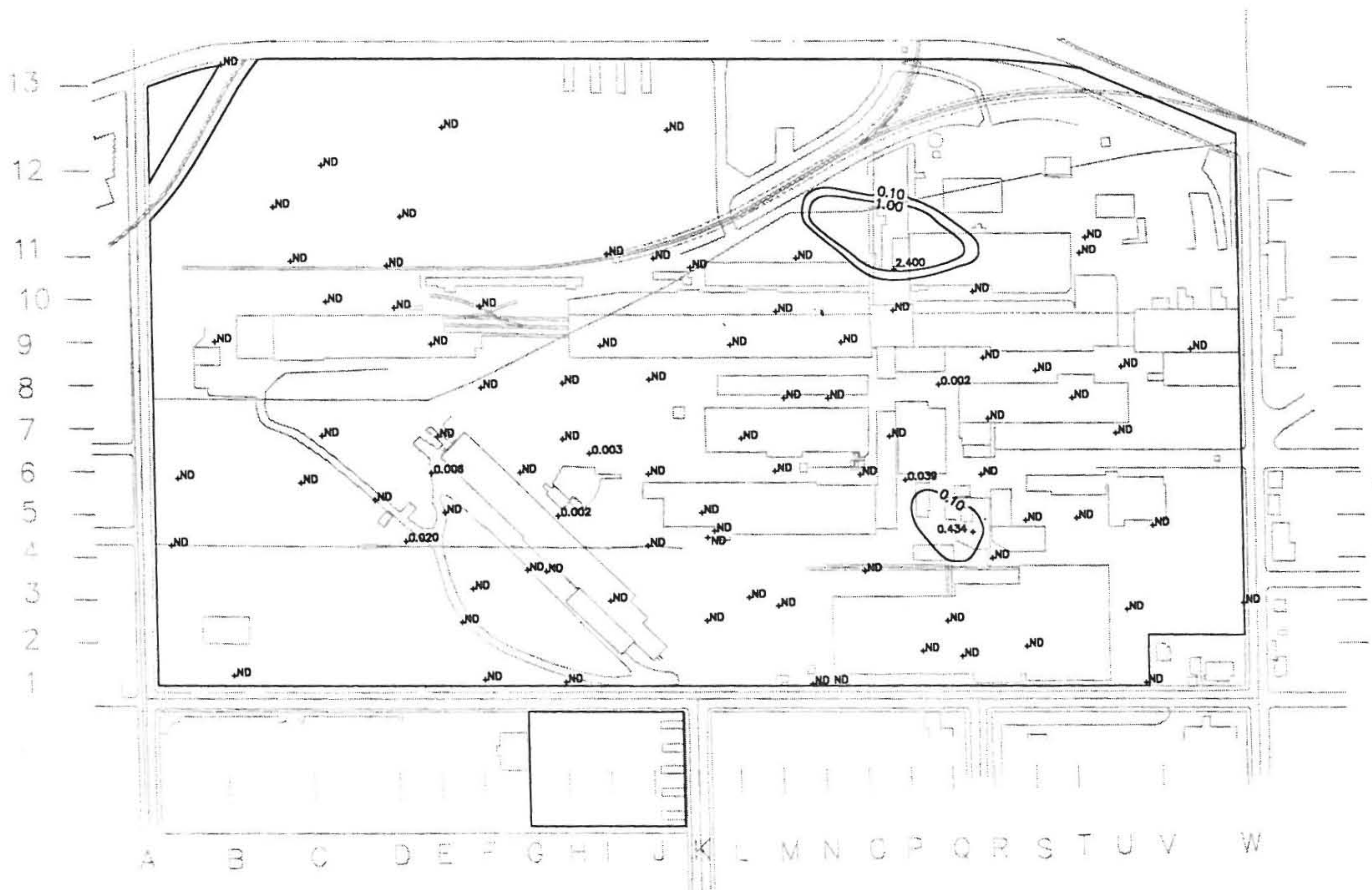
Figure 6.46

Distribution of BTEX in Soil
(0 to 2 Feet Depth)



BTEX Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

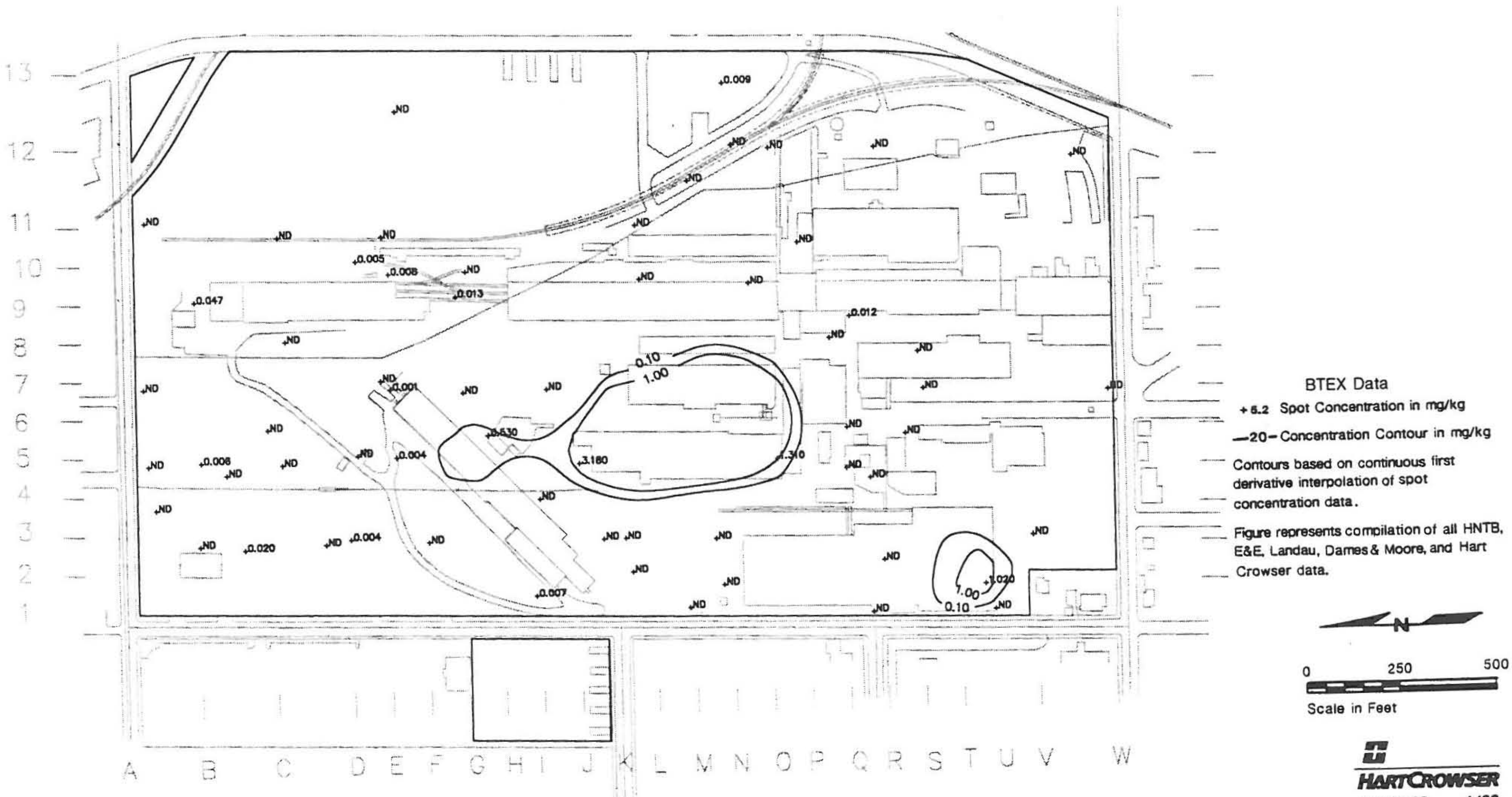
Scale in Feet

HARTCROWSER

J-1639-09 1/89

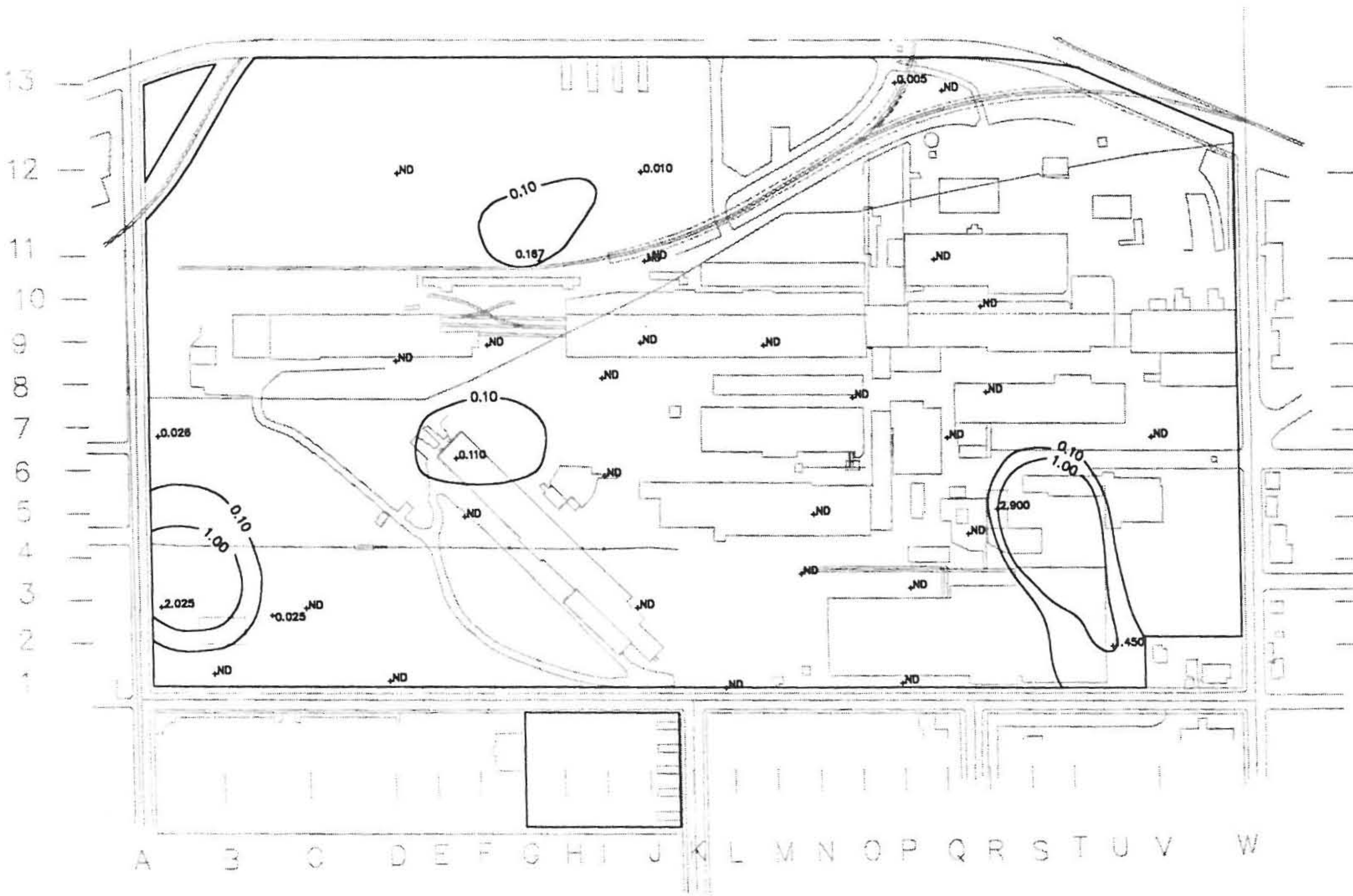
Figure 6.47

Distribution of BTEX in Soil
(>2 to 4.5 Feet Depth)



HARTCROWSER
J-1639-09 1/89
Figure 6.48

Distribution of BTEX in Soil
(>4.5 to 7 Feet Depth)



BTEX Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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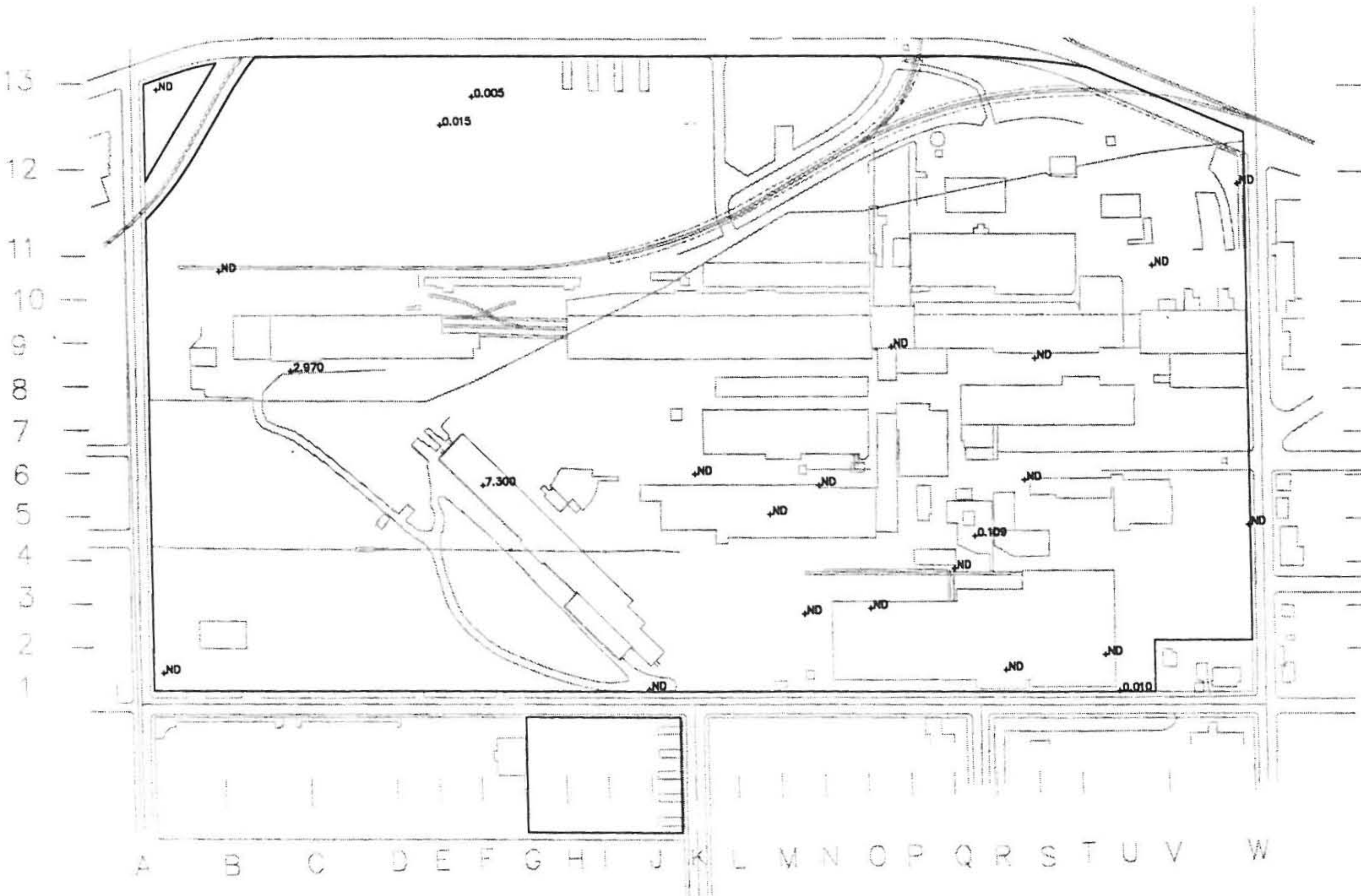
Figure 6.49

Distribution of BTEX in Soil
(>7 Feet Depth)



BTEX Data

+6.2 Spot Concentration in mg/kg

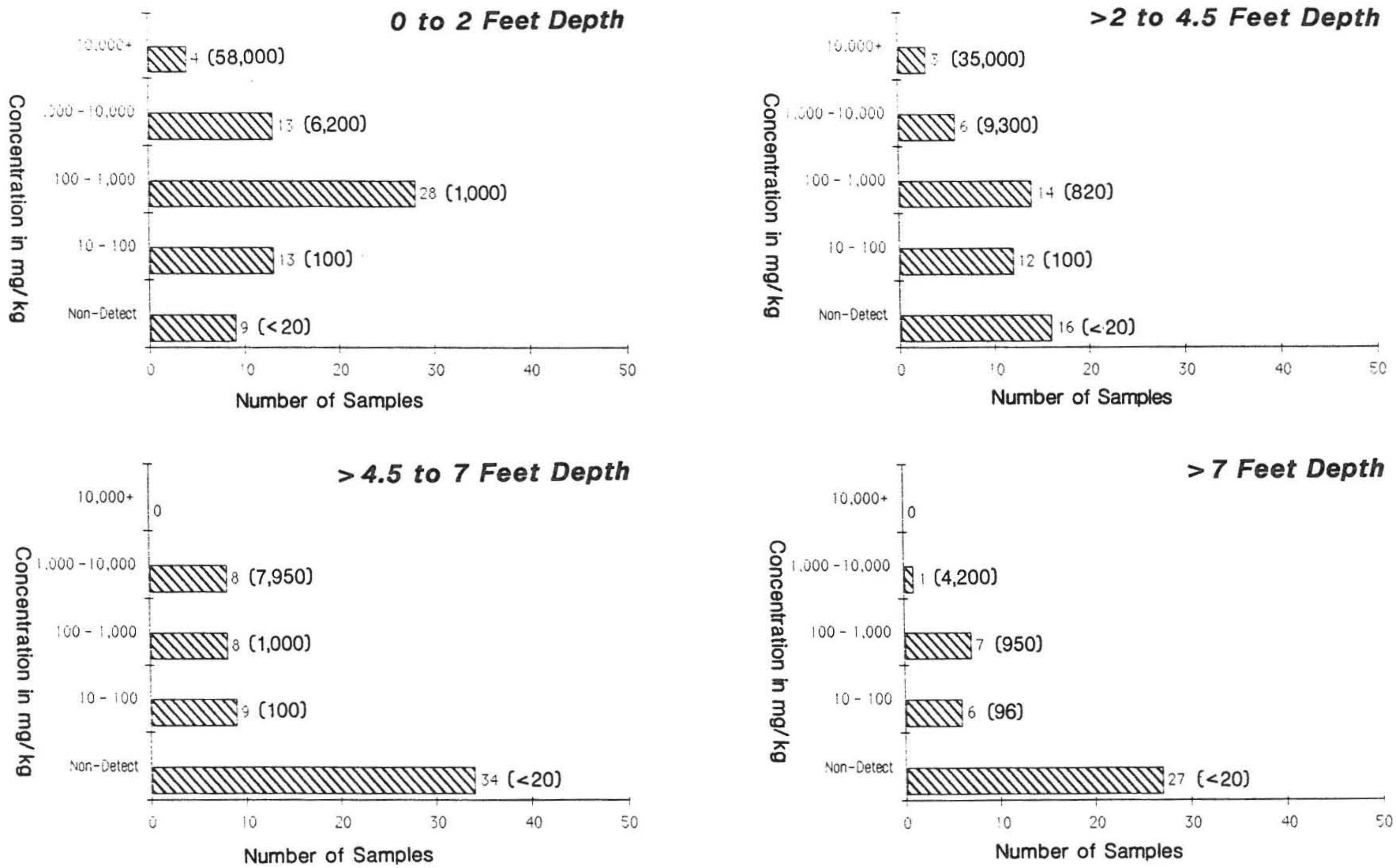
No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

0 250 500
Scale in Feet

HARTCROWSER
J-1639-09 1/89
Figure 6.50

Distribution of TPH Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
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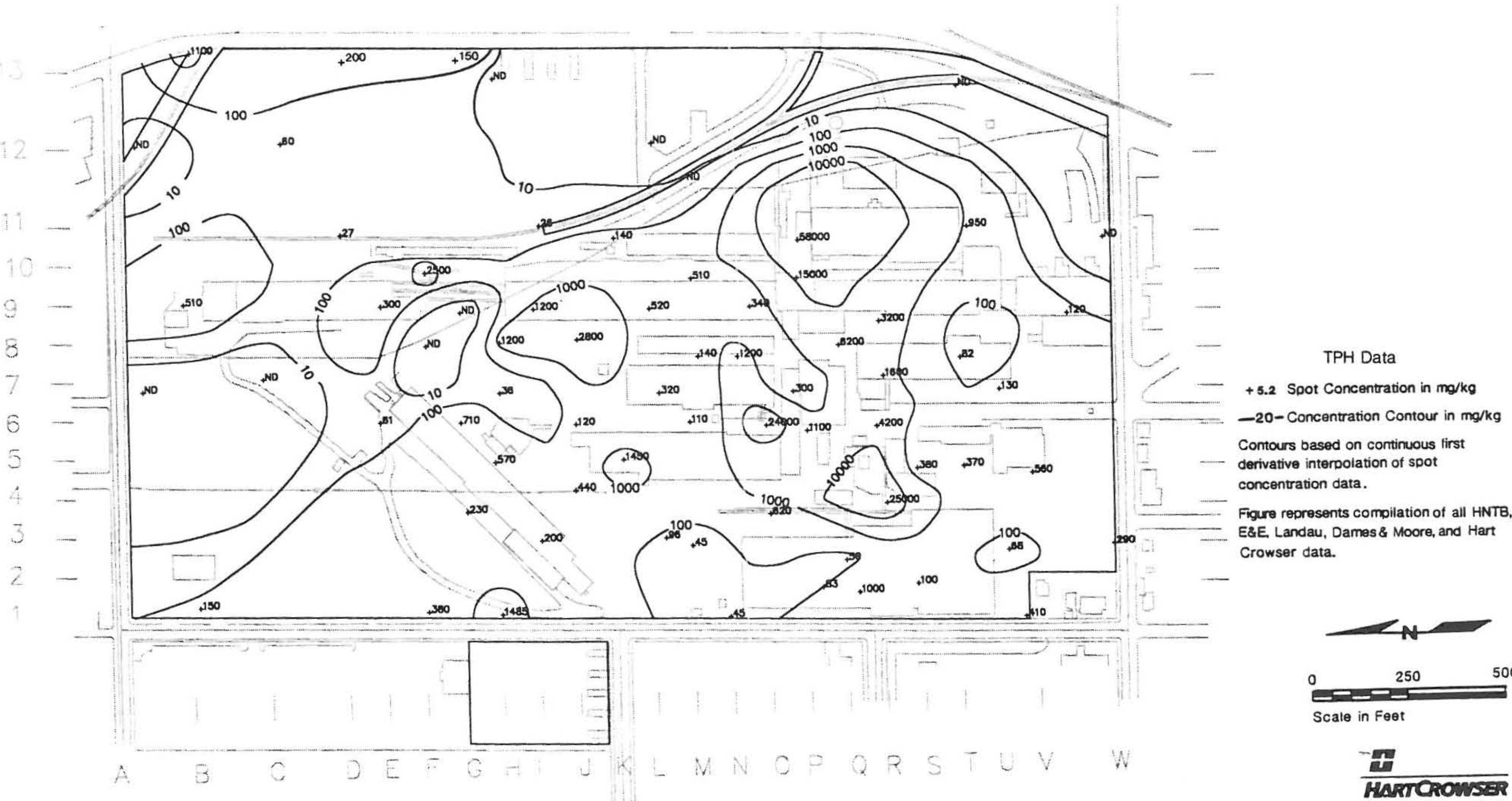
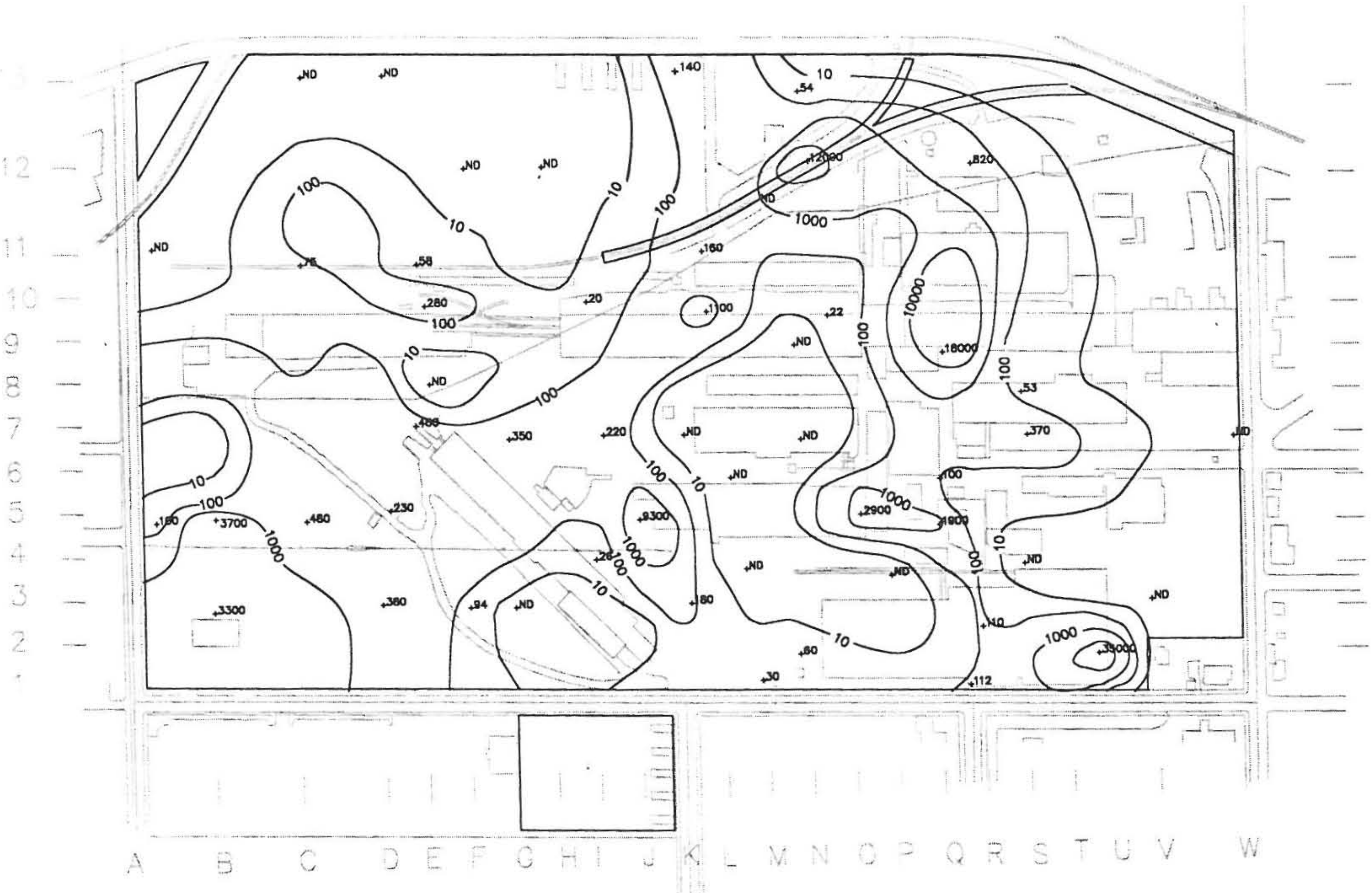
Figure 6.51

Distribution of TPH in Soil
(0 to 2 Feet Depth)



HARTCROWSER
J-1639-09 *1/89*
Figure 6.52

Distribution of TPH in Soil
(> 2 to 4.5 Feet Depth)



TPH Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

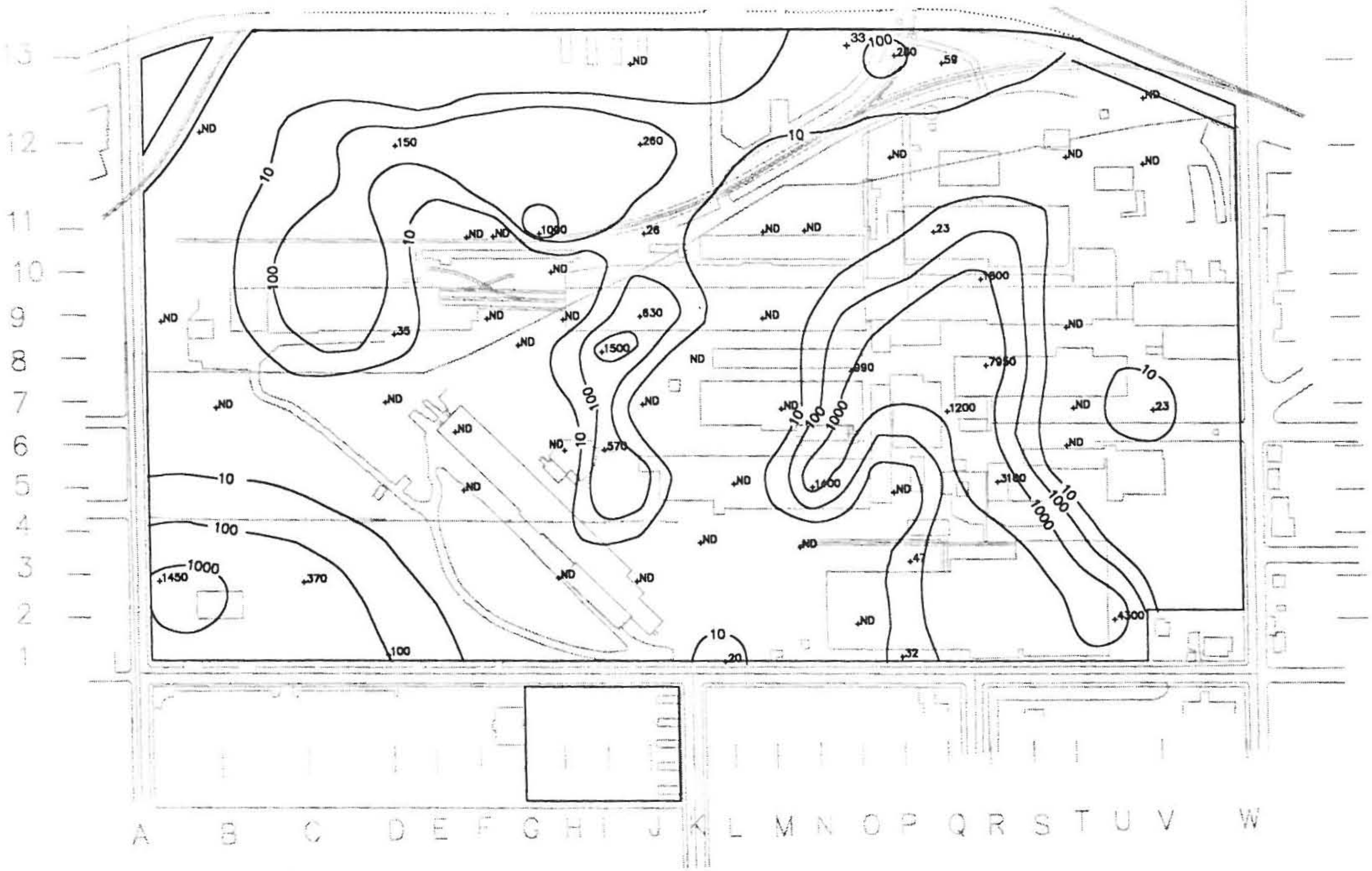
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.53

Distribution of TPH in Soil
(>4.5 to 7 Feet Depth)



TPH Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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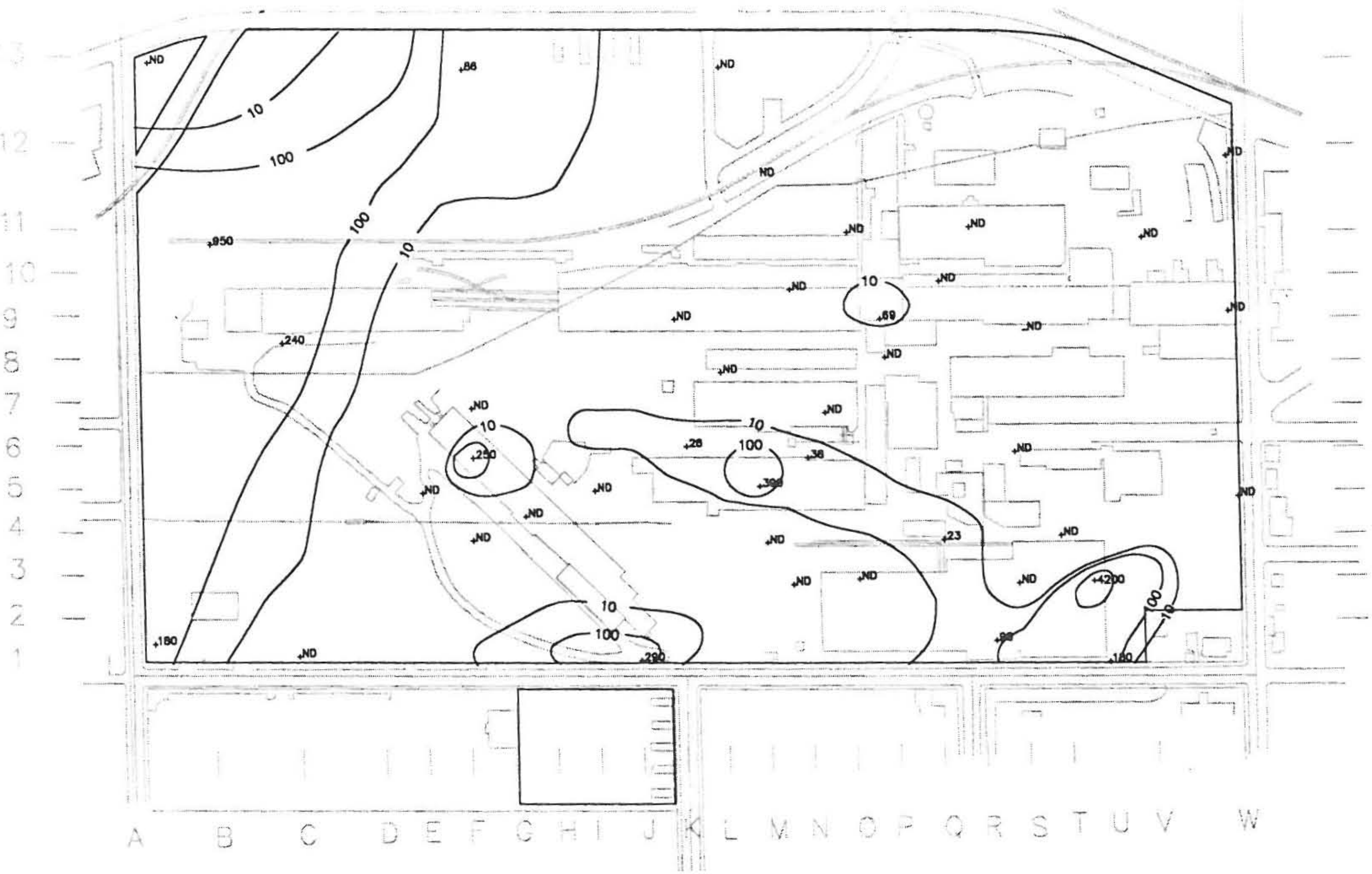
Figure 6.54

Distribution of TPH in Soil
(>7 Feet Depth)



TPH Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

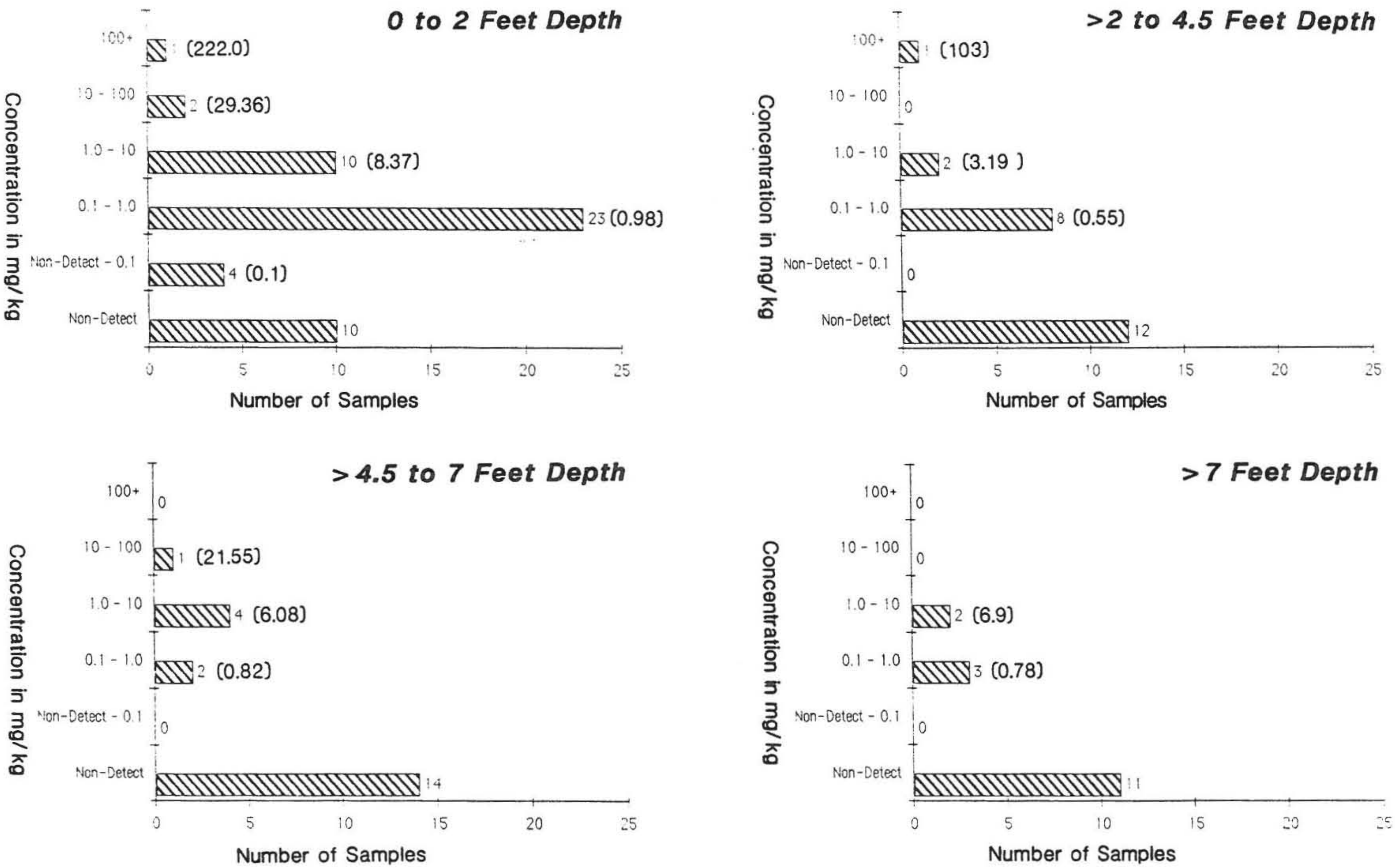
N

0 250 500

Scale in Feet

HARTCROWSER
J-1639-09 1/89
Figure 6.55

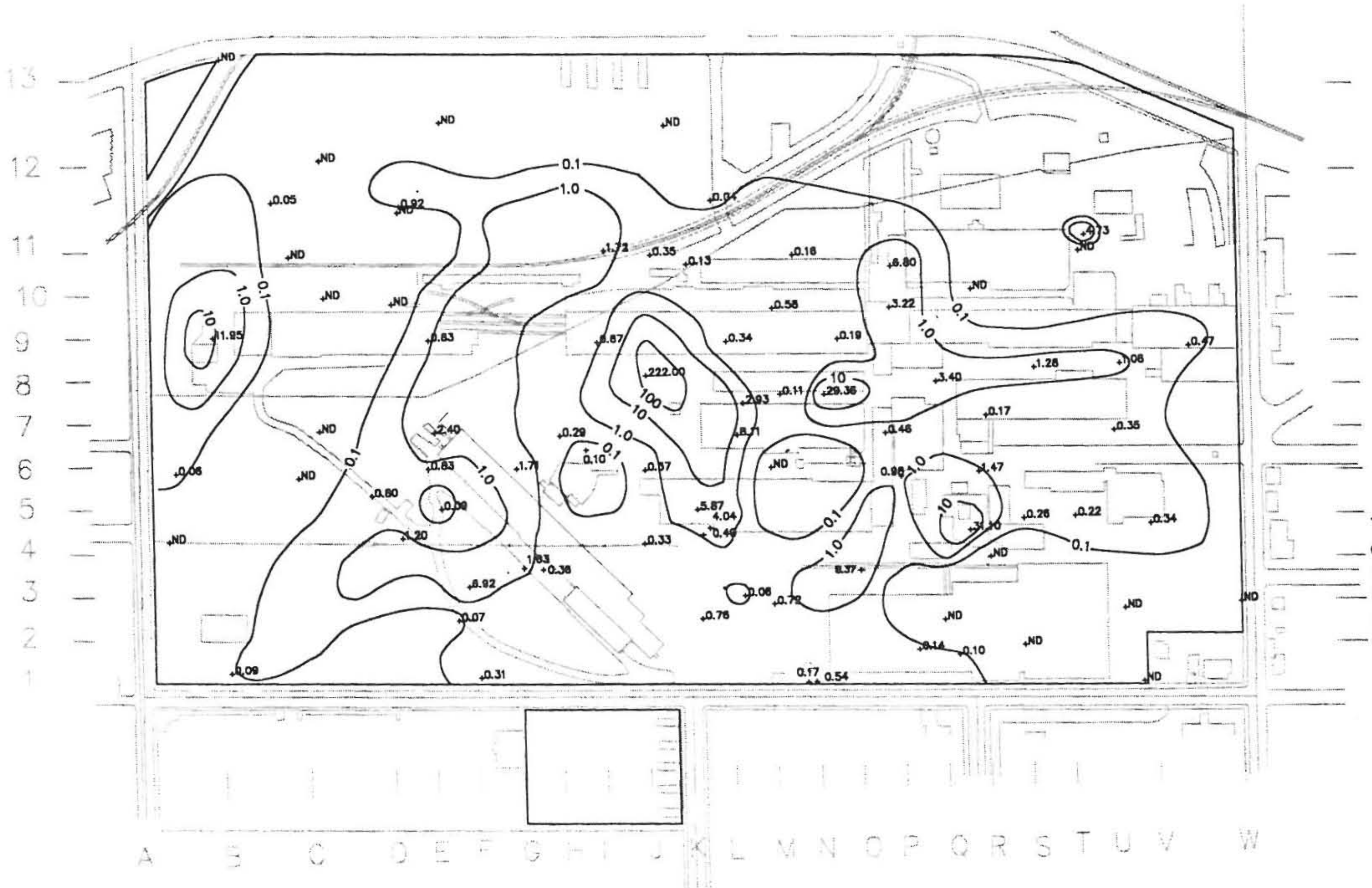
Distribution of LPAH Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.56

Distribution of LPAH in Soil
(0 to 2 Feet Depth)



LPAH Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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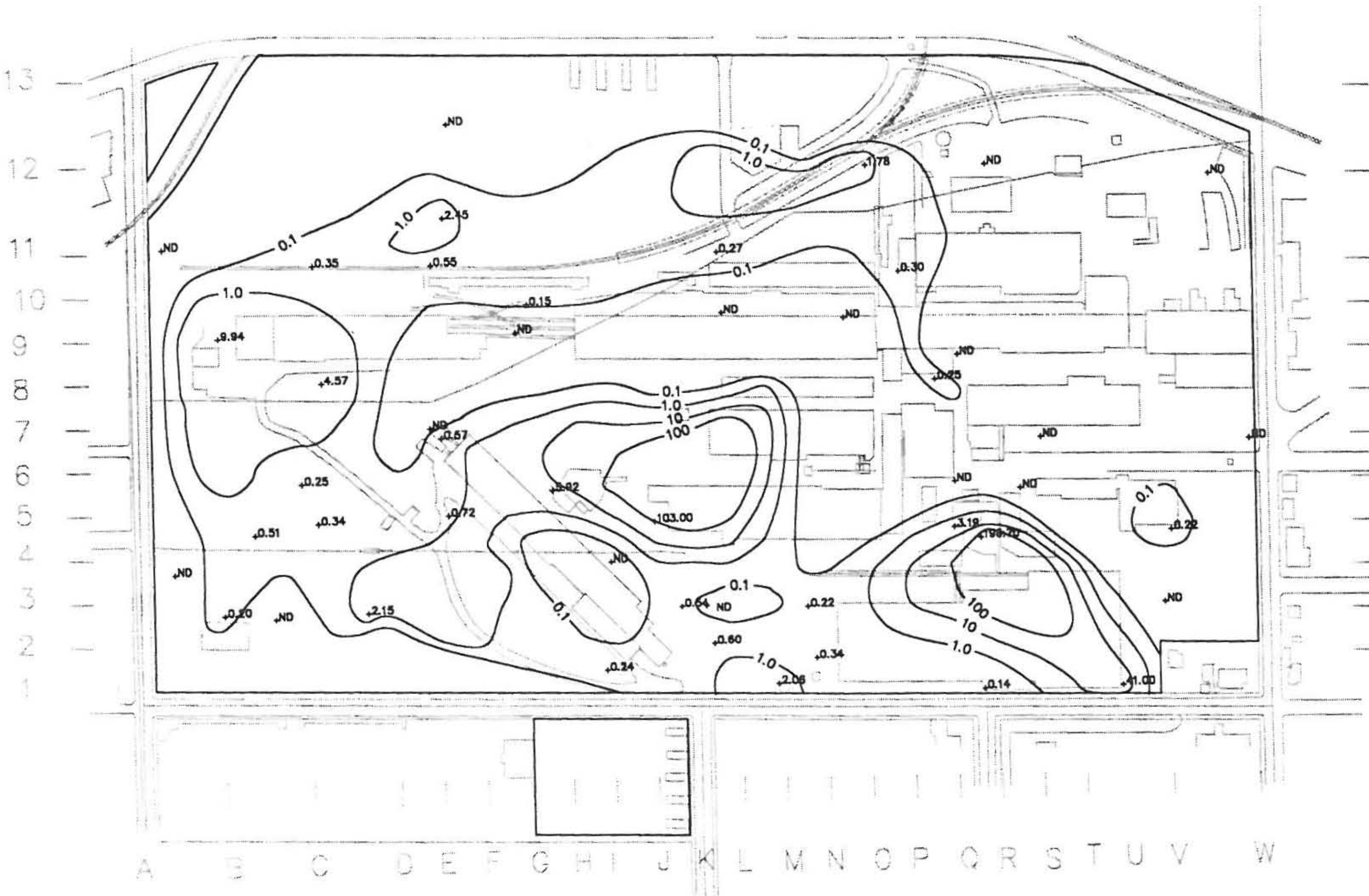
Figure 6.57

Distribution of LPAH in Soil
(>2 to 4.5 Feet Depth)



LPAH Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

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Figure 6.58

Distribution of LPAH in Soil
(>4.5 to 7 Feet Depth)

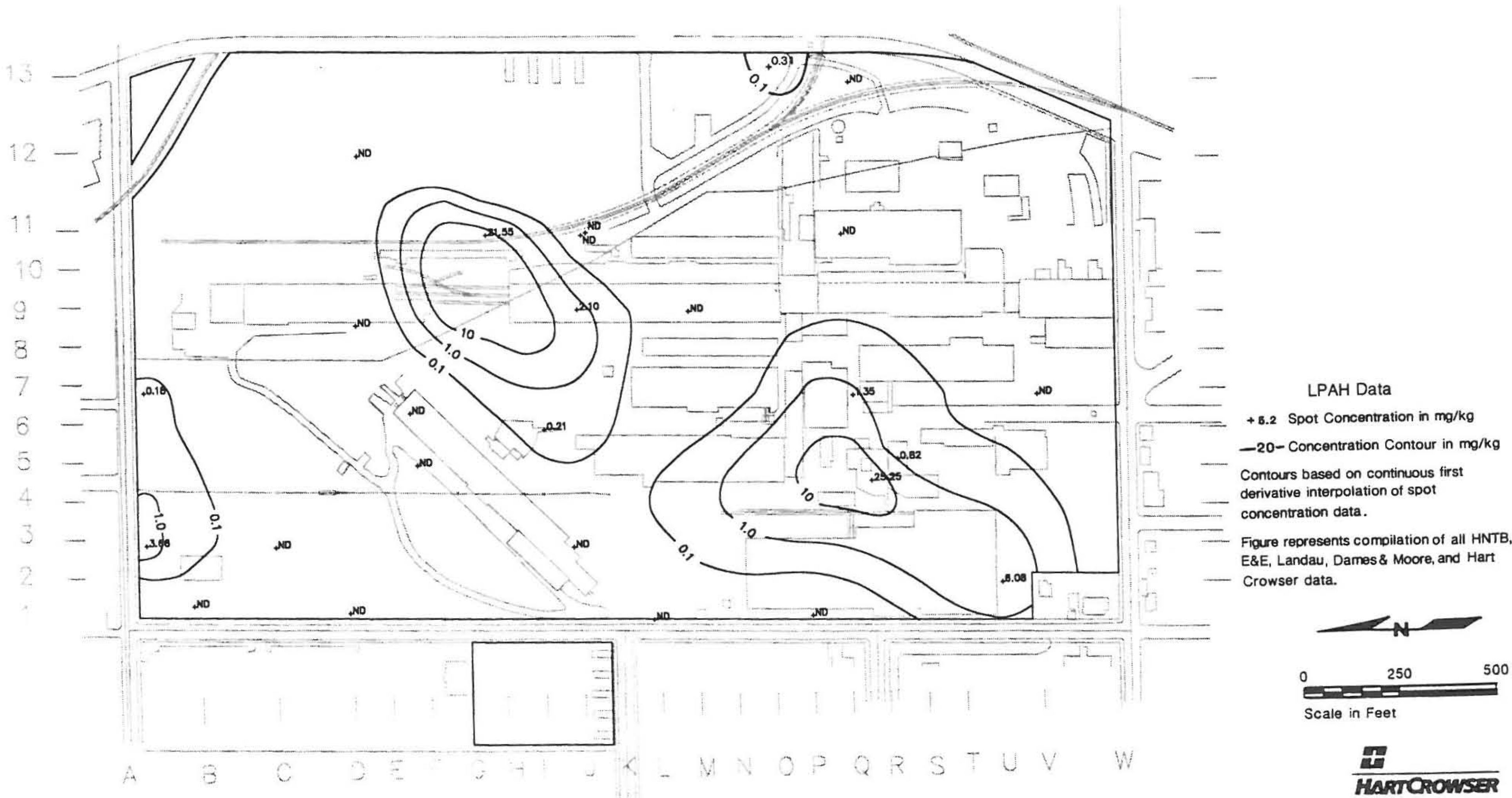

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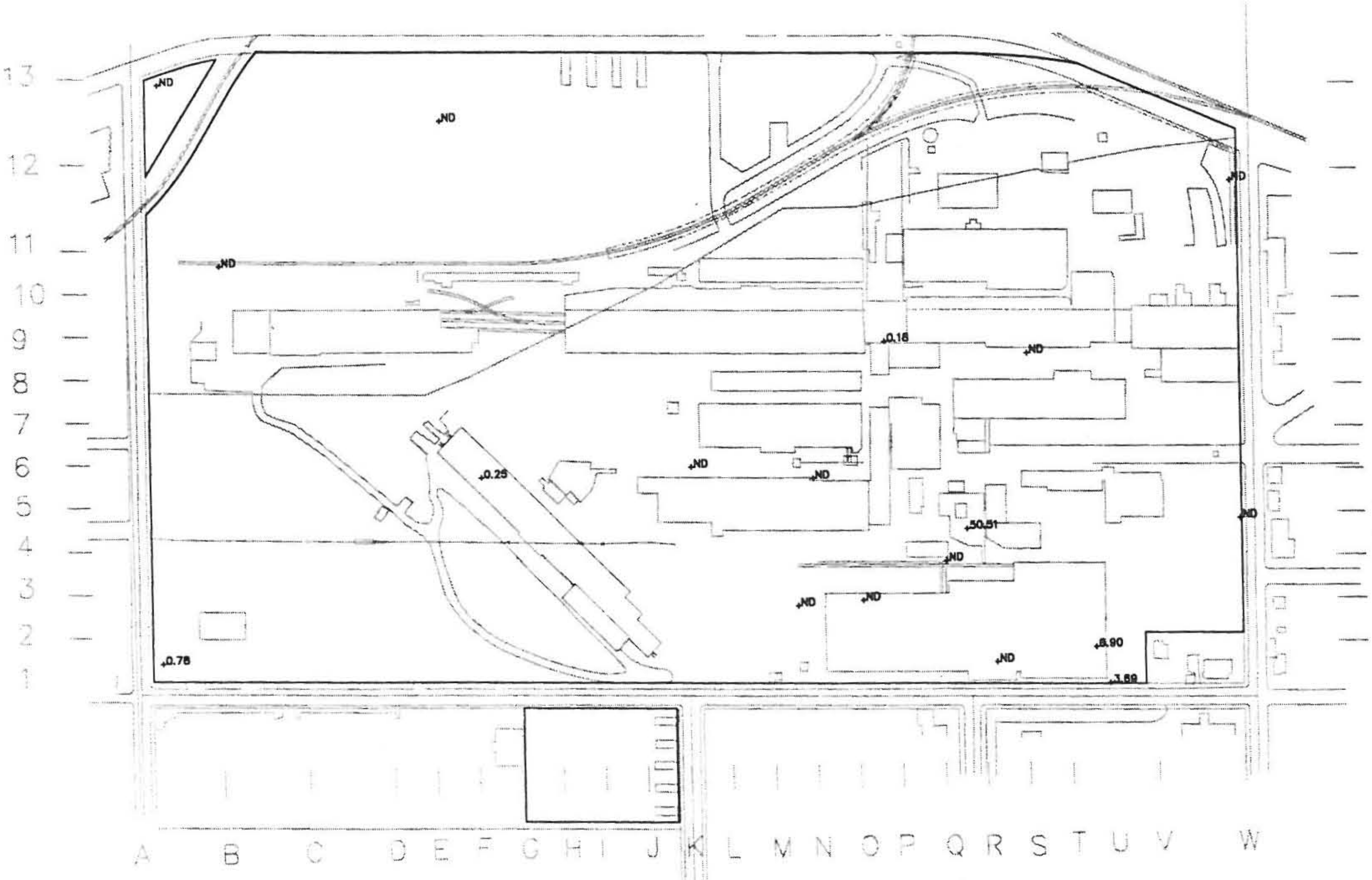
Figure 6.59

Distribution of LPAH in Soil
(>7 Feet Depth)



LPAH Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

Scale in Feet

HARTCROWSER

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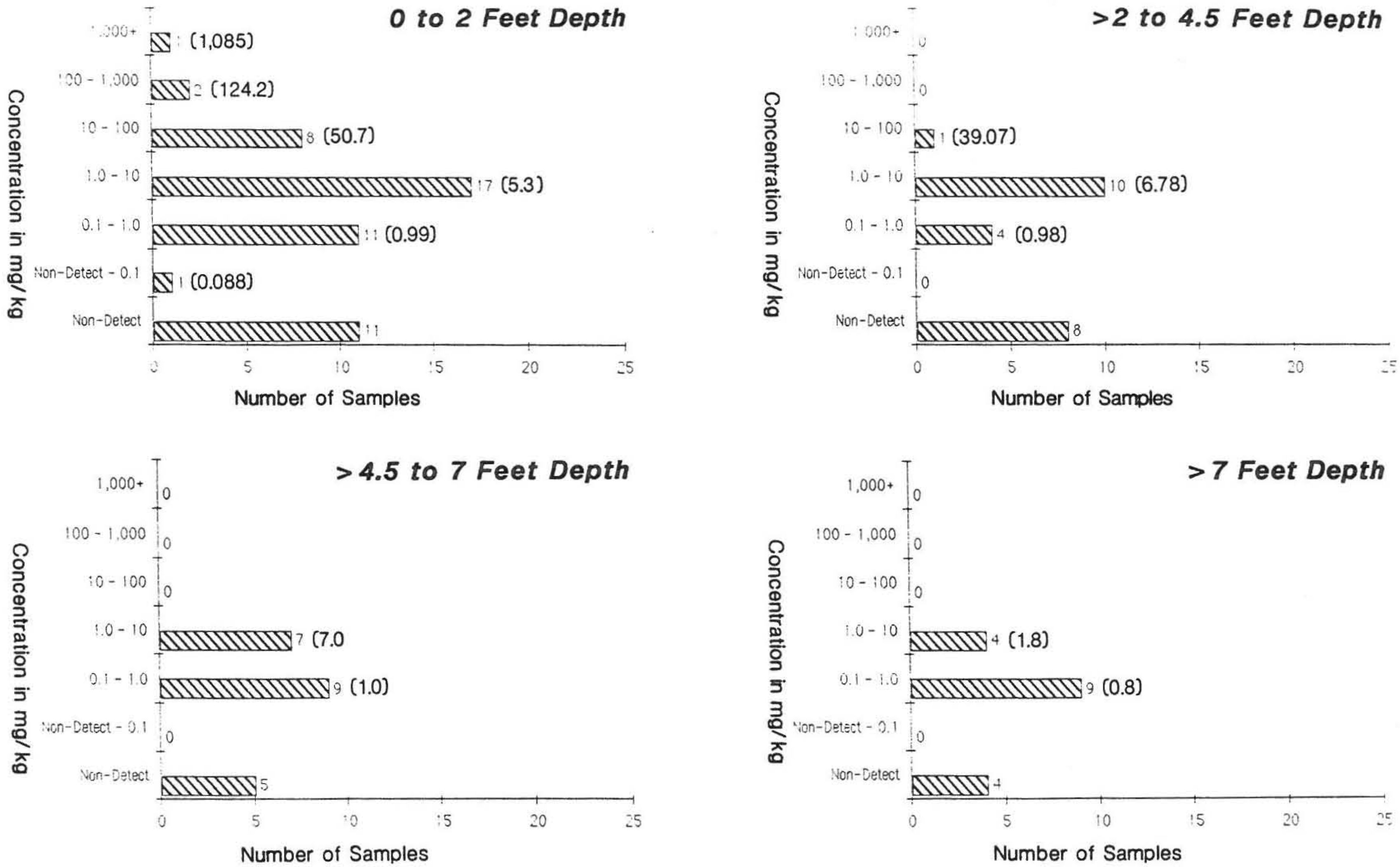
Figure 6.60

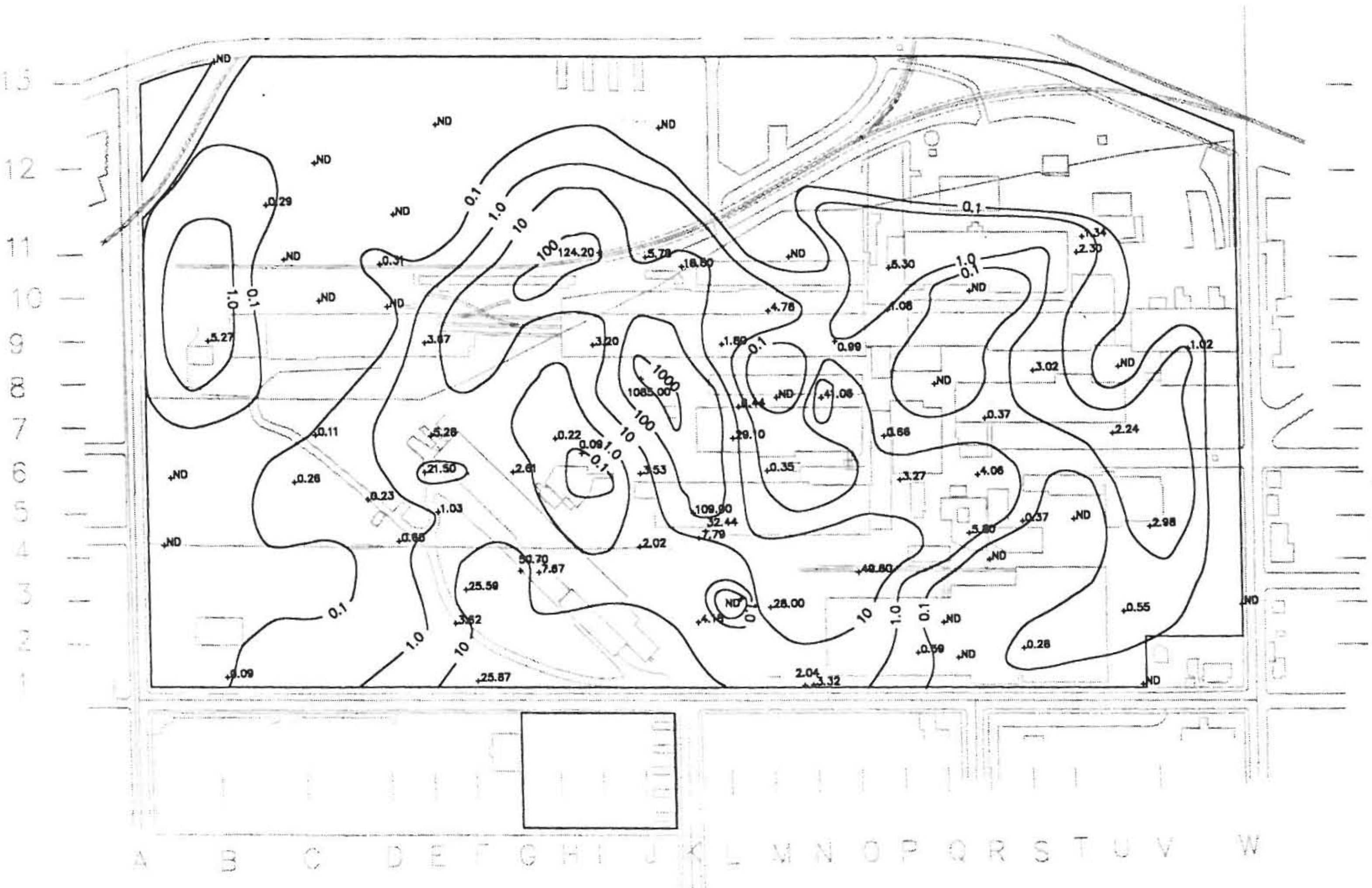
Distribution of HPAH Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.61

Distribution of HPAH in Soil
(0 to 2 Feet Depth)



HPAH Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

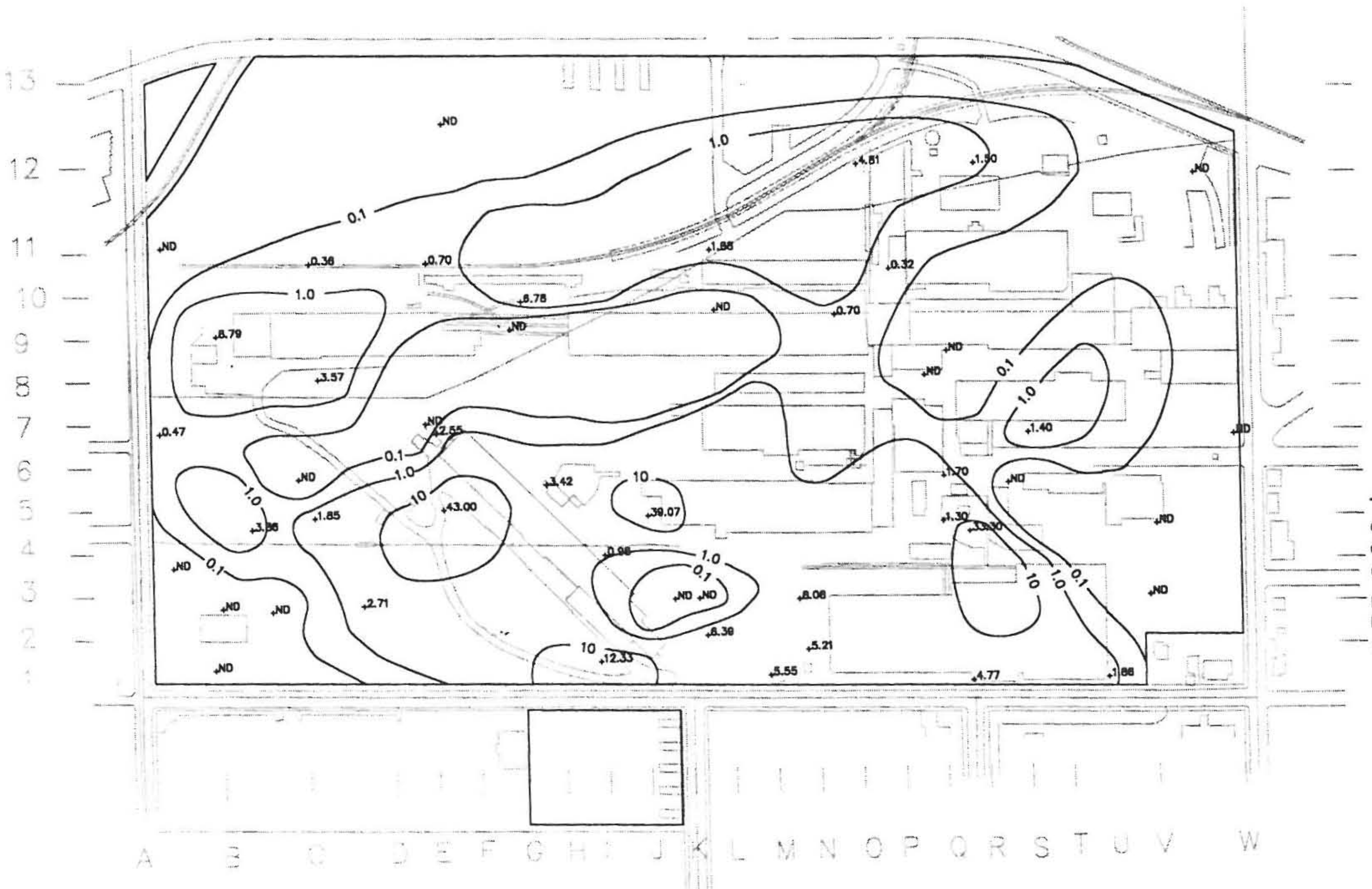
Scale in Feet

HARTCROWSER

J-1639-09 *1/89*

Figure 6.62

Distribution of HPAH in Soil
(>2 to 4.5 Feet Depth)



HPAH Data

+5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

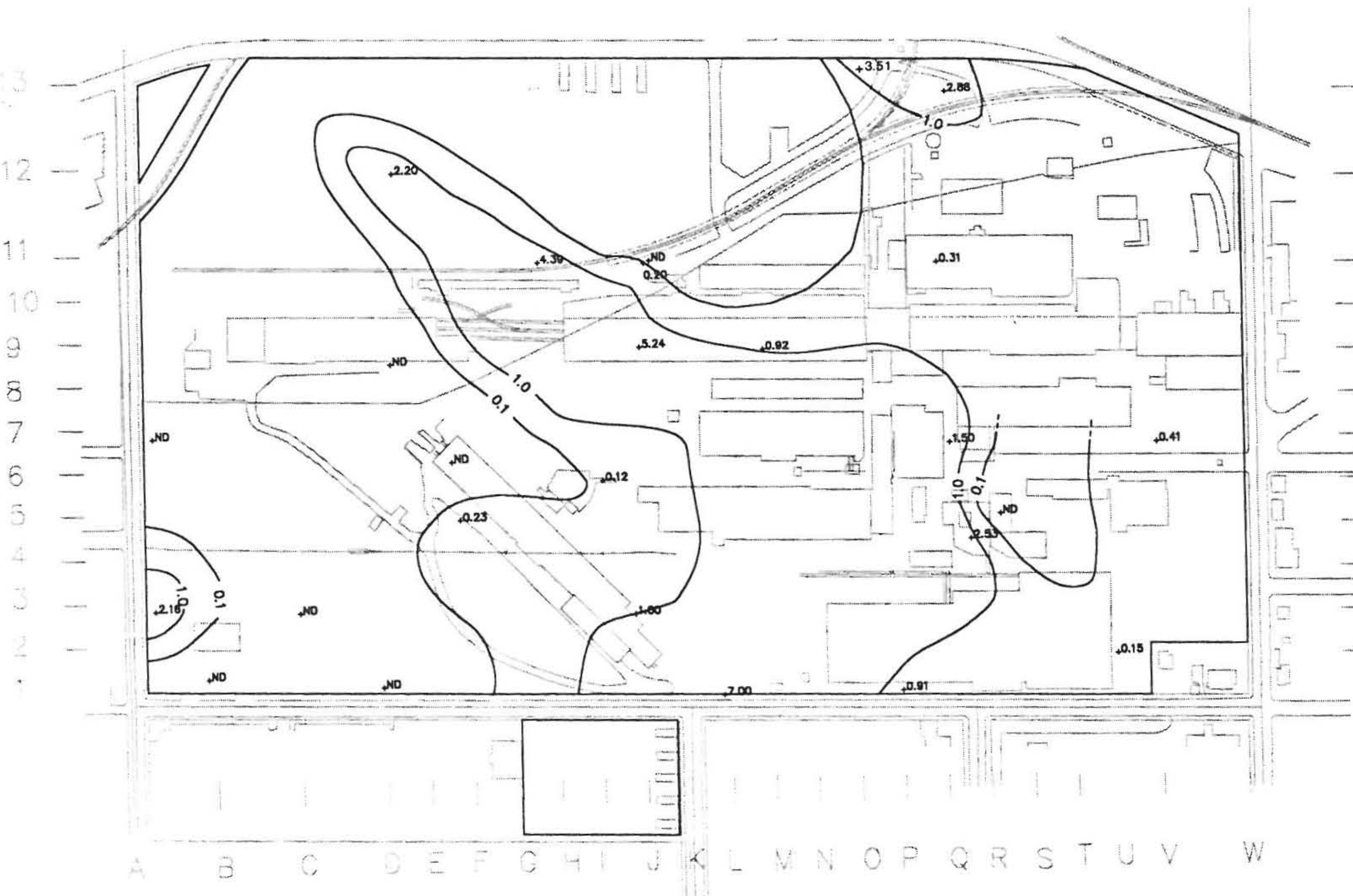
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.63

Distribution of HPAH in Soil
(>4.5 to 7 Feet Depth)



HPAH Data

+ 5.2 Spot Concentration in mg/kg

—20— Concentration Contour in mg/kg

Contours based on continuous first derivative interpolation of spot concentration data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

N

0 250 500

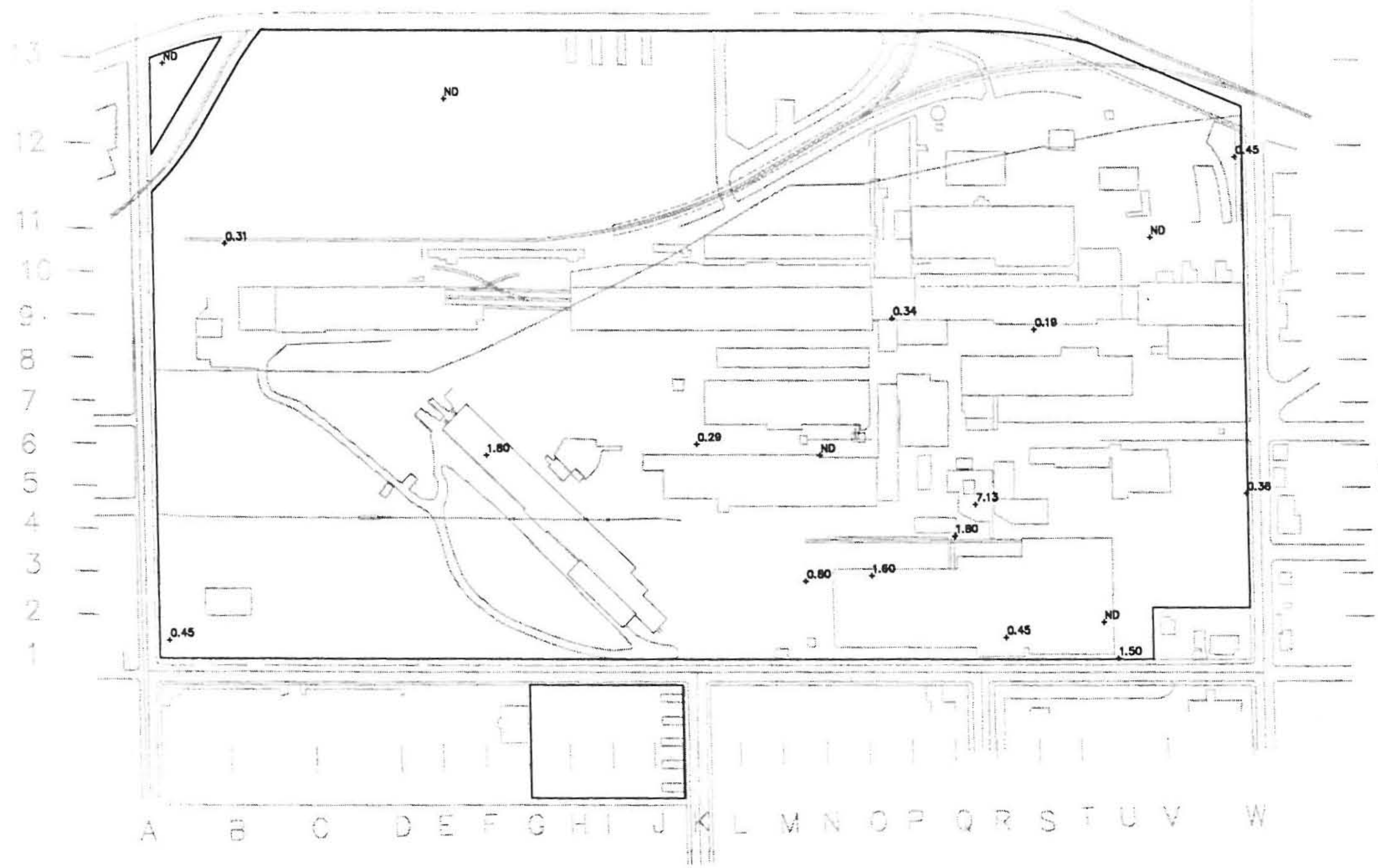
Scale in Feet

HARTCROWSER

J-1639-09 1/89

Figure 6.64

Distribution of HPAH in Soil
(> 7 Feet Depth)

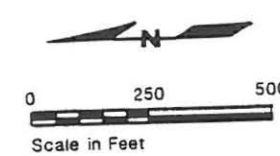


HPAH Data

+5.2 Spot Concentration in mg/kg

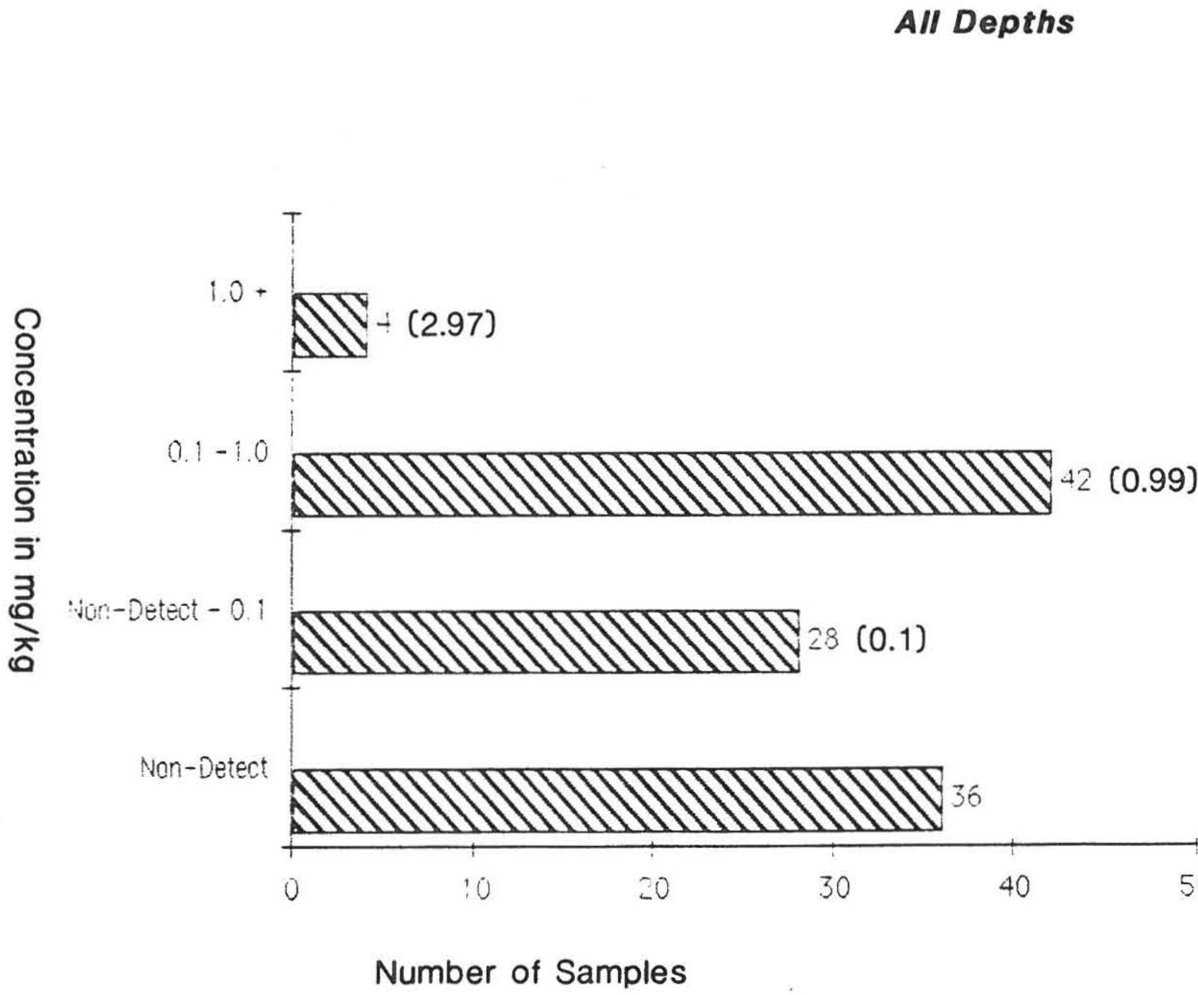
No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.



HARTCROWSER
J-1639-09 1/89
Figure 6.65

Distribution of Total Phthalates Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
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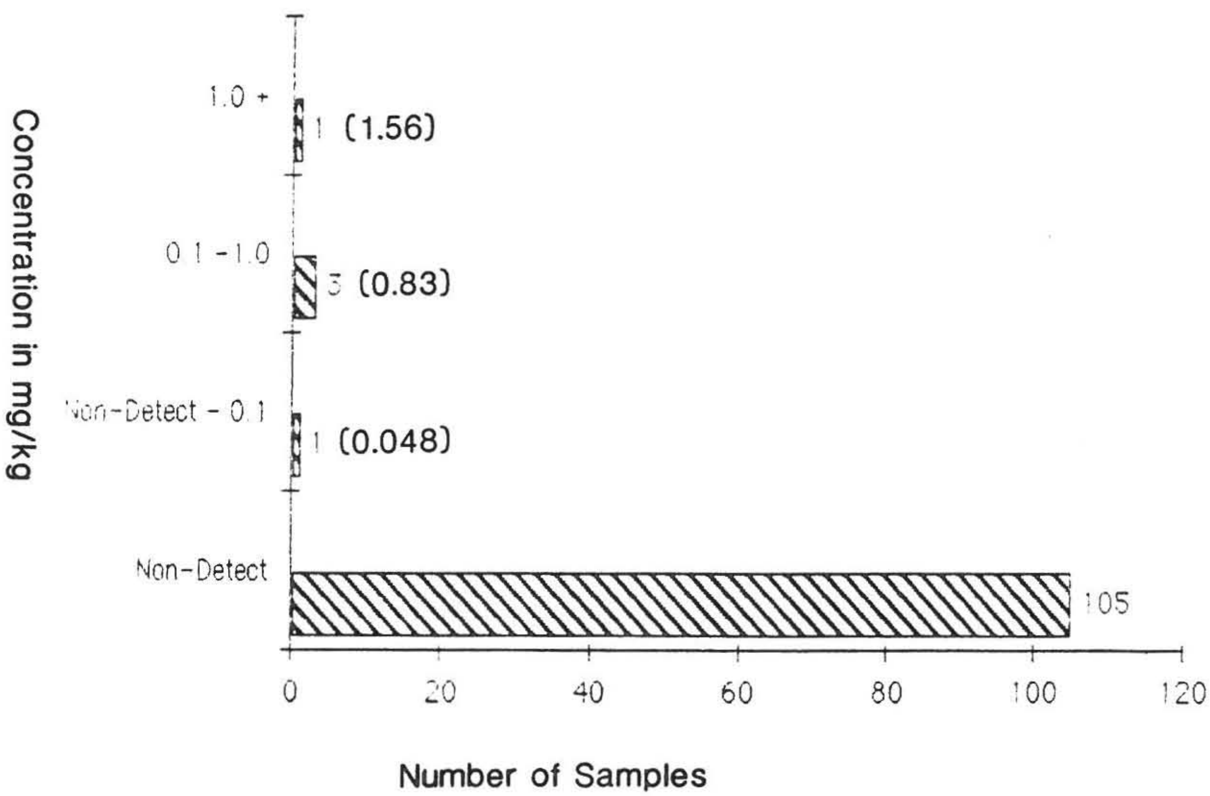
Figure 6.66

Distribution of Total Phenols Concentration Data

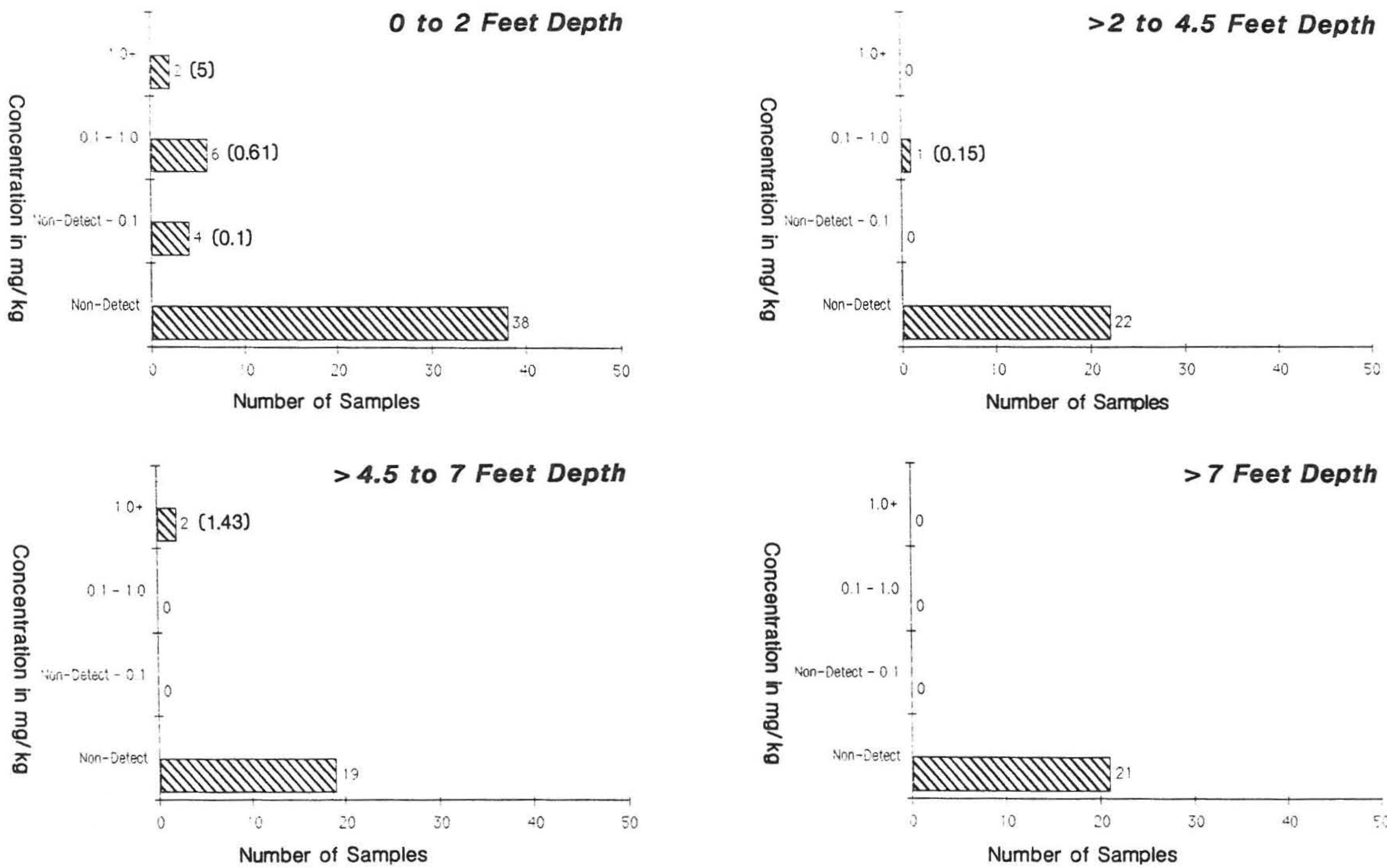
All Depths



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.67

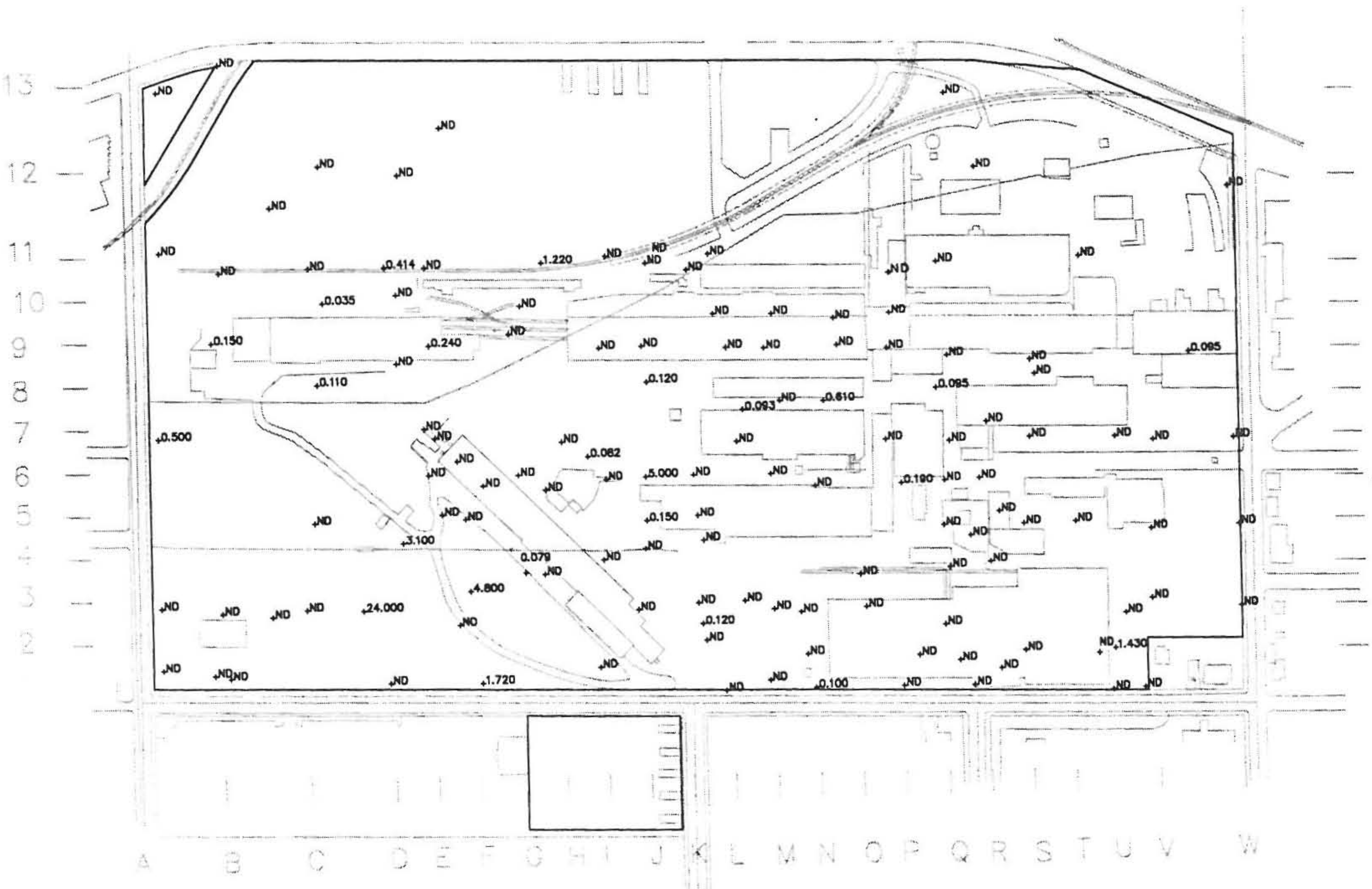
Distribution of Total PCBs Concentration Data



Histograms present distribution of Hart Crowser data collected from June through September 1988. First number after bar presents number of samples in that concentration range. Second number (in parentheses) presents the highest sample concentration detected in each range.

HARTCROWSER
J-1639-09 1/89
Figure 6.68

Distribution of PCBs in Soil
(All Depths)



PCB's Data

+5.2 Spot Concentration in mg/kg

No contours generated from spot concentration data due to the variability of the data.

Figure represents compilation of all HNTB, E&E, Landau, Dames & Moore, and Hart Crowser data.

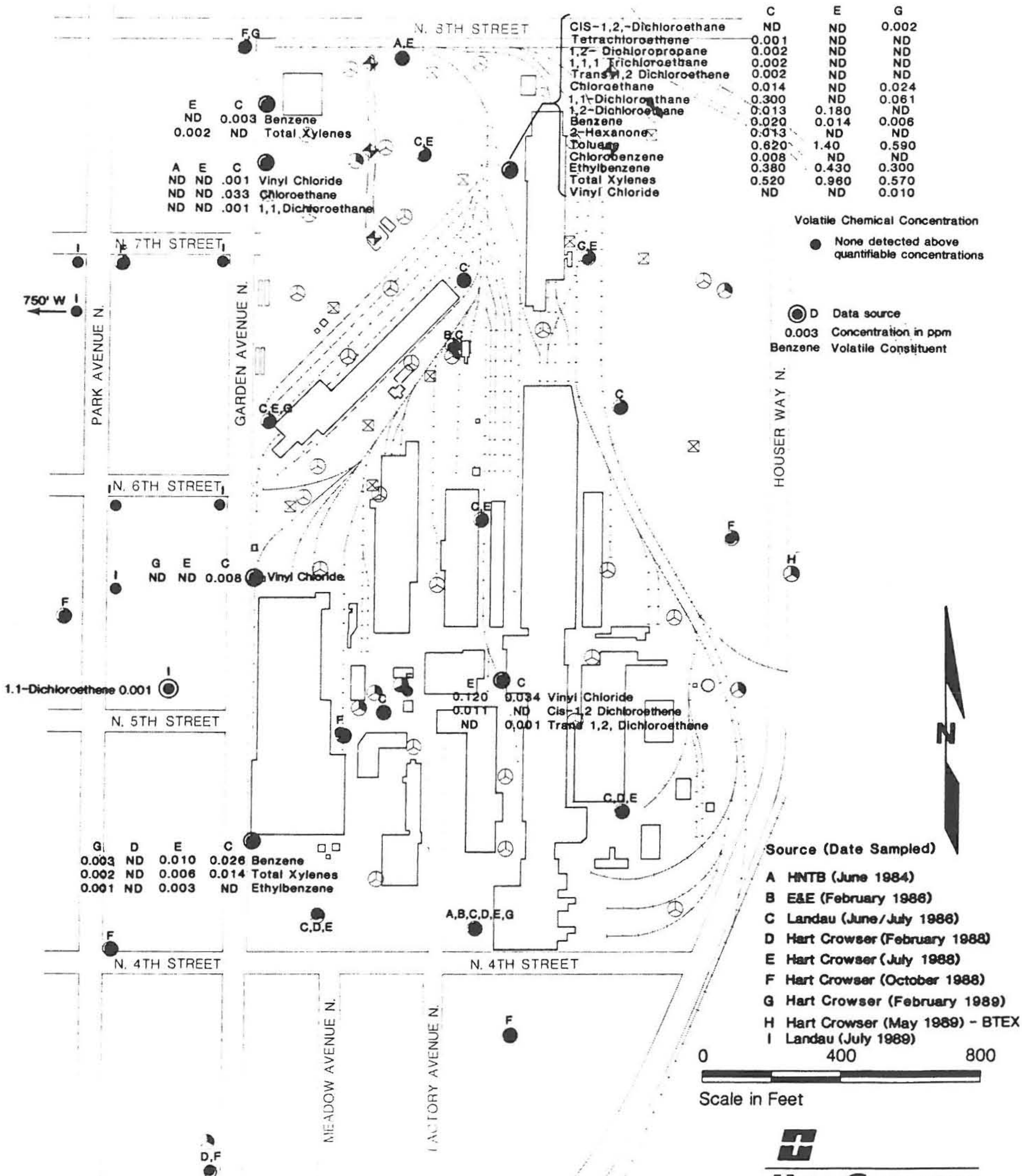
N

0 250 500

Scale in Feet

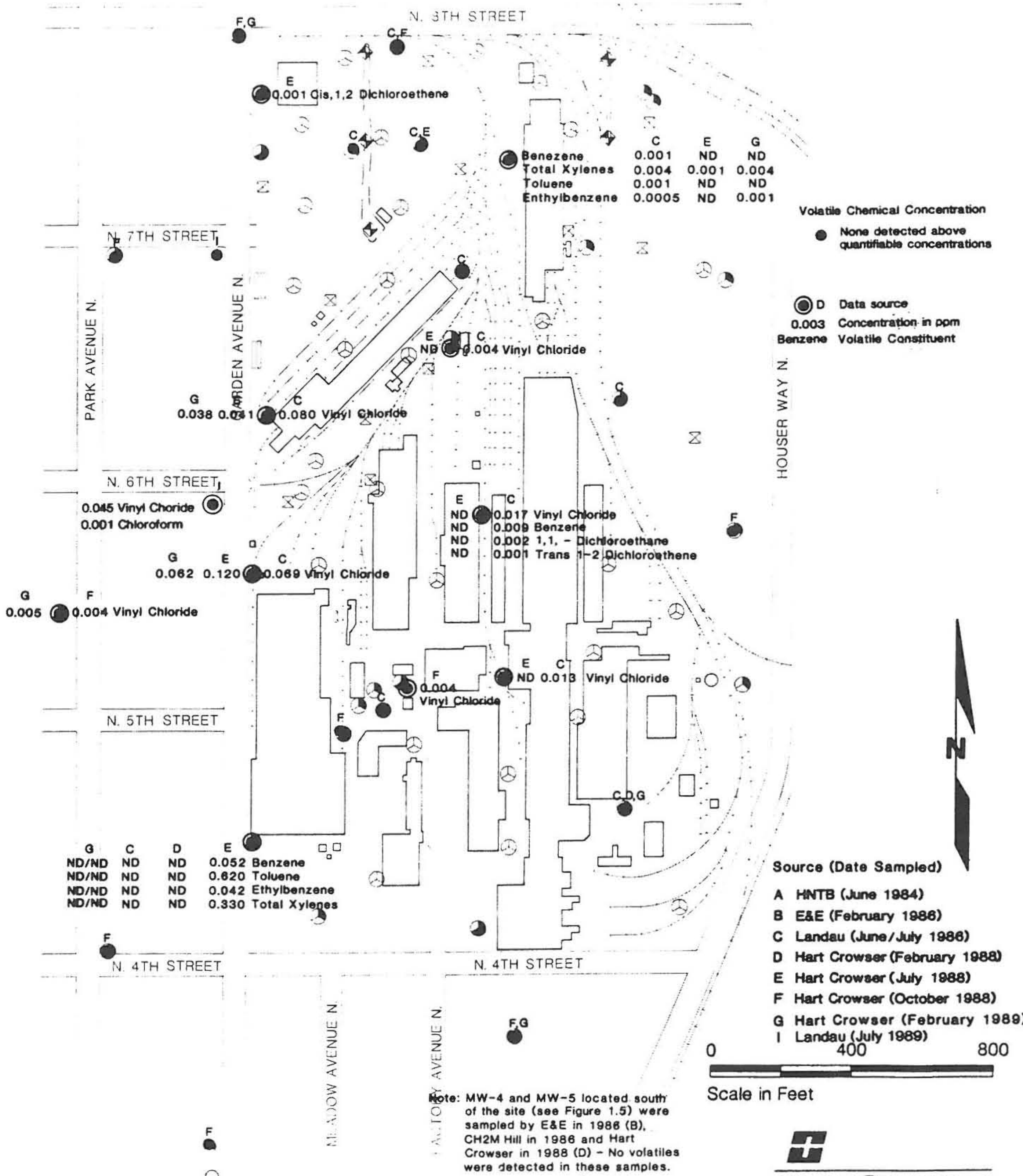
HARTCROWSER
J-1639-09 1/89
Figure 6.69

Distribution of Volatile Chemicals in Groundwater from Shallow Wells



HARTCROWSER
J-1639-09 1/89
Figure 6.70

Distribution of Volatile Chemicals in Groundwater from Deep Wells

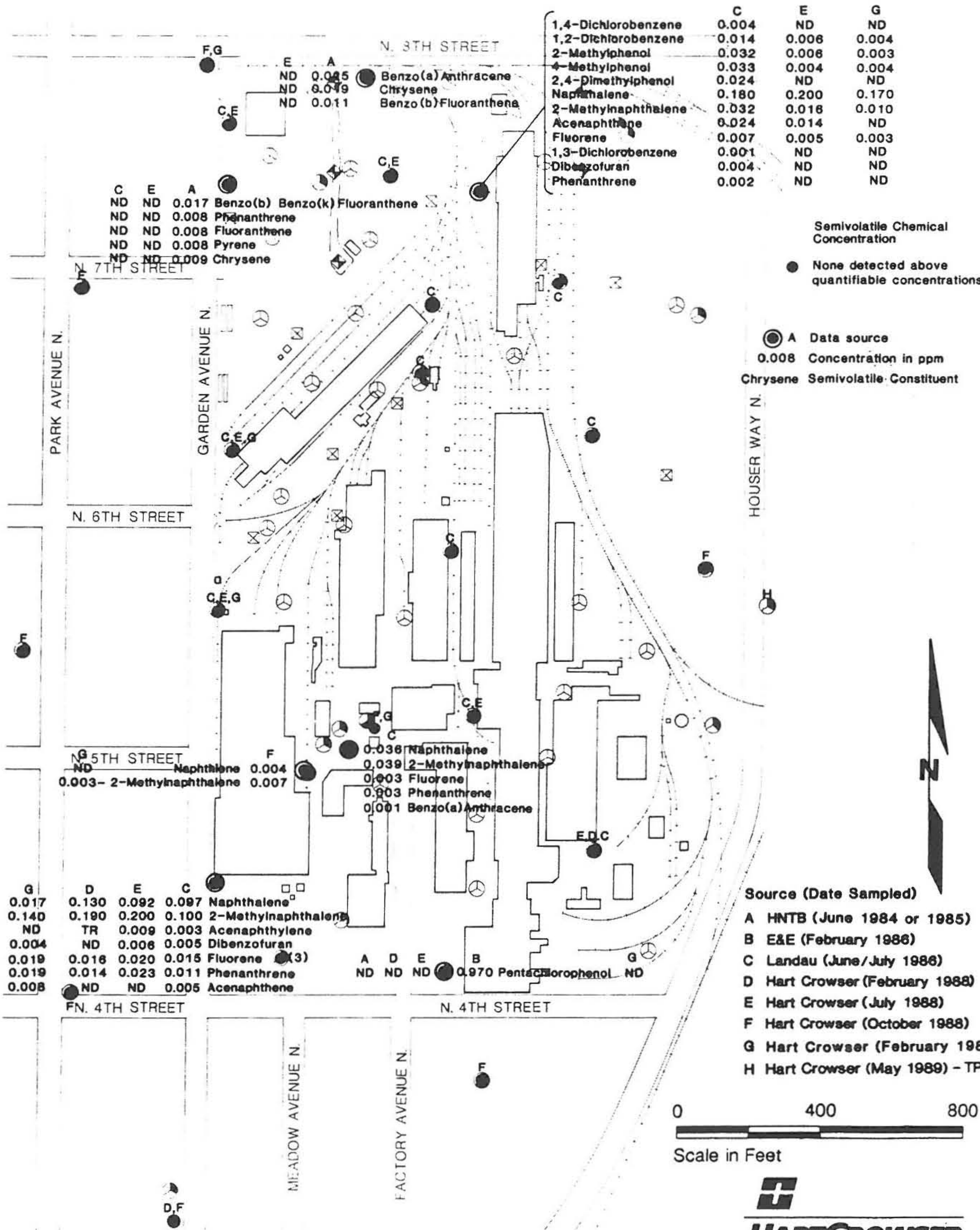


HARTCROWSER

J-1639-09 *1/89*

Figure 6.71

Distribution of Semivolatile Chemicals in Groundwater from Shallow Wells

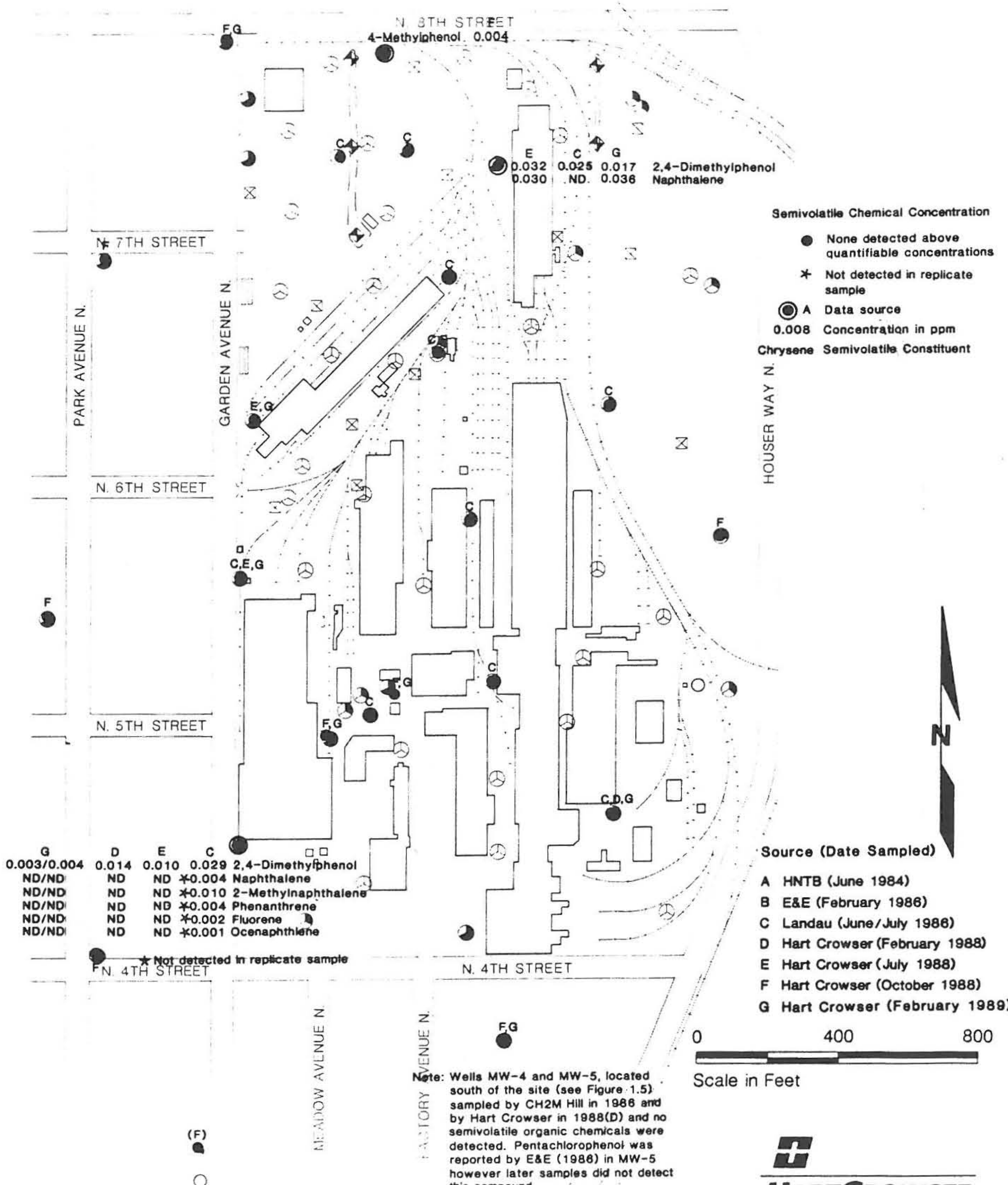


HARTCROWSER

J-1639-09 1/89

Figure 6.72

Distribution of Semivolatile Chemicals in Groundwater from Deep Wells

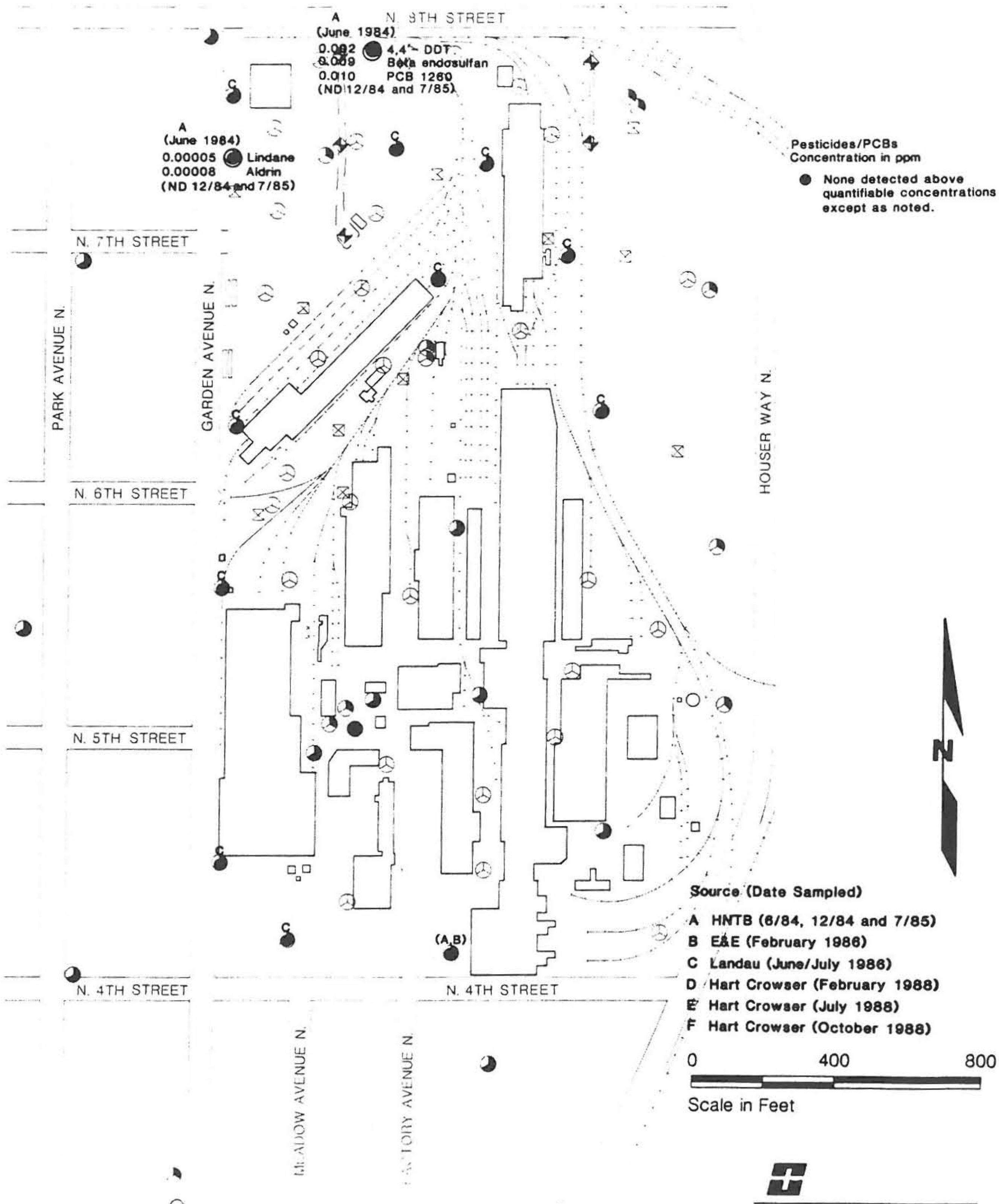


HARTCROWSER

J-1639-09 *1/89*

Figure 6.73

Distribution of Pesticides/PCBs in Groundwater from Shallow Wells

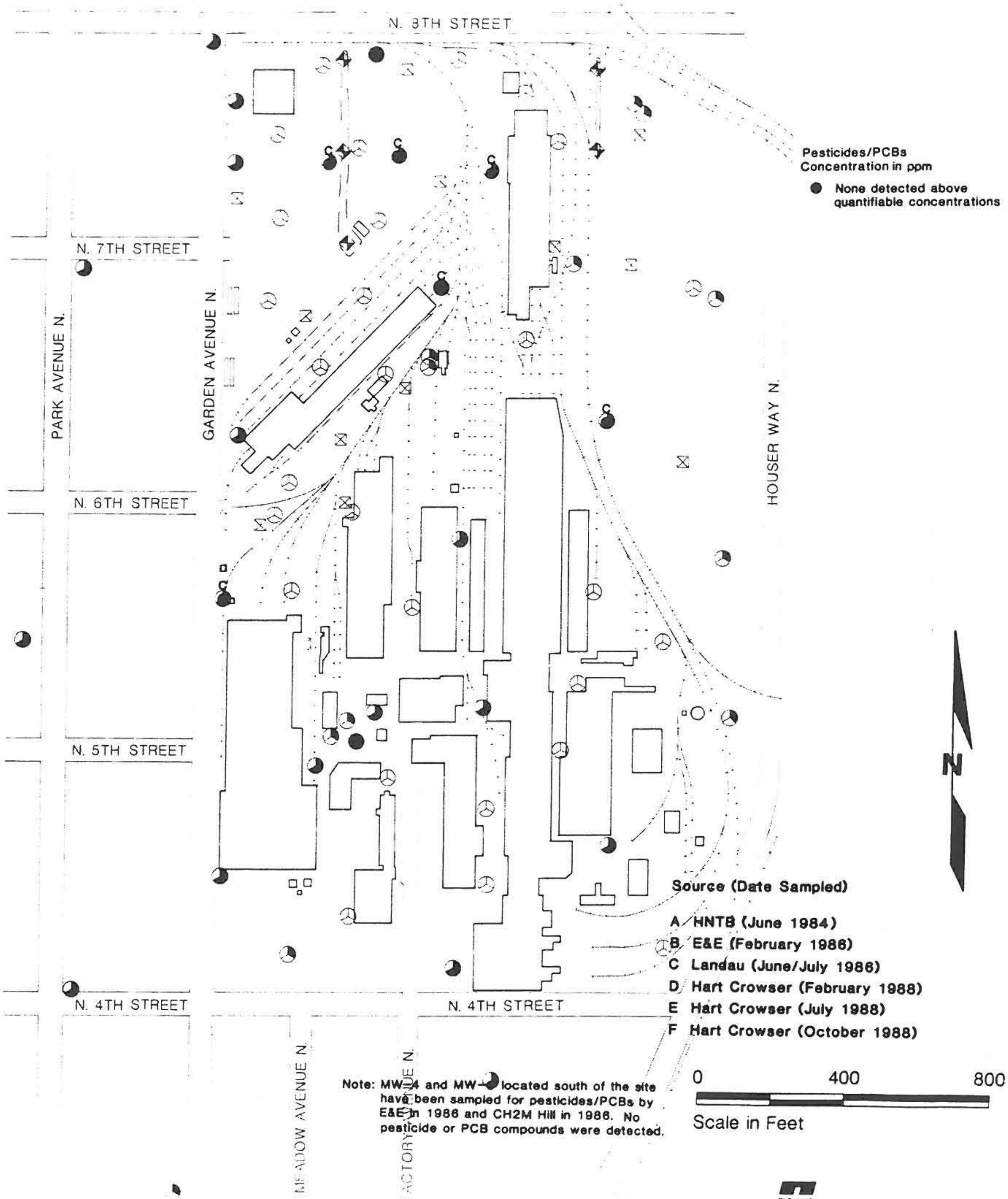


HARTCROWSER

J-1639-09 1/89

Figure 6.74

Distribution of Pesticides/PCBs in Groundwater from Deep Wells



Note: MW-4 and MW-? located south of the site have been sampled for pesticides/PCBs by E&E in 1986 and CH2M Hill in 1986. No pesticide or PCB compounds were detected.

HARTCROWSER

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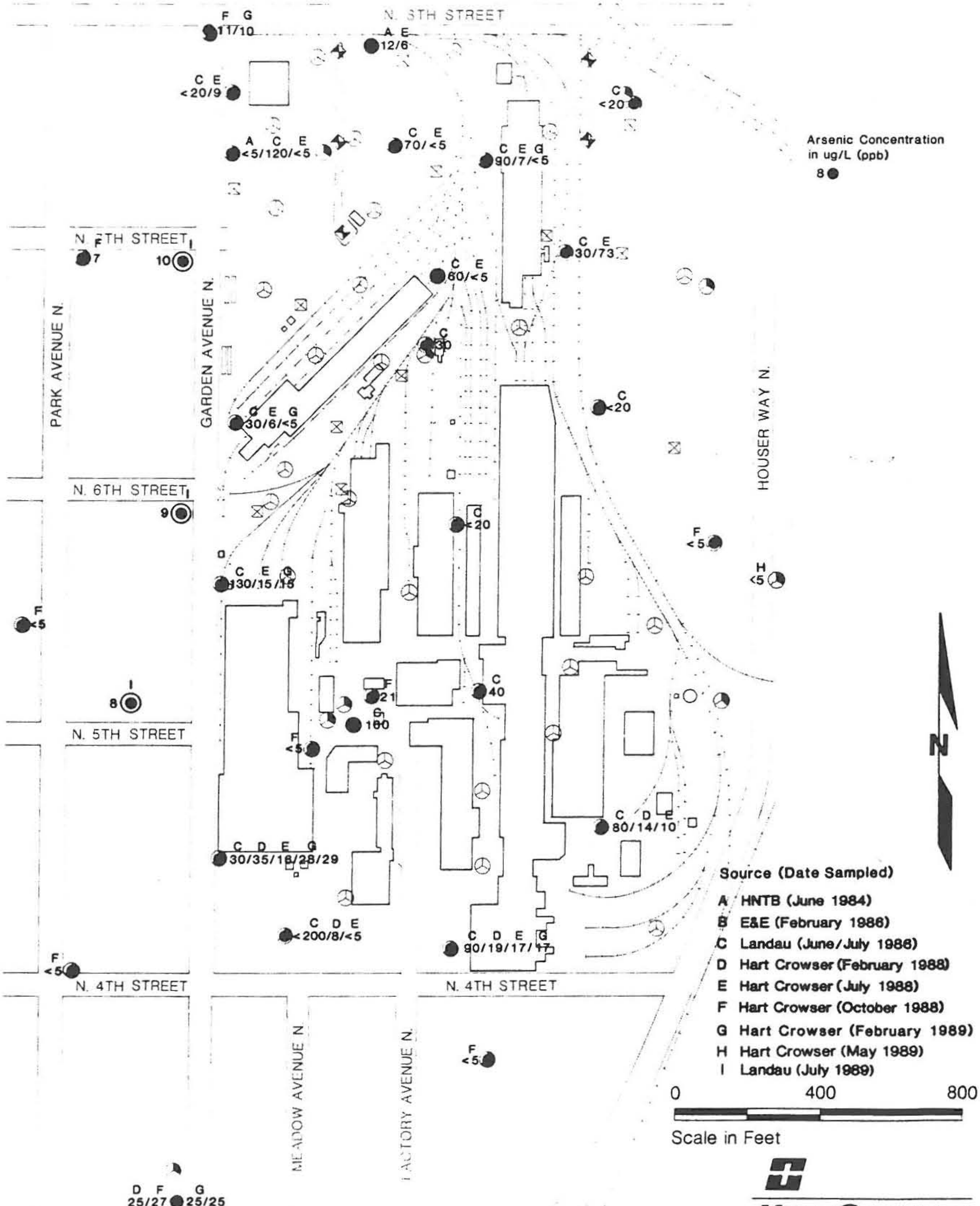
Figure 6.75

Distribution of Arsenic in Groundwater from Shallow Wells



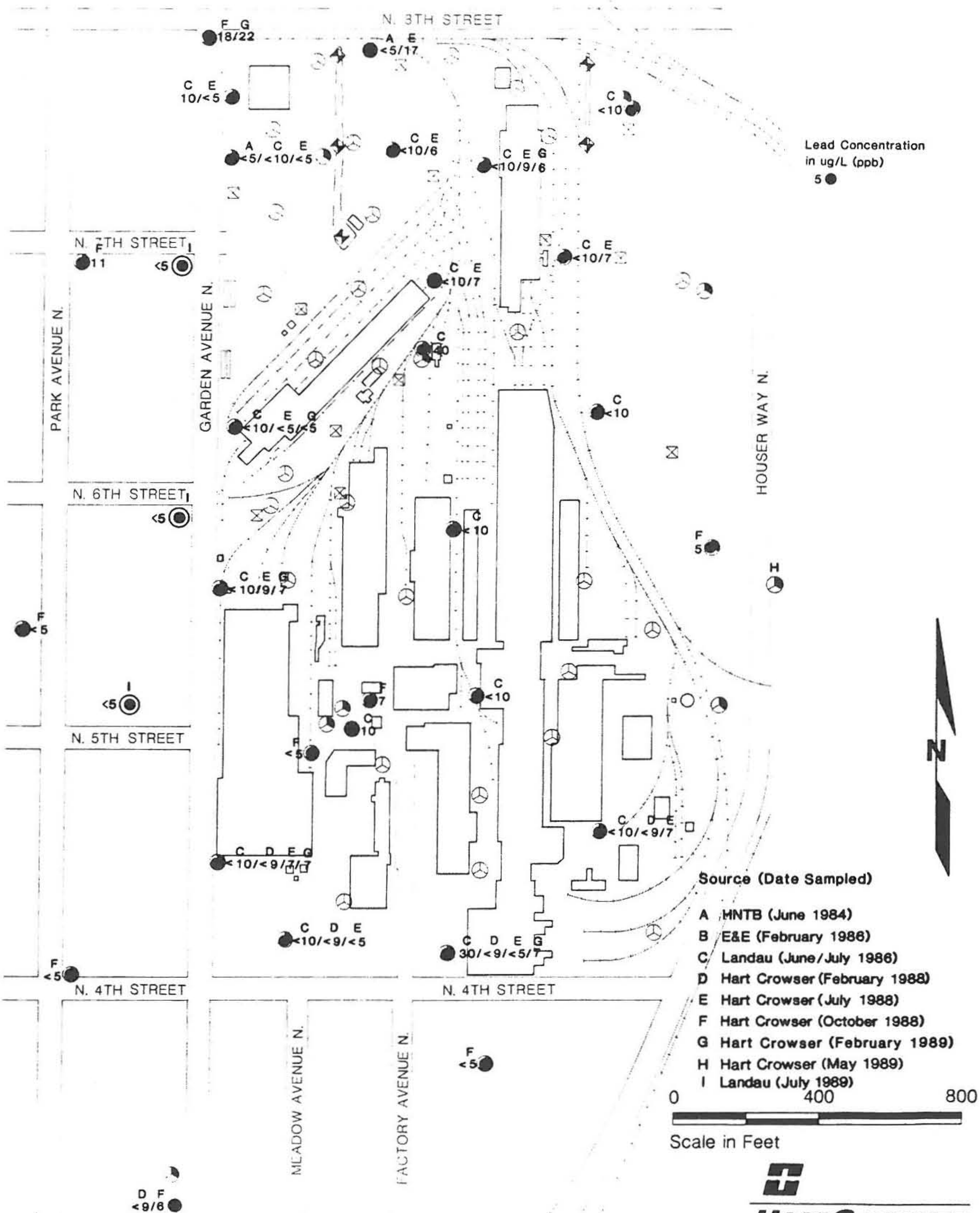
Data for I = Total not dissolved metals concentration.

HARTCROWSER

J-1639-09 *1/89*

Figure 6.76

Distribution of Lead in Groundwater from Shallow Wells



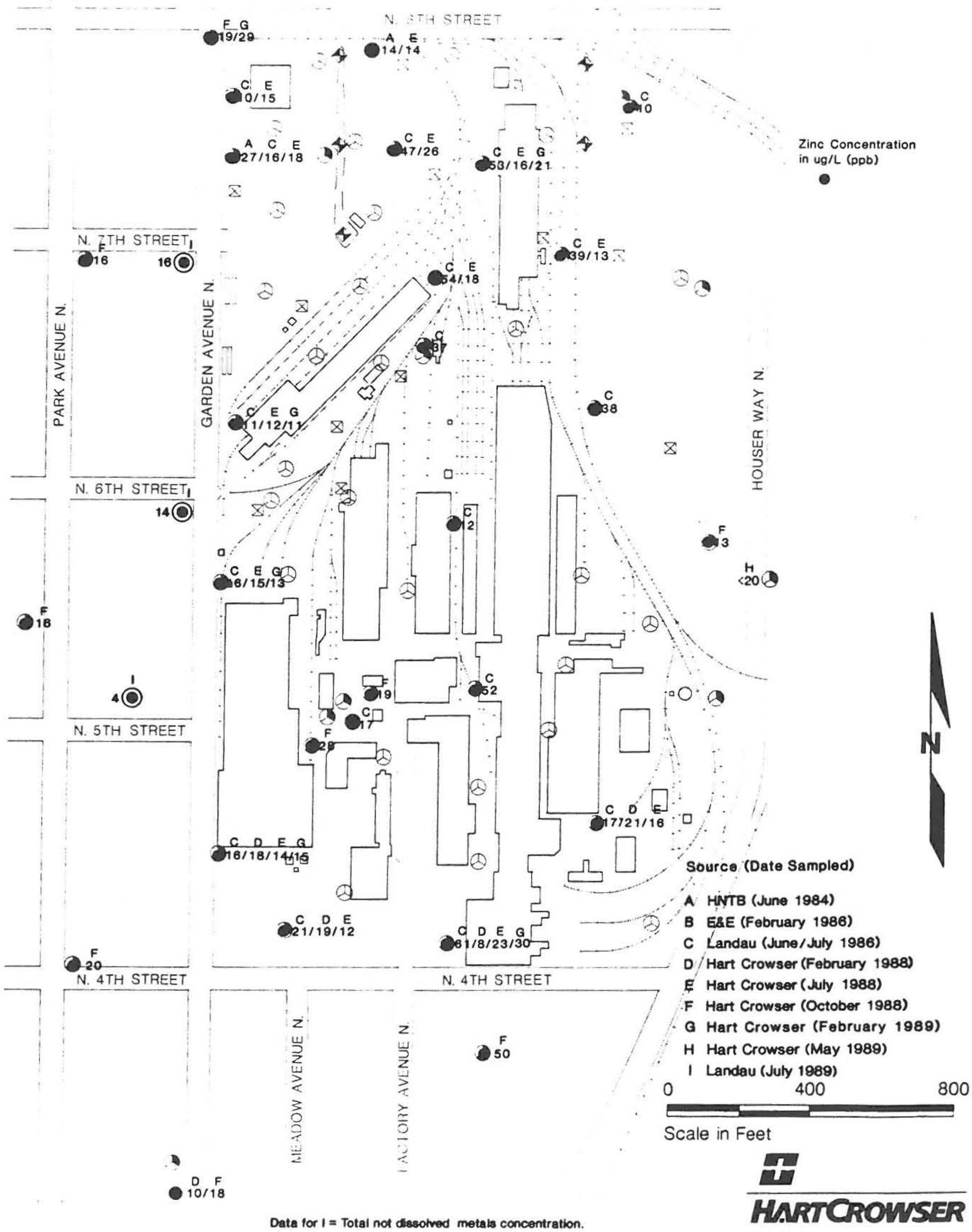
Data for I = Total not dissolved metals concentration.

HARTCROWSER

J-1639-09 1/89

Figure 6.77

Distribution of Zinc in Groundwater from Shallow Wells

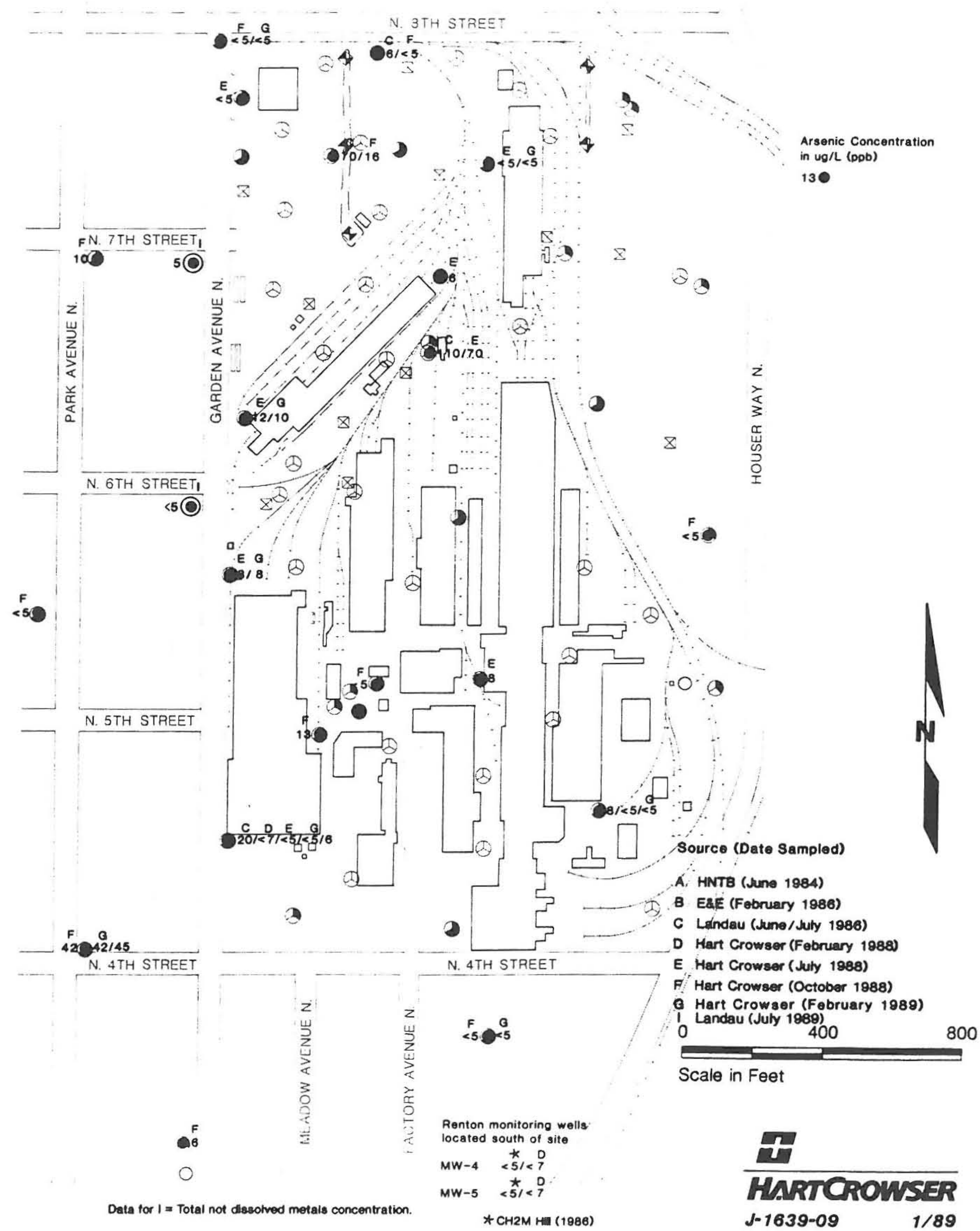


HARTCROWSER

J-1639-09 1/89

Figure 6.78

Distribution of Arsenic in Groundwater from Deep Wells

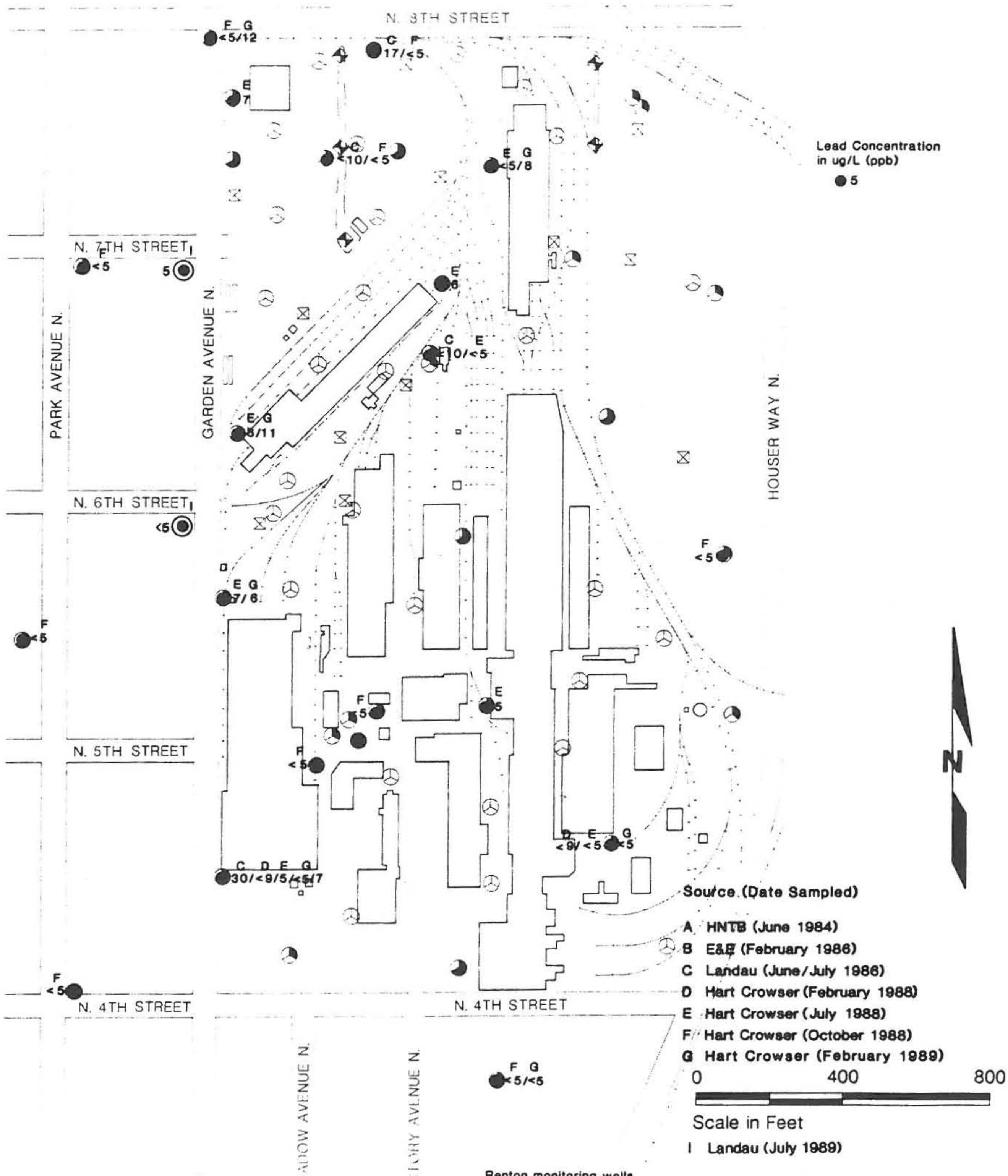


HARTCROWSER

J-1639-09 *1/89*

Figure 6.79

Distribution of Lead in Groundwater from Deep Wells



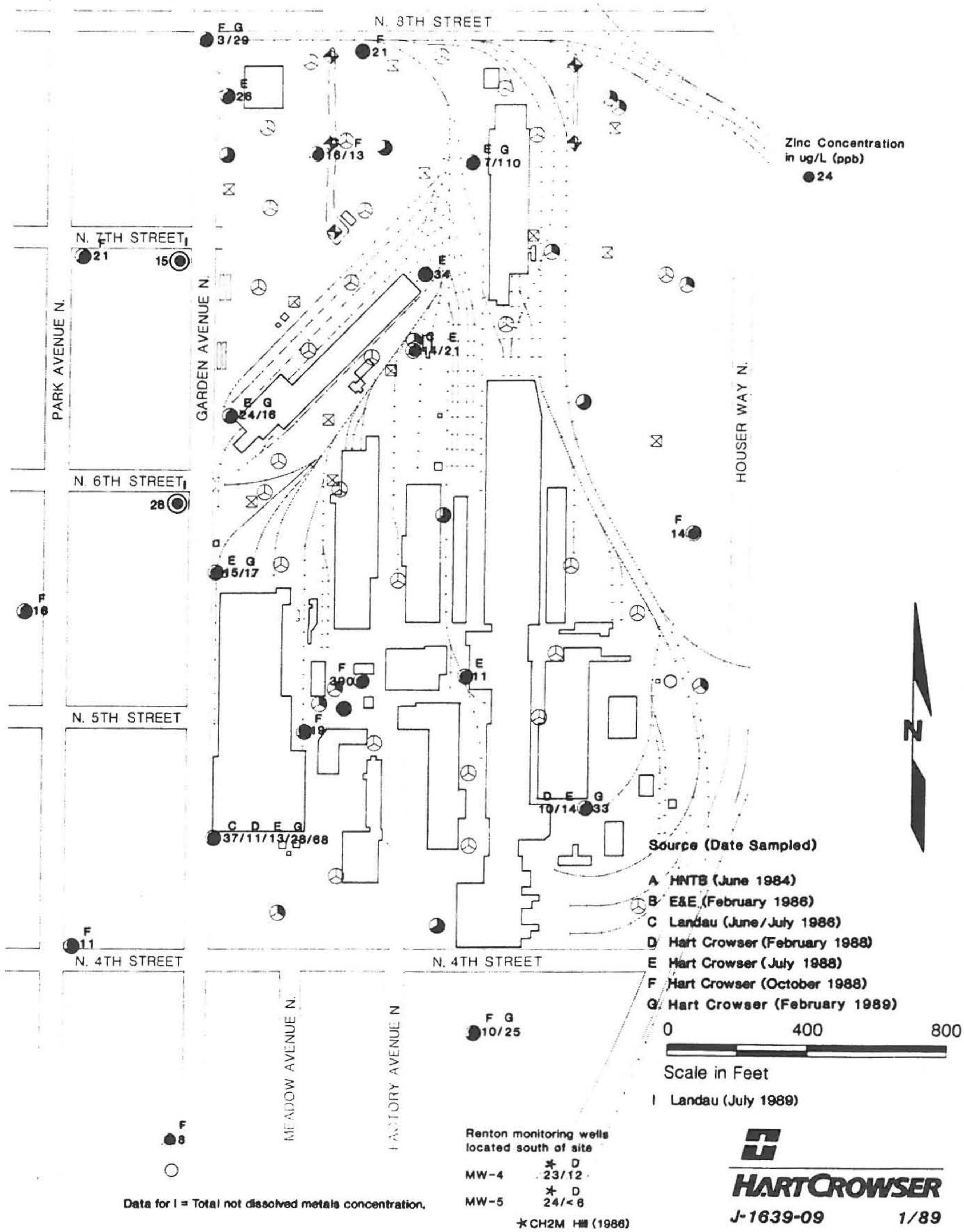
Data for I = Total not dissolved metals concentration.

HARTCROWSER

J-1639-09 1/89

Figure 6.80

Distribution of Zinc in Groundwater from Deep Wells



HARTCROWSER

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Figure 6.81

7.0 CONTAMINANTS OF CONCERN

7.1 BASIS OF SELECTION - PRELIMINARY SCREENING

As discussed in Sections 6.2 and 6.3, a large number of soil and water samples have been collected within the PACCAR site vicinity. These data were collected in an effort to characterize the nature, extent, and degree of contamination which may have been related to previous site activities. These data also form the basis for assessments of human health and environmental risks associated with site waste constituents, and will ultimately guide the selection of an appropriate remedial action.

Of the 163 potential waste constituents which have been analyzed at the PACCAR site, 92 (56 percent) have been detected in at least one soil or water sample (Tables 7.1 and 7.2, respectively). In situations such as this where many chemicals are present at a site, EPA guidelines recommend that a group of "indicator chemicals" be selected which form the basis of subsequent evaluations of site risks (EPA, 1986a). Such indicator chemicals are selected based on consideration of the concentrations encountered, environmental mobility, and toxicity.

In this Remedial Investigation, the indicator chemical selection process involved a detailed review of the following information:

- o Potential migration and exposure routes; and
- o Chemical toxicity/carcinogenicity.

A comparison of concentrations measured on-site with those reported in off-site reference or background locations is also presented. The background comparison, however, was not used as a basis for selection of indicator chemicals.

Each of these factors is discussed below.

7.1.1 Potential Migration and Exposure Routes

Hydrogeologic and water quality data presented in previous sections of this report indicate that waste constituents have been released into groundwaters beneath the PACCAR site. Because a hydraulic connection exists between these groundwaters and the Renton water supply system, potential drinking water exposure to site contaminants was evaluated. Preliminary drinking water exposure evaluations were conducted by comparing the **maximum** 1986 to 1989 water concentrations measured on-site (Table 7.2) with applicable drinking water standards and criteria (EPA, 1986b; EPA, 1988b). This screening evaluation conservatively assumed full exposure (2 liters/day consumption over a lifetime) to the maximum concentration.

Since groundwaters and surface waters may also discharge into the Cedar River and Lake Washington, potential aquatic life exposures were also considered. Accordingly, the preliminary screening evaluation included a (conservative) comparison of the **maximum** measured (1986 to 1989) on-site water concentration with the most restrictive aquatic life criteria (EPA, 1986b).

Exposure of industrial workers to site soil constituents was also considered. Such exposures may result from inhalation of contaminated dust and vapors, incidental soil consumption resulting from earth moving activities, and dermal contact. In general, at the concentrations of the identified soil constituents measured at the PACCAR site (Table 7.1), incidental soil consumption and dust inhalation are likely to represent the predominant terrestrial exposure pathways (EPA, 1986a). Other pathways are relatively less important exposure routes for the identified site contaminants, and were not considered in this screening evaluation.

Based on data presented in Section 9.0, exposure to contaminated soils via ingestion and dust inhalation may occur at an upper-bound rate of approximately 100 mg/day. Similar to the water data discussed above, for the purposes of this preliminary screening evaluation, soil exposure was conservatively evaluated at the **maximum** measured on-site concentration, regardless of soil depth or cover characteristics.

Other important assumptions used in the preliminary screening evaluation included:

- o Absorption of all chemicals was assumed to be 100 percent; and

Table 7.1 – Summary of Soil Constituent Detections at the PACCAR Renton Site (Sheet 1 of 4)

PARAMETER:	Detection Frequency (a)	Soil Concentration in mg/kg (ppm) (dry wt.) Maximum On-Site Value	Regional Background Upper 95%	Background Exceeded	Worst-case Soil Ingestion Criteria	Prelim. Soil Constituent of Concern
METALS AND INORGANICS:						
pH	31/31 *	6.2 – 10.8	4.0 – 6.4	*****		
Aluminum	7/7 *	14,600.0	64,000.0			
Antimony	0/4	3.0 U	1.5		2,103	
Arsenic	279/280 *	180.0	32.3	*	0.04	****
Barium	40/44 *	630.0	197.2	*	27,024	
Beryllium	4/4 *	0.3	0.4			
Cadmium	125/289 *	35.0	1.4	**	75	
Chromium	325/327 *	1,600.0	68.2	**	1,052	*
Cobalt	3/8 *	24.0	12.0	*		
Copper	282/282 *	1,600.0	20.7	**	19,506	
Cyanide	15/39 *	57.0	–	*	10,515	
Iron	7/7 *	39,200.0	36,000.0	*	135,121	
Lead	241/334 *	19,000.0	58.0	***	736	**
Magnesium	5/5 *	5,280.0	6,600.0			
Manganese	5/5 *	714.0	496.0	*	115,668	
Mercury	24/43 *	0.7	0.4	*	1,052	
Nickel	283/284 *	330.0	68.7	*	10,515	
Potassium	5/5 *	5,710.0	11,000.0			
Selenium	2/39 *	2.1	0.5	*	5,258	
Silver	30/46 *	360.0	0.9	***	105	*
Sodium	5/5 *	394.0	23,000.0			
Thallium	0/2	1.0	–			
Tin	2/2 *	1,450.0	3,533.0			
Titanium	1/1 *	206.0	–			
Vanadium	4/5 *	42.0	–			
Zinc	290/290 *	6,400.0	95.2	**	111,935	
ORGANIC SCREEN PARAMETERS						
Total ABNs (GC/FID)	121/150 *	950	5 U	***		
Total Halogenated Hydrocarbons	7/15 *	30	1 U	**		
Total Pesticides (as Heptaclor)	23/35 *	120	1 U	***		
Total Petroleum Hydrocarbons	139/229 *	58,000	5 U	*****		
Total Phenol	3/12 *	1	1 U			
Total Photoionization (H–Nu)	626/626 *	180	5 U	**		
Total Volatiles (as N–Dodecane)	22/33 *	42	1 U	**		
VOLATILE ORGANIC COMPOUNDS						
Acetone	85/113 *	3.00	0.10 U	**	1,574,290	
Benzene	1/113 *	0.00	0.01 U	*	10	
Bromodichloromethane	0/113	0.01 U	0.01 U			
Bromoform	0/113	0.01 U	0.01 U			
Bromomethane	0/113	0.01 U	0.01 U			
2–Butanone	21/113 *	0.70	0.10 U	*	114,932	
Carbon Disulfide	5/113 *	0.01	0.01 U	*		
Carbon Tetrachloride	0/113	0.01 U	0.01 U			
Chlorobenzene	0/113 *	0.01 U	0.01 U			
Chloroethane	0/113 *	0.01 U	0.01 U			
Chloroform	0/113	0.01 U	0.01 U			
Chloromethane	0/113	0.01 U	0.01 U			
Dibromochloromethane	0/113	0.01 U	0.01 U			
1,1–Dichloroethane	0/113 *	0.01 U	0.01 U			
1,2–Dichloroethane	0/113 *	0.01 U	0.01 U			
1,1–Dichloroethene	0/113 *	0.01 U	0.01 U			

Table 7.1 – Summary of Soil Constituent Detections at the PACCAR Renton Site (Sheet 2 of 4)

PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Regional Background Upper 95%	Background Exceeded	Worst-case Soil Ingestion Criteria	Prelim. Soil Constituent of Concern
		Soil Concentration in mg/kg (ppm) (dry wt.)				
cis-1,2-Dichloroethene	0/74 *	0.01 U	0.01 U			
trans-1,2-Dichloroethene	1/113 *	0.02	0.01 U	*		
1,2-Dichloropropane	0/113 *	0.01 U	0.01 U			
cis-1,3-Dichloropropene	0/113	0.01 U	0.01 U			
trans-1,3-Dichloropropene	0/113	0.01 U	0.01 U			
Ethylbenzene	23/113 *	2.00	0.01 U	***	52,576	
2-Hexanone	0/113 *	0.01 U	0.01 U			
Methylene Chloride	38/113 *	0.42	0.01 U	**	835	
4-Methyl-2-Pentanone	0/113	0.01 U	0.01 U			
Styrene	0/113	0.01 U	0.01 U			
1,1,2,2-Tetrachloroethane	0/112	0.01 U	0.01 U			
Tetrachloroethene	2/113 *	0.00	0.01 U			
Toluene	13/113 *	0.14	0.01 U	**	157,729	
1,1,1-Trichloroethane	3/110 *	0.02	0.01 U	*	262,881	
1,1,2-Trichloroethane	0/113	0.01 U	0.01 U			
Trichloroethene	2/113 *	0.01	0.01 U			
Vinyl Acetate	1/113 *	0.29	0.01 U	**		
Vinyl Chloride	1/113 *	0.01	0.01 U	*	30	
Total Xylenes	38/114 *	5.00	0.01 U	***	5,258	
PESTICIDES AND PCBs						
Aldrin	0/35	0.001 U	0.001 U			
a-BHC	0/35	0.001 U	0.001 U			
b-BHC	0/35	0.001 U	0.001 U			
d-BHC	0/35	0.001 U	0.001 U			
g-BHC (Lindane)	0/35	0.001 U	0.001 U			
Chlordane	0/35	0.001 U	0.001 U			
Dieldrin	0/35	0.001 U	0.001 U			
4,4'-DDD	0/35	0.001 U	0.001 U			
4,4'-DDE	1/35 *	0.003	0.001 U	*	1.5	
4,4'-DDT	1/35 *	0.014	0.001 U	**	1.5	
Endosulfan	0/35	0.001 U	0.001 U			
Endosulfan II	0/35	0.001 U	0.001 U			
Endosulfan Sulfate	0/35	0.001 U	0.001 U			
Endrin	0/35	0.001 U	0.001 U			
Endrin Ketone	0/35	0.001 U	0.001 U			
Heptachlor	0/35	0.001 U	0.001 U			
Heptachlor Epoxide	0/35	0.001 U	0.001 U			
Methoxychlor	0/35	0.001 U	0.001 U			
Polychlorinated Biphenyls:						
Aroclor 1016	0/150	0.01 U	0.001 U			
Aroclor 1221	0/150	0.01 U	0.001 U			
Aroclor 1232	0/150	0.01 U	0.001			
Aroclor 1242	0/150	0.01 U	0.001			
Aroclor 1248	0/150	0.01 U	0.002			
Aroclor 1254	20/150 *	5.00	0.004	****	0.1	**
Aroclor 1260	12/150 *	24.00	0.002	*****	0.1	**
Toxaphene	0/35	0.001 U	0.001 U			
OTHER SEMIVOLATILE ORGANIC COMPOUNDS						
Acenaphthene	30/188 *	13.00	0.01 U	****		
Acenaphthylene	17/188 *	84.00	0.01 U	****		
Aniline	0/115	0.01 U	0.01 U			

Table 7.1 - Summary of Soil Constituent Detections at the PACCAR Renton Site (Sheet 3 of 4)

PARAMETER:	Detection Frequency (a)		Soil Concentration in mg/kg (ppm) (dry wt.) Maximum On-Site Value		Regional Background Upper 95%		Background Exceeded	Worst-case Soil Ingestion Criteria	Prelim. Soil Constituent of Concern
Anthracene	47/188	*	32.00		0.01	U	****		
Benzidine	0/115		0.01	U	0.01	U			
Benzoic Acid	1/188	*	0.25		0.01	U	**		
Benzo(a)anthracene	83/189	*	120.00		0.01	U	*****	0.05	***
Benzo(a)pyrene	98/189	*	98.00		0.02		*****	0.05	***
Benzo(b)fluoranthene	68/188	*	78.00		0.02		*****	0.05	***
Benzo(g,h,i)perylene	49/189	*	64.00		0.01	U	*****		
Benzo(k)fluoranthene	66/188	*	66.00		0.05		*****	0.05	***
Benzyl Alcohol	0/188		0.01	U	0.01	U			
Bis(2-chloroethoxy)methane	0/188		0.01	U	0.01	U			
Bis(2-chloroethyl)ether	0/188		0.01	U	0.01	U			
Bis(2-chloroisopropyl)ether	0/188		0.01	U	0.01	U			
Bis(2-ethylhexyl)phthalate	105/189	*	14.00		0.04		***	315,457	
4-Bromophenyl phenylether	0/188		0.01	U	0.01	U			
Butylbenzylphthalate	8/188	*	15.00		0.01	U	****		
4-Chloroaniline	0/188		0.01	U	0.01	U			
2-Chloroethylvinylether	0/34		0.01	U	0.01	U			
4-Chloro-3-methylphenol	0/187		0.01	U	0.01	U			
2-Chloronaphthalene	0/188		0.01	U	0.03				
2-Chlorophenol	0/188		0.01	U	0.01	U			
4-Chlorophenyl phenylether	0/188		0.01	U	0.01	U			
Chrysene	83/189	*	88.00		0.04		****		
Dibenzofuran	36/188	*	11.00		0.01	U	****		
Dibenzo(a,h)anthracene	23/189	*	16.00		0.01	U	****	0.05	***
1,2-Dichlorobenzene	0/188	*	0.01	U	0.01	U			
1,3-Dichlorobenzene	0/188	*	0.01	U	0.01	U			
1,4-Dichlorobenzene	0/187	*	0.01	U	0.15				
3-3'-Dichlorobenzidine	1/189	*	0.00		0.01	U			
2,4-Dichlorophenol	0/188		0.01	U	0.01	U			
Diethyl phthalate	1/188	*	0.89		0.02		**	5,257,624	
2,4-Dimethylphenol	2/188	*	0.19		0.03		*		
Dimethyl phthalate	0/188		0.01	U	0.01	U			
Di-n-butyl phthalate	10/188	*	2.20		0.59		*	525,762	
Di-n-octyl phthalate	10/189	*	11.00		0.04		***		
4,6-Dinitro-2-methylphenol	0/188		0.01	U	0.01	U			
2,4-Dinitrophenol	0/188		0.01	U	0.01	U			
2,4-Dinitrotoluene	0/188		0.01	U	0.01	U			
2,6-Dinitrotoluene	0/188		0.01	U	0.01	U			
1,2-Diphenylhydrazine	0/115		0.01	U	0.01	U			
Fluoranthene	81/188	*	200.00		0.05		****	3,155	
Fluorene	39/188	*	34.00		0.01	U	****		
Hexachlorobenzene	2/188	*	16.00		0.01	U	****	0.31	**
Hexachlorobutadiene	0/188		0.01	U	0.01	U			
Hexachlorocyclopentadiene	0/188		0.01	U	0.01	U			
Hexachloroethane	0/188		0.01	U	0.01	U			
Indeno(1,2,3-cd)pyrene	43/189	*	75.00		0.01	U	****	0.05	***
Isophorone	0/188		0.01	U	0.01	U			
2-Methylnaphthalene	68/188	*	200.00		0.01	U	*****		
2-Methylphenol	2/188	*	0.20		0.01	U	**		
4-Methylphenol	7/188	*	0.40		0.01	U	**		
Naphthalene	46/188	*	76.00		0.05		****		
2-Nitroaniline	0/187		0.01	U	0.01	U			
3-Nitroaniline	0/188		0.01	U	0.01	U			
4-Nitroaniline	2/188	*	7.20		0.01	U	***		

Table 7.1 – Summary of Soil Constituent Detections at the PACCAR Renton Site (Sheet 4 of 4)

	Soil Concentration in mg/kg (ppm) (dry wt.)					
PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Regional Background Upper 95%	Background Exceeded	Worst-case Soil Ingestion Criteria	Prelim. Soil Constituent of Concern
Nitrobenzene	0/188	0.01 U	0.01 U			
2-Nitrophenol	0/188	0.01 U	0.01 U			
4-Nitrophenol	0/188	0.01 U	0.01 U			
N-Nitrosodiphenylamine	0/188	0.01 U	0.01 U			
N-Nitroso-di-n-propylamine	0/188	0.01 U	0.01 U			
Pentachlorophenol	3/187 *	9.60	0.01 U	***	157,729	
Phenanathrene	115/188 *	150.00	0.03	****		
Phenol	8/188 *	0.80	0.15	*	52,576	
Pyrene	90/188 *	280.00	0.02	*****		
1,2,4-Trichlorobenzene	0/188	0.01 U	0.01 U			
2,4,5-Trichlorophenol	0/188	0.01 U	0.01 U			
2,4,6-Trichlorophenol	0/188	0.01 U	0.01 U			

NOTES:

a. Detection frequency refers to the number of detections divided by the number of observations
b. U indicates analyte not detected. Value expressed is the detection limit.
c. J indicates analyte was detected below the established limit of detection.
d. B indicates the analyte was detected in the method blank associated with the sample.
e. Soil and water quality criteria based on preliminary human health and environmental risk assessments; see text.
f. * indicates that the analyte was present at a concentration 1 to 10 times higher than the 95th percentile regional background level. ** indicates a 10 to 100-fold elevation, *** indicates a 100 to 1,000-fold elevation, and so on.

- o The principal exposed population was assumed to be represented by a 70 kg (150 lb) adult who lives and works at or adjacent to the PACCAR site throughout his or her entire lifetime.

7.1.2 Chemical Toxicity and Carcinogenicity

Current EPA criteria and the toxicological literature were reviewed in selecting "acceptable" dose and risk criteria (see Sections 7.2 and 9.0 for a more complete description). Both carcinogenic and non-carcinogenic risks were evaluated, with the most sensitive toxicological response forming the basis for the preliminary screening. For suspected carcinogens, a conservative reference risk of 10^{-6} (one-in-one million) was used as a basis for screening. In situations where a discrepancy exists between regulatory standards and calculated risk-based criteria (e.g., as with arsenic in drinking water), the most restrictive existing or proposed regulatory standard for that exposure route was used. Some chemicals detected at the PACCAR site lacked the necessary toxicological criteria to perform a quantitative screening.

7.1.3 Reference Comparisons

Each of the constituents identified at the PACCAR site were evaluated to assess whether the detections constituted a statistically significant ($P < 0.05$) elevation above local and/or regional reference values. As a basis to evaluate the **maximum** measured on-site soil concentration, preliminary reference values were computed as the upper 95th percentile of concentrations measured in relatively pristine forest environments of the Cascade Mountain foothills (METRO, 1985a). Concentrations reported from these reference locations represent conservatively low estimates of local reference soil concentrations in the Renton industrial area which surrounds the PACCAR site. These reference soil values are summarized in Table 7.1.

For water samples, reference comparisons were based on data collected from monitoring wells installed upgradient of the site and from locations beyond possible site influence. These reference locations included monitoring wells LW-4S, OSP-1S, OSP-1D, MW-1-Renton, and

MW-7-Renton (Figure 5.1). The upper 95th percentile water reference values calculated from these data are summarized in Table 7.2. These reference concentrations are also similar to data reported for the Cedar River upstream of potential inputs from the PACCAR site (METRO, 1982).

The soil and water background comparisons were performed for all constituents detected at the PACCAR site, and are summarized in Tables 7.1 and 7.2. If the **maximum** measured on-site value for a given constituent exceeded the 95th percentile reference concentration, then a statistically significant elevation of that constituent was assumed to have occurred (for screening purposes). Overall, 83 parameters (51 percent of the total) were identified which exceeded reference concentrations in water and/or soil media. As discussed above, the reference comparison was **not** used a basis for selection of indicator chemicals. The comparison serves only as a relative index of on-site contamination.

7.2 INDICATOR CHEMICALS

A summary of the exposure and toxicity screening evaluations for soil and water are presented in Tables 7.1 and 7.2, respectively. Overall, 26 (16 percent) of the 163 chemical parameters analyzed during this investigation (and/or during previous studies) exceeded the preliminary screening criteria. These parameters included metals, volatile organic compounds, polychlorinated biphenyls (PCBs), high molecular weight polycyclic aromatic hydrocarbons (HPAHs), phthalate esters, chlorinated benzenes, and pentachlorophenol. Based on the screening evaluations, both soil and water media may represent potential contaminant exposure pathways.

Table 7.2 – Summary of Water Constituent Detections at the PACCAR Renton Site (Sheet 1 of 4)

All Concentrations in ug/L unless otherwise indicated

PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Reference Wells Upper 95%	Background Exceeded	Most Restrictive Water Quality Criteria	Prelim. Water Constituent of Concern
METALS AND INORGANICS:						
pH	17/17	5.6 – 7.8	5.6 – 7.8			
Aluminum	17/17	63,000	–			
Antimony	0/0	–	–			
Arsenic	59/117	160	5 U	**	20	*
Barium	10/17	220	–			
Beryllium	0/7	5 U	–			
Cadmium	5/45	2	2			
Chromium	26/101	38	2	**	11	*
Cobalt	3/7	40	–			
Copper	48/90	50	8	*	4	*
Cyanide	0/17	5 U	–			
Iron	13/20	61,000	47,000			
Lead	43/115	40	5	*	1	**
Magnesium	7/7	24,200	–			
Manganese	5/7	2,950	–			
Mercury	1/29	3	5			
Nickel	18/90	49	6	*	13	*
Potassium	7/7	6,270	–			
Selenium	0/7	20 U	–			
Silver	7/28	5	5			
Sodium	7/7	109,000	–			
Thallium	0/7	10 U	–			
Tin	0/7	40 U	–			
Titanium	0/0	–	–			
Vanadium	0/7	50 U	–			
Zinc	108/114	390	75	*	47	*
ORGANIC SCREEN PARAMETERS						
Total ABNs (GC/FID)	1/1	10,000	5 U	****	N.D.	
Total Halogenated Hydrocarbons	0/0	–	–			
Total Pesticides (as Heptaclor)	4/4	100	–			
Total Petroleum Hydrocarbons	0/0	–	–			
Total Phenol	9/9	68	1 U	**	N.D.	
Total Photoionization (H–Nu)	0/0	–	–			
Total Volatiles (as N–Dodecane)	2/2	4,000	–			
VOLATILE ORGANIC COMPOUNDS						
Acetone	28/127	440 B	9 B	**	N.D.	
Benzene	12/127	52	1 U	**	5	**
Bromodichloromethane	0/127	1 U	1 U			
Bromoform	0/127	1 U	1 U			
Bromomethane	0/127	1 U	1 U			
2–Butanone	0/127	3 U	3 U			
Carbon Disulfide	0/127	1 U	1 U			
Carbon Tetrachloride	0/127	1 U	1 U			
Chlorobenzene	2/127	9	3 U	*	100	
Chloroethane	2/127	33	3 U	**		
Chloroform	0/127	1 U	1 U			
Chloromethane	0/127	1 U	1 U			
Dibromochloromethane	0/127	3 U	3 U			
1,1–Dichloroethane	6/127	300	1 U	***		
1,2–Dichloroethane	1/127	13	1 U	**	5	*
1,1–Dichloroethene	2/127	1	1 U	*	7	

Table 7.2 – Summary of Water Constituent Detections at the PACCAR Renton Site (Sheet 2 of 4)

All Concentrations in ug/L unless otherwise indicated

PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Reference Wells Upper 95%	Background Exceeded	Most Restrictive Water Quality Criteria	Prelim. Water Constituent of Concern
cis-1,2-Dichloroethene	3/127	11	1 U	**	70	
trans-1,2-Dichloroethene	5/127	2	1 U	*	70	
1,2-Dichloropropane	2/127	2	1 U	*	5	
cis-1,3-Dichloropropene	0/127	3 U	3 U			
trans-1,3-Dichloropropene	0/127	3 U	3 U			
Ethylbenzene	10/127	430	1 U	***	30	**
2-Hexanone	2/127	13	3 U	*	N.D.	
Methylene Chloride	14/127	330 B	26 B			
4-Methyl-2-Pentanone	0/127	3 U	3 U			
Styrene	0/127	1 U	1 U			
1,1,2,2-Tetrachloroethane	0/127	3 U	3 U			
Tetrachloroethene	2/127	1	1 U	*	5	
Toluene	14/127	1,400	1 U	****	40	**
1,1,1-Trichloroethane	2/127	2	1 U	*	200	
1,1,2-Trichloroethane	0/127	1 U	1 U			
Trichloroethene	1/127	1	1 U	*	5	
Vinyl Acetate	0/127	1 U	1 U			
Vinyl Chloride	18/128	120	1 U	***	1	***
Total Xylenes	16/127	960	1 U	***	20	**
PESTICIDES AND PCBs						
Aldrin	1/43	0.08	0.01 U			
a-BHC	0/43	0.01 U	0.01 U			
b-BHC	0/43	0.01 U	0.01 U			
d-BHC	0/43	0.01 U	0.01 U			
g-BHC (Lindane)	1/43	0.05	0.01 U			
Chlordane	0/43	0.04 U	0.04 U			
Dieldrin	0/43	0.02 U	0.02 U			
4,4'-DDD	0/43	0.04 U	0.04 U			
4,4'-DDE	0/43	0.02 U	0.02 U			
4,4'-DDT	1/43	2.00	0.04 U			
Endosulfan	0/43	0.02 U	0.02 U			
Endosulfan II	1/43	9.00	0.03 U			
Endosulfan Sulfate	0/43	0.03 U	0.03 U			
Endrin	0/43	0.04 U	0.04 U			
Endrin Ketone	0/43	0.04 U	0.04 U			
Heptachlor	0/43	0.01 U	0.01 U			
Heptachlor Epoxide	0/43	0.01 U	0.01 U			
Methoxychlor	0/43	0.10 U	0.10 U			
Polychlorinated Biphenyls:						
Aroclor 1016	0/47	0.30 U	0.30 U			
Aroclor 1221	0/47	0.10 U	0.10 U			
Aroclor 1232	0/47	0.10 U	0.10 U			
Aroclor 1242	0/47	0.10 U	0.10 U			
Aroclor 1248	0/47	0.10 U	0.10 U			
Aroclor 1254	0/47	0.30 U	0.30 U			
Aroclor 1260	1/47	10.00	0.10 U			
Toxaphene	0/43	0.80 U	0.80 U			
OTHER SEMIVOLATILE ORGANIC COMPOUNDS						
Acenaphthene	10/101	24	2 U	**	520	
Acenaphthylene	3/101	3	2 U	*	N.D.	
Aniline	0/101	10 U	10 U			

Table 7.2 – Summary of Water Constituent Detections at the PACCAR Renton Site (Sheet 3 of 4)

All Concentrations in ug/L unless otherwise indicated

PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Reference Wells Upper 95%	Background Exceeded	Most Restrictive Water Quality Criteria	Prelim. Water Constituent of Concern
Anthracene	0/101	2 U	2 U			
Benzidine	0/101	50 U	50 U			
Benzoic Acid	0/101	50 U	50 U			
Benzo(a)anthracene	0/101	2 U	2 U		0	
Benzo(a)pyrene	0/101	4 U	4 U			
Benzo(b)fluoranthene	0/101	4 U	4 U			
Benzo(g,h,i)perylene	0/101	4 U	4 U			
Benzo(k)fluoranthene	0/101	4 U	4 U			
Benzyl Alcohol	0/101	2 U	2 U			
Bis(2-chloroethoxy)methane	0/101	2 U	2 U			
Bis(2-chloroethyl)ether	0/101	2 U	2 U			
Bis(2-chloroisopropyl)ether	0/101	2 U	2 U			
Bis(2-ethylhexyl)phthalate	39/101	* 12	2 U	*	3	*
4-Bromophenyl phenylether	0/101	4 U	4 U			
Butylbenzylphthalate	0/101	2 U	2 U			
4-Chloroaniline	0/101	2 U	2 U			
2-Chloroethylvinylether	0/101	2 U	2 U			
4-Chloro-3-methylphenol	0/101	4 U	4 U			
2-Chloronaphthalene	0/101	2 U	2 U			
2-Chlorophenol	0/101	2 U	2 U			
4-Chlorophenyl phenylether	0/101	2 U	2 U			
Chrysene	0/101	2 U	2 U			
Dibenzofuran	8/101	6	2 U	*	N.D.	
Dibenzo(a,h)anthracene	0/101	4 U	4 U			
1,2-Dichlorobenzene	4/101	14	2 U	*	10	*
1,3-Dichlorobenzene	2/101	1	2 U	*	N.D.	
1,4-Dichlorobenzene	2/101	4	2 U	*	5	
3-3'-Dichlorobenzidine	0/101	20 U	20 U			
2,4-Dichlorophenol	0/101	4 U	4 U			
Diethyl phthalate	12/101	1	2 U	*	3	
2,4-Dimethylphenol	4/101	32	2 U	**	400	
Dimethyl phthalate	0/101	2 U	2 U			
Di-n-butyl phthalate	10/101	7	2 U	*	3	*
Di-n-octyl phthalate	2/101	2	2 U			
4,6-Dinitro-2-methylphenol	0/101	20 U	20 U			
2,4-Dinitrophenol	0/101	20 U	20 U			
2,4-Dinitrotoluene	0/101	4 U	4 U			
2,6-Dinitrotoluene	0/101	4 U	4 U			
1,2-Diphenylhydrazine	0/101	4 U	4 U			
Fluoranthene	0/101	2 U	2 U			
Fluorene	2/101	20	2 U	**	N.D.	
Hexachlorobenzene	0/101	2 U	2 U			
Hexachlorobutadiene	0/101	2 U	2 U			
Hexachlorocyclopentadiene	0/101	4 U	4 U			
Hexachloroethane	0/101	4 U	4 U			
Indeno(1,2,3-cd)pyrene	0/101	4 U	4 U			
Isophorone	0/101	2 U	2 U			
2-Methylnaphthalene	12/101	200	2 U	***	N.D.	
2-Methylphenol	4/101	32	2 U	**	N.D.	
4-Methylphenol	4/101	33	2 U	**	N.D.	
Naphthalene	14/101	200	4 U	**	620	
2-Nitroaniline	0/101	4 U	4 U			
3-Nitroaniline	0/101	10 U	10 U			
4-Nitroaniline	0/101	4 U	4 U			

Table 7.2 – Summary of Water Constituent Detections at the PACCAR Renton Site (Sheet 4 of 4)

All Concentrations in ug/L unless otherwise indicated

PARAMETER:	Detection Frequency (a)	Maximum On-Site Value	Reference Wells Upper 95%	Background Exceeded	Most Restrictive Water Quality Criteria	Prelim. Water Constituent of Concern
Nitrobenzene	0/101	2 U	2 U			
2-Nitrophenol	0/101	4 U	4 U			
4-Nitrophenol	0/101	20 U	20 U			
N-Nitrosodiphenylamine	0/101	2 U	2 U			
N-Nitroso-di-n-propylamine	0/101	2 U	2 U			
Pentachlorophenol	3/101	970	20 U	**	30	**
Phenanathrene	10/101	23	2 U	**	N.D.	
Phenol	5/101	3	2 U	*	300	
Pyrene	0/101	2 U	2 U			
1,2,4-Trichlorobenzene	0/101	2 U	2 U			
2,4,5-Trichlorophenol	0/101	4 U	4 U			
2,4,6-Trichlorophenol	0/101	4 U	4 U			

NOTES:

a. Detection frequency refers to the number of detections divided by the number of observations
b. U indicates analyte not detected. Value expressed is the detection limit.
c. J indicates analyte was detected below the established limit of detection.
d. B indicates the analyte was detected in the method blank associated with the sample.
e. * indicates that the analyte was present at a concentration 1 to 10 times higher than the 95th percentile regional background level. ** indicates a 10 to 100-fold elevation, *** indicates a 100 to 1,000-fold elevation, and so on.
f. N.D. indicates parameter not analyzed.
g. Water quality criteria based on EPA (1986b; 1988b).

Prior to developing the final list of indicator chemicals for the PACCAR site, an additional verification of constituent detections was performed for all data collected prior to the present (i.e., 1988) investigation. The quality and/or validity of these previous data are less certain than that of the most recent sampling and analysis effort. Constituent detections reported from previous studies, but which were not confirmed during the present investigation (if confirmation sampling was conducted), represent "questionable" occurrences.

Based on a comparison of prior and more recent sampling results, three (3) of the twenty-six (26) parameters identified in preliminary screening evaluations appeared to represent questionable detections. These parameters included pentachlorophenol, bis(2-ethylhexyl) phthalate, and di-n-butyl phthalate. All such questionable occurrences occurred in previous groundwater samples, and are discussed in detail below.

The occurrence of pentachlorophenol at levels above detection has only been reported for two monitoring wells; MW-3I (970 ug/L) and MW-5-Renton (19 ug/L). Both of these detections occurred during a single limited sampling effort conducted by EPA in early 1986 (Ecology and Environment, 1986). Only the reported MW-3I value exceeded the most restrictive water quality criterion of 30 ug/L (proposed secondary drinking water standard; EPA, 1988b). Although the laboratory which initially performed the determinations did not report analytical difficulties associated with the analysis, three subsequent samplings of these (and many other) wells have not confirmed the presence of pentachlorophenol in on-site waters of the PACCAR site. The reported detections may possibly have resulted from mis-identification of some other compound present in the samples. Regardless, because of discrepancies in these chemical results, pentachlorophenol was removed from the list of indicator chemicals evaluated in this Remedial Investigation.

The two phthalate esters identified in the preliminary screening evaluation - bis(2-ethylhexyl)phthalate and di-n-butyl phthalate - may also have been an artifact of analytical methodologies. These two phthalates are common field and laboratory contaminants, and are routinely detected in analytical "blank" solutions (Romberg et al., 1984; Laucks Laboratories, unpublished data). If the possible contribution of these laboratory contaminants is subtracted from recent (1986 to 1988) sample values, no water samples would exhibit concentrations in excess of the most restrictive criterion (3 ug/L suggested for aquatic life; EPA, 1986b). Accordingly, both phthalate ester compounds were removed from the list of indicator chemicals.

Selected physical, chemical, and toxicological properties of the remaining twenty-three (23) indicator chemicals identified at the PACCAR site are summarized in Table 7.3. Pertinent environmental characteristics of each of these chemicals or appropriate chemical groupings is discussed below.

7.2.1 Metals

Arsenic

Arsenic occurs naturally in soils of the Puget Sound area, and economic quantities of mineral deposits of this metal have existed in the nearby Black Diamond area. Background concentrations of arsenic in regional soils typically range from approximately 5 to 30 mg/kg (ppm; dry wt) (METRO, 1985a). Levels of up to 180 mg/kg have been reported at the PACCAR site (Table 7.1). Water concentrations are also somewhat elevated at the site, with levels of up to 160 ug/L (Table 7.2).

The mobility of arsenic appears to vary considerably between different soil/water environments, possibly as a result of different chemical conditions. At the PACCAR site, the mobility of arsenic in soils was evaluated in part using Extraction Procedure Toxicity (EP Tox) analyses. The "mobile" arsenic concentration, evaluated using the somewhat rigorous conditions of the EP Tox analysis, was compared with the corresponding total arsenic level in the soil sample. The results of these comparisons (evaluated using regression analyses) suggested that the apparent soil:water distribution coefficient at the site exceeds 6,500:1 (Table 7.3; based on the lower 95 percent regression slope). Based on these data, under most conditions arsenic would be expected to be strongly associated with site soils.

Table 7.3 – Summary of Constituents of Concern, PACCAR Site

PARAMETER	Media of Concern a		Evidence of Human Carcinogenicity b	CAS #	Molec. Weight in gm	Spec. Gravity at 25 C in gm/ml	Vapor Pressure at 25 C in mm Hg	Water Solubil. at 25 C in ug/L	Soil: Water Partit. (wt/wt) c	Bioconc. in L/kg
	Soil	Water								
METALS:										
Arsenic	X	X	SUFFICIENT (A)	7740-38-2	74.9	–	–	–	6,500 +	44
Chromium (VI)	X	X	SUFFICIENT (A)	7440-47-3	52.0	–	–	–	7,700 +	16
Copper		X	NO EVIDENCE (D)	7440-50-8	63.5	–	–	–	14,000 +	160
Lead	X	X	INADEQUATE (B2)	7439-92-1	207.2	–	–	–	1,700 +	690
Nickel (salts)		X	NOT EVALUATED	7440-02-0	58.7	–	–	–	680 +	54
Silver	X		NOT EVALUATED	7440-22-4	107.9	–	–	–	–	1
Zinc		X	NOT EVALUATED		65.4	–	–	–	670 +	430
VOLATILE ORGANICS:										
Benzene		X	SUFFICIENT (A)	71-43-2	78.1	0.88	1E+02	2E+06	1	5
1,2-Dichloroethane		X	INADEQUATE (B2)	75-34-3	99.0	1.24	2E+02		1	1
Ethylbenzene		X	INADEQUATE (B2)	100-41-4	106.2	0.87	7E+00	2E+05	1	38
Toluene		X	NO EVIDENCE (D)	108-88-3	92.2	0.87	2E+01	5E+05	1	11
Vinyl Chloride		X	SUFFICIENT (A)	75-01-4	62.5	0.91	3E+03		1	1
Xylene		X	ON LINE	1330-20-7	106.2	0.87	8E+00	3E+02	1	–
EXTRACTABLE ORGANICS:										
Benzo(a)anthracene	X	X	INADEQUATE (B2)	56-55-3	228.3		5E-09	1E+01	86,000	30
Benzo(a)pyrene	X		INADEQUATE (B2)	50-32-8	252.0		5E-09	4E+00	86,000	30
Benzo(b)fluoranthene	X		INADEQUATE (B2)		252.3		1E-10	–	86,000	30
Benzo(k)fluoranthene	X		INADEQUATE (B2)	207-08-9	252.3		1E-10	–	86,000	30
Dibenzo(a,h)anthracene	X		INADEQUATE (B2)	53-70-3	276.4		1E-10	5E-01	86,000	30
1,2-Dichlorobenzene		X	NOT EVALUATED	95-50-1	147.0	1.30	1E+00	1E+05	3	56
Hexachlorobenzene	X		INADEQUATE (B2)		284.8	1.57		1E+05	3	8,700
Indeno(1,2,3-cd)pyrene	X		INADEQUATE (B2)		276.3		1E-10	–	86,000	30
PCB Aroclor 1254	X		INADEQUATE (B2)		328.4	1.54	8E-05	1E+01	1,000	45,000
PCB Aroclor 1260	X		INADEQUATE (B2)	11096-82-5	377.5	1.62	4E-05	3E+00	1,000,000	45,000

a. See Tables 7.1 and 7.2 for basis of selection of indicator chemicals.

b. Evidence for human carcinogenicity of the indicator chemicals based on EPA's determination of available data, as outlined below (chemicals with a categorization of B2 and above are considered potential human carcinogens for risk assessment purposes):

Evidence for Human Carcinogenicity	Evidence for Animal Carcinogenicity			
	Sufficient	Limited	No data	No evidence
Sufficient	A	A	A	A
Limited	B1	B1	B1	B1
Inadequate	B2	C	D	D
No data	B2	C	D	E
No evidence	B2	C	D	E

c. The soil:water partition coefficients for metals were based on site EP Tox data, as discussed in the text; the remaining chemical properties were based on Callahan et al. (1979) and EPA (1988c).

Oral ingestion of arsenic by humans at relatively high doses is known to initiate a variety of toxic effects. The existing toxicologic criteria for chronic exposures to arsenic are based on symptoms such as keratosis and hyperpigmentation (EPA, 1989c). Although no acceptable daily Intake for chronic exposure (AIC) has been determined for arsenic, the interim (ATSDR) value proposed by the Agency for Toxic Substances and Disease Registry (ATSDR) is 1 ug/kg-day, although this is not a final value.

High oral doses of arsenic are also suspected of initiating skin cancer (EPA, 1989c). The previous cancer potency slope of 15 $(mg/kg\text{-}day)^{-1}$ used to evaluate carcinogenicity is currently under EPA review.

EPA (1988b) reports that the most appropriate study for addressing the carcinogenic oral exposures to arsenic was conducted by Tseng, 1977, in which a cross-sectional study of 40,000 Taiwanese exposed to arsenic in drinking water experienced a significant excess of skin cancer in comparison to control populations. Both human- and animal-based studies for this compound have been classified as sufficient, and the compound has been accorded a Class A (known human carcinogen) status for oral exposure. Based on the above study EPA developed a proposed quantitative estimate of carcinogenic potency in the form of a oral "unit risk" (cited in EPA, 1988b; updated 12/88). Following standard exposure assumptions, the estimated oral potency slope, derived from the reported unit cancer risk is approximately 1.5 $(mg/kg\text{-}day)^{-1}$, representing a reduction in potency over the previous oral cancer potency slope of 15 $(mg/kg\text{-}day)^{-1}$ (EPA, 1988b). This proposed value, which reflects the most recent opinions regarding the mechanisms of action of ingested inorganic arsenic, was used to address carcinogenic oral exposures of this compound for the purposes of this risk assessment.

Recent investigations have suggested that arsenic ingested orally may be a necessary micronutrient for humans (EPA, 1988c), although this assumption is currently being reviewed by the EPA Risk Assessment Forum and Science Advisory Board. It is not currently known whether a threshold exposure to arsenic is required to initiate carcinogenesis.

The existing Maximum Contaminant Level (MCL) for total arsenic in drinking water is 50 ug/L. The proposed MCL and Maximum Contaminant Level Goal (MCLG) are 30 and 0 ug/L, respectively.

Inhalation exposures to relatively high doses of arsenic are suspected of initiating respiratory cancers in humans (EPA, 1989c). The presently accepted inhalation carcinogenic potency value is 50 $(mg/kg\text{-}day)^{-1}$.

The Office of Drinking Water subcommittee has expressed interest in proposed alternative theories of arsenic-associated cancer risk, although no related findings have yet been issued. For the purpose of the present assessment we recognize the most recent proposed MCLG for arsenic of 0 ug/L (reflecting a non-threshold human carcinogen), and the most recent proposed MCL of 30 ug/L.

Chromium

Chromium occurs in soils of the Puget Sound area at concentrations typically ranging from 10 to 70 mg/kg (METRO, 1985a). At the PACCAR site, chromium levels in soils have been reported as high as 1,600 mg/kg (Table 7.1). Water samples also reveal an on-site concentration increase, with maximum levels of 38 ug/L reported in groundwater (Table 7.2).

Like many of the metals, chromium generally exhibits a strong affinity for soil particles, though environmental conditions may influence its mobility (Callahan et al., 1979). Based on the results of EP Tox analyses, the apparent soil:water distribution coefficient of chromium at the PACCAR site exceeds 7,700:1 (Table 7.3; lower 95 percent slope). Under most conditions at the PACCAR site, therefore, very little of the chromium present in soil is expected to be mobile within the aquatic phase.

Environmental conditions also partly affect the relative amounts of different forms of chromium, and particularly between the +III and +VI valence states. The toxicity of chromium varies widely between theses two valence states, with chromium (VI) being the more toxic and potentially carcinogenic state of this metal. Limited analyses of soil samples collected from the PACCAR site, however, have not detected the presence of chromium (VI) at quantifiable levels. Measured concentrations of chromium in water samples have not exceeded drinking water regulations (proposed MCL and MCLG values of 100 ug/L as total chromium), but may exceed aquatic life criteria (11 ug/L for protection from chronic toxicity) if a large percentage of the total chromium were present in the +VI form.

Oral doses of chromium are known to be toxic to humans, and the current Reference Dose (RfD) for evaluating risks from such exposures is 5 ug/kg-day (EPA, 1989c). Oral exposures of chromium are not suspected to initiate carcinogenesis.

Inhalation exposures of hexavalent chromium are suspected to initiate lung cancers at high doses. The current potency factor developed by EPA to assess risks associated with such exposures is 41 $(mg/kg\text{-}day)^{-1}$.

Copper

Copper concentrations in background soils typically range from 5 to 20 mg/kg (METRO, 1985a). Levels are elevated at the PACCAR site to a maximum concentration of approximately 1,600 mg/kg. On-site water concentrations of copper were also somewhat elevated relative to local reference values, and reached a maximum level of 50 ug/L in surface stormwater.

Copper exhibits a very strong affinity for solid surfaces and is among the more "particle active" of metals. This chemical behavior was also observed during EP Tox analyses, and the apparent soil:water distribution coefficient of copper at the PACCAR site exceeded 14,000:1 (Table 7.3; lower 95 percent slope). Very little of the copper present in soil is expected to be mobile.

Copper is a necessary micronutrient for humans, and toxic effects to man have only been observed at very high dose levels. However, copper is toxic to aquatic life, with the degree of toxicity reduced with increasing water hardness. Several surface water and groundwater locations at the PACCAR site exhibited copper concentrations in excess of the most restrictive (i.e., protection against chronic toxicity) aquatic life criterion of 4 ug/L.

Lead

Like other metals, lead is ubiquitous in the environment, with natural soil concentrations ranging from approximately 10 to 60 mg/kg (METRO, 1985a). Concentrations of lead are considerably greater near roadways, and average lead levels of street dust in the metropolitan Seattle region frequently exceed 1,000 mg/kg (Galvin and Moore, 1982). Soil lead levels may also be elevated to approximately 10,000 mg/kg adjacent to residences as a result of lead-based paint accumulations (EPA, 1986c). At the PACCAR site, soil lead concentrations have been measured at up to 19,000 mg/kg.

Nearly all forms of lead are relatively insoluble in water, and readily precipitate as carbonate, sulfate, or sulfide complexes. Lead also exhibits a high affinity for particulate materials, which is consistent with the minimum soil:water distribution coefficient calculated from EP Tox data of 1,700:1 (Table 7.3; lower 95 percent slope). Atmospheric lead is also typically associated with airborne particulates.

Blood lead levels of children have been shown to be correlated with environmental lead levels and the magnitude of adverse health effects. The most sensitive health effects include chronic conditions, but not carcinogenesis. In consideration of new health effects information, EPA proposed the "maximum safe blood level" guideline for pediatric exposures to be 10 - 15 ug/dL, from the former value of 30 ug/dL (EPA, 1988d). Since children in urban areas often exhibit blood lead levels in excess of this new guideline (Glass, 1984), ambient lead exposure is of general concern. No toxicity criteria for lead exposure are currently verified by EPA (1988a; 1989c).

The concern over lead exposure is evident in the progressive reduction of the average drinking water standard (MCL) for lead from 50 ug/L to the most recent anticipated (Sept 1989) EPA proposal of 5 ug/L in source water and 10 ug/L in tap water (EPA, 1989d; 95 percent of tap water samples also less than 20 ug/L). The maximum water lead concentration measured at the PACCAR site was 40 ug/L (see Figure 6.77). The aquatic life chronic toxicity criterion of 1 ug/L (based on an average hardness of 50 mg/L) may also be exceeded in on-site surface waters, though even "background" lead levels in the Cedar River regularly exceed this criterion (METRO, 1982).

Nickel

Background concentrations of nickel in the Puget Sound area are approximately 10 to 70 mg/kg (METRO, 1985a). The maximum value of 330 mg/kg at the PACCAR site is considered moderately elevated, compared with some of the other metals (Table 7.1). The maximum nickel concentration in on-site groundwaters of 48 ug/L is also higher than the local reference water value (Table 7.2).

Nickel is somewhat more mobile in soil/water environments than many of the other metals. This general characteristic is consistent with the minimum soil:water partition coefficient, calculated using EP Tox data, of 680:1 (Table 7.3).

Refinery dusts of nickel are considered by EPA to be potentially carcinogenic via the inhalation route. However, the soluble salts likely to be present at the PACCAR site have not been characterized as carcinogenic (EPA, 1988a). Oral exposures of all forms of nickel are not considered carcinogenic.

In consideration of potential toxicity, EPA has calculated a water quality criterion for nickel of 13 ug/L (protection of human health against toxicity associated with ingestion of contaminated drinking water and fish/shellfish). Some surface water samples collected from the PACCAR site have exceeded this criterion.

Silver

Relative to background concentrations levels of silver in regional soils of approximately 0.1 to 1.0 mg/kg, the maximum measured concentration at the PACCAR site of 360 mg/kg is quite elevated (Table 7.1; METRO, 1985a). However, no significant elevation of silver in water samples above reference concentrations was observed (Table 7.2).

The primary environmental form of silver is a sulfide complex, which is very insoluble in water. Accordingly, this metal is expected to exhibit strong sorption characteristics onto site soils, although the EP Tox data available for the site are too limited to confirm such a condition.

Studies have shown no evidence that silver is carcinogenic to animals or humans. No MCL for drinking water has been established for this compound. Accordingly, the most appropriate criterion is the ambient water quality criterion for the protection of human health against ingestion of contaminated drinking water and fish/shellfish, which has been established at 50 ug/L (EPA, 1986b).

Zinc

Background concentrations of zinc in the Puget Sound region range between 20 and 80 mg/kg (METRO, 1985a). On-site soil levels frequently exceeded this background range, and reached maximum concentrations of approximately 6,400 mg/kg (Table 7.1). The maximum zinc concentration measured in on-site surface waters of 390 ug/L is also higher than the local reference water value (Table 7.2).

Like many of the other metals discussed above, zinc is generally strongly sorbed onto soils and sediments in aquatic environments. This general characteristic is consistent with the minimum soil:water distribution coefficient, calculated from EP Tox data, of 670:1 (Table 7.3; lower 95 percent slope).

Like copper, zinc is a necessary micronutrient for humans, and toxic effects to man have only been observed at very high dose levels. However, zinc is toxic to aquatic life, with the degree of toxicity reduced with increasing water hardness. Several surface water and groundwater locations at the PACCAR site exhibited zinc concentrations in excess of the most restrictive aquatic life criterion of 47 ug/L.

7.2.2 Volatile Organics

Benzene

Levels of benzene measured in groundwater beneath the PACCAR site have been reported up to a maximum concentration of 52 ug/L, which is above both local reference values and the existing drinking water standard of 5 ug/L

(Table 7.2). Benzene was generally undetectable in soils at the PACCAR site (Table 7.1).

Benzene is highly volatile in soil and water environments, and volatilization losses to the atmosphere represent a major environmental transport and (ultimately) fate pathway for this compound. Similarly, the rather high water solubility and low solids affinity result in a high mobility within groundwater environments.

The potential carcinogenic properties of benzene administered through both inhalation and absorption pathways is well documented for animals. The primary toxicologic endpoint which forms the basis for human toxicity criteria from both oral and inhalation exposures to benzene is leukemia (EPA, 1989c). The verified potency slope for risk assessment purposes for both pathways is 2.9×10^{-2} $(mg/kg\text{-}day)^{-1}$.

Aquatic life criteria for benzene (approx. 5,300 ug/L for acute toxicity) are much less restrictive than those based on human health considerations. Existing aquatic life water quality criteria have not been exceeded at the PACCAR site.

1,2-Dichlorobenzene

Soil samples did not exhibit detectable concentrations of 1,2-dichlorobenzene (Table 7.1). However, this compound was occasionally detected in water samples, and the maximum reported concentration of 14 ug/L exceeded both the reference value and the proposed secondary drinking water standard, based on aesthetic qualities, of 10 ug/L (Table 7.2). However, no on-site concentrations exceeded the proposed primary drinking water standard (MCL and MCLG) based on toxicity of 600 ug/L or the suggested aquatic life chronic toxicity criterion of 760 ug/L.

The most sensitive toxicological response to oral and inhalation exposures to 1,2-dichlorobenzene are liver abnormalities and decreased weight gain, respectively (EPA, 1989c). The existing Reference Dose for evaluating risks of both oral and inhalation exposures is 0.4 mg/kg-day. This compound has not been classified by EPA as a potential animal or human carcinogen.

1,2-Dichloroethane

Concentrations of 1,2-dichloroethane in groundwaters were rarely detectable, but were reported at 13 ug/L in one on-site groundwater sample (Table 7.2). This single measured value exceeded the existing drinking water standard of 5 ug/L, and therefore this constituent was included as a contaminant of concern. 1,2-dichloroethane was not detected in soil samples (Table 7.1). Like benzene, 1,2-dichloroethane volatilizes readily to the atmosphere, and also is highly mobile within groundwater environments.

Experimental administration of 1,2-dichloroethane to animals provide evidence of the carcinogenicity of this compound via both the oral and inhalation exposure routes. Even though data for human exposures are inadequate, EPA has classified this compound as a probable human carcinogen for the purpose of developing risk-based criteria. The primary toxicologic endpoint which forms the basis for human toxicity criteria from both oral and inhalation exposures is tumor initiation within the circulatory system (EPA, 1989c). The verified potency slope for risk assessment purposes for both pathways is 9.1×10^{-2} $(mg/kg\text{-}day)^{-1}$.

Ethylbenzene + Toluene + Xylene (ETX)

The three "ETX" compounds are characterized by similar source, transport, fate, and toxicity characteristics, and therefore have been combined for the purpose of developing exposure and risk assessments. The combined ETX concentration at the PACCAR site reached a maximum concentration of approximately 2.8 mg/L (ppm) in shallow groundwaters, which exceeded local background levels (Table 7.2). Overall, soil concentrations were similar to the water data, with a maximum reported concentration of approximately 7.1 mg/kg (dry wt). The similarity of soil and groundwater concentrations is consistent with the high aqueous mobility of these compounds. ETX compounds are also quite volatile.

None of the ETX compounds have been classified by EPA as potential animal or human carcinogens, and all criteria formulated for these compounds have been based on chronic toxic effects. Based on toxicity evaluations, the proposed primary drinking water standards for ethylbenzene, toluene, and xylene are 700 ug/L, 2,000 ug/L, and 10,000 ug/L, respectively (EPA, 1988b). Proposed secondary drinking water standards based on aesthetic (i.e., taste/odor) concerns are much lower than the toxicity criteria; at 30 ug/L, 40 ug/L, and 20 ug/L, respectively.

The lowest Reference Dose or AIC values reported for the ETX compounds are 0.1 mg/kg-day and 0.4 mg/kg-day for oral and inhalation exposures, respectively. These values were derived based on toxicologic data on ethylbenzene and xylenes, respectively (EPA, 1989c). Use of these toxicity criteria to evaluate risks associated with combined ETX exposures will somewhat overestimate actual risks.

Vinyl Chloride (VC)

Although vinyl chloride was generally undetectable in site soils (Table 7.1), its occurrence in groundwater was more common (Table 7.2). The maximum concentration measured in on-site groundwater was 120 ug/L, which is above both local reference values and the existing (enforceable) drinking water standard of 2 ug/L.

Under normal atmospheric conditions, vinyl chloride is present primarily as a vapor, and exhibits very rapid volatilization rates from both water and soil. The volatilization half-life of vinyl chloride at a depth of 10 cm (4 in.) in dry soil has been estimated at approximately 12 hours (EPA, 1985a). Similar half-lives are expected in water. As ambient pressure increases, however, vinyl chloride exhibits a greater tendency to remain within the water phase. This physical-chemical characteristic may partly explain why concentrations at depth within the aquifer under the PACCAR site tend to be greater than those nearer the surface.

However, the observed depth distribution of vinyl chloride may also be attributable to its formation as a degradation product of another chlorinated compound (e.g., dichloroethylene or trichloroethylene) which may have flowed downward through the aquifer as a result of relatively high specific gravity properties. The specific gravity of vinyl chloride is less than that of water and would not be expected to exhibit such sinking properties (Table 7.3).

Vinyl chloride exhibits considerable mobility within soil/water environments.

The carcinogenic properties of vinyl chloride are well known, and EPA considers the available evidence sufficient for the purposes of establishing both oral and inhalation criteria (EPA, 1988b). Suspected tumor initiation sites due to oral and inhalation exposures to vinyl chloride are the liver and lung, respectively. Overall, the carcinogenic potency of vinyl chloride administered by the inhalation route is approximately ten times less than that of the oral route. Potential carcinogenic effects are more restrictive than those based on other toxic effects, and formed the basis for promulgation of the existing drinking water standard of 1.5 ug/L (actually enforced at 2 ug/L).

7.2.3 Semivolatiles

Polycyclic Aromatic Hydrocarbons (PAHs)

The compounds included in the PAH grouping included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene. These compounds represent the PAHs for which sufficient data exist to allow classification as potential carcinogens (EPA, 1988a). Environmental source, transport, and fate characteristics are also similar.

Unlike the contaminants discussed above, the PAH compounds were frequently detected in soils at concentrations well above the regional reference concentrations, but have not been detected in water samples (Tables 7.1 and 7.2). This condition is consistent with the rather low mobility of PAHs in soil/water environments (Table 7.3). PAHs are also relatively non-volatile. One of the principal environmental fate pathways of PAHs is biodegradation, and typical half-lives of these chemicals in soils range from several months to several years, depending upon soil moisture and nutritional factors. Metabolism of PAHs also contributes to the rather low observed bioaccumulation of these chemicals, compared with predicted values.

EPA (1986b) has determined a marine acute toxicity value of 300 ug/L for total PAHs, indicating the potential for substantial toxicity to aquatic organisms. No criterion for freshwater acute toxicity or freshwater/marine chronic toxicity has been derived by EPA for the PAHs.

Acute toxicity of PAHs to mammals has been shown to be limited, and will therefore not be considered on the basis of non-carcinogenic endpoints. No oral AIC or RfD value has been derived for this class of compounds.

Potential Carcinogenicity of HPAHs

PAH mixtures are known to be carcinogenic to humans, although toxic potential on an individual basis has not been well characterized. Of the thirteen PAH isomers classified as priority pollutants, EPA has classified nine HPAH compounds, including Benzo(a)pryrene (B(a)P), as potential carcinogens.

The carcinogenic potency values assigned to PAHs are reported in Table 7.4. They are based on toxicological information derived from B(a)P alone. The traditional approach to assigning carcinogenic potency values involves using B(a)P as an indicator or surrogate compound, and assumes that other HPAH isomers are as toxic (i.e., potentially carcinogenic) as B(a)P. This toxicologic assumption is regarded as conservative, for reasons discussed below.

Using the assumption of B(a)P surrogacy and the standard linear multistage model for determination of carcinogenic potency, the potency values for carcinogenic PAH compounds has been estimated by EPA at 6.11 $(mg/kg\text{-}day)^{-1}$ for oral exposures, and 11.5 $(mg/kg\text{-}day)^{-1}$ for inhalation exposures. It should be noted that these values are currently under intensive review within various offices of EPA, and are not presently regarded by that agency as verified toxicologic criteria for use in risk assessment.

The assumption that all carcinogenic PAHs have potencies equivalent to that of B(a)P has been challenged both within the scientific community and from within EPA. It has been consistently reported that B(a)P is one of the most potent PAHs tested (EPA, 1986d; Clement Associates, Inc., 1988).

As an alternative to the traditional EPA model for PAH carcinogenicity, Thorslund et al. (1987) has reported a two-stage model for prediction of carcinogenicity. A key advantage of this model is that it is theoretically derived and reflects known biological principles, yet is simple enough to develop estimates of carcinogenic potency using limited data. The model simulates a two-stage physiological process whereby carcinogenesis is initiated, as follows: (1) a normal cell is "initiated" and becomes a preneoplastic, first-stage cell, and (2) this cell is further "promoted" into a neoplastic cell which contributes to tumor development. A major underlying assumption of this model is that because various carcinogenic PAHs appear to be metabolized to similar reactive intermediates, they produce comparable adducts with DNA and histologically similar tumors at similar sites in experimental animals, a common mechanism of action for different PAH isomers is indicated.

Using the alternative two-stage model, Clement Associates (1988) developed relative potency estimates for various PAH isomers, shown in Table 7.4. These relative estimates can be used to estimate cancer risk associated with any exposure to multiple PAHs (for which potency estimates are available). Additivity of dose is assumed in the absence of contrary evidence.

Clement Associates (1988) compares potency values derived from the linearized multi-stage model with corresponding results for the alternative (biologically responsive; i.e., two-stage) model, and reports that with few exceptions the two-stage model indicates superior predictive ability when fit to toxicological data.

The two-stage model may be preferable to the more conventional approach because: (a) it has the same form in all cases, whereas the multi-stage model invokes different stages to fit different data sets (making relative potency estimates dose-dependent; and (b) it is based on a specific model of the two affected transitions (for which strong experimental support has been

Table 7.4 - Summary of Relative Carcinogenic Potencies of PAH Compounds

	Carcinogenic Status		Carcinogenic Potency Factor (mg/kg-day)-1		Relative (c) Potency	
	EPA (a)	IARC (b)	Multi-Stage	Two-Stage	Estimates	Reference
ORAL EXPOSURES:						
Acenaphthene	--	3				
Acenaphthylene	--	3				
Anthracene	--	4				
Benzo(a)anthracene	B2	1			0.145	Bingham and Falk (1969)
Benzo(a)pyrene	B2	1	6.10E+00 (a)	4.53E-01 (d)	1.000	
Benzo(b)fluoranthene	B2	1			0.115	Deutsch-Wenzel et al. (1983)
Benzo(g,h,i)perylene	B2	--			0.018	Deutsch-Wenzel et al. (1983)
Benzo(k)fluoranthene	D	1			0.053	Deutsch-Wenzel et al. (1983)
Chrysene	B2	2			0.004	Wynder and Hoffman (1959)
Dibenzo(a,h)anthracene	B2	1			1.110	Wynder and Hoffman (1959)
Fluoranthene	--	4				
Fluorene	--	3				
Indeno(1,2,3-cd)pyrene	C	1			0.078	Deutsch-Wenzel et al. (1983)
Naphthalene	--	4				
Phenanthrene	--	3				
Pyrene	--	4				
INHALATION EXPOSURES:						
Acenaphthene	--	3				
Acenaphthylene	--	3				
Anthracene	--	4				
Benzo(a)anthracene	B2	1			0.145	Bingham and Falk (1969)
Benzo(a)pyrene	B2	1	1.15E+01 (a)	3.20E+00 (d)	1.000	
Benzo(b)fluoranthene	B2	1			0.115	Deutsch-Wenzel et al. (1983)
Benzo(g,h,i)perylene	B2	--			0.018	Deutsch-Wenzel et al. (1983)
Benzo(k)fluoranthene	D	1			0.053	Deutsch-Wenzel et al. (1983)
Chrysene	B2	2			0.004	Wynder and Hoffman (1959)
Dibenzo(a,h)anthracene	B2	1			1.110	Wynder and Hoffman (1959)
Fluoranthene	--	4				
Fluorene	--	3				
Indeno(1,2,3-cd)pyrene	C	1			0.078	Deutsch-Wenzel et al. (1983)
Naphthalene	--	4				
Phenanthrene	--	3				
Pyrene	--	4				

NOTES:

(a) As reported by EPA (1986a) (Superfund Public Health Evaluation Manual), and EPA 1986d (Health Effects Assessment for PAHs

(b) Based on the classification used by the International Agency for Research on Cancer (IARC), where:

1 = sufficient animal evidence of carinogenicity;

2 = limited animal evidence of carcinogenicity;

3 = inadequate evidence to permit evaluation of carcinogenicity;

4 = no evidence of carcinogenicity.

(c) Thorslund, personal communication (1989) developed with the PAHs), while for the multi-stage model the transitions are unspecified.

An unbiased validation of any predictive carcinogenesis model is not possible using available experimental techniques. The tumor rates predicted by the model in the low-dose range are far below those that can be reliably measured using animal bioassays. Accordingly, direct experimental evidence for the model must be obtained at exposure levels far in excess of those expected to occur in the environment. There are instances, however, of partial validation of the two-stage model. For example, based on data reported by Thyssen et al. (1981), the two-stage model is quite predictive of observed respiratory tract tumors in hamsters.

Use of the two-stage model with high levels of exposure, however, can lead to biological interactions that would not be expected to occur at environmental levels, resulting in deviations from what is predicted. In general, this method tends to overestimate toxicity at high exposure concentrations and to give good results at more moderate levels. The approach may therefore be viewed as conservative for PAH mixtures, which would enhance overall credibility.

HPAH Carcinogenicity at the PACCAR Site

Table 7.4 presents the relative exposures to HPAH compounds at the PACCAR site using the two approaches to estimating carcinogenicity potential. For the sake of comparison the present EPA potency values using the multi-stage model were used, while for the two-stage model estimated B(a)P potency values of 3.20 and 0.453 $(mg/kg\text{-}day)^{-1}$ were used for inhalation and oral exposures, respectively. These values are approximately 3.6 and 13.5 times lower than the present EPA multi-stage potency estimates for inhalation and oral exposures, respectively.

Toxicity equivalency factors (shown in Table 7.4) were also used in developing relative risk estimates. The concentrations identified at the PACCAR site produced a predicted cancer risk (i.e., combining average surficial soil concentrations of HPAH compounds with potency values) for inhalation exposures, which is less by at least a factor of 10 for the two-stage model (assuming variable toxicity equivalency rather than uniform B(a)P surrogacy). For oral exposures the discrepancy between the cancer risk estimates is even greater, with two-stage model-derived estimates lower than multi-stage (and B(a)P surrogacy-based) estimates by a factor of 50.

Based on these calculations, assumptions regarding both the cancer mechanism (i.e., two-stage versus multi-stage) and relative potency (relative equivalence versus surrogacy) appear to have a significant effect on the resulting risk estimates. The differences between the approaches and assumptions are recognized by EPA, and Region 10 presently considers the output from both models relevant and appropriate for risk assessment (L. Woodruff, personal communication). Presently, there is no basis to determine which approach is most defensible for risk assessment purposes, since EPA has not officially review. For the purposes of this report, the present EPA risk model (multi-stage; B(a)P surrogacy) is considered the "primary" approach to HPAH risk assessment, while the alternative approach is presented as a "secondary" method. The uncertainty regarding cancer risk estimates for HPAHs will be discussed further in the risk assessment section of this report (Section 9).

Hexachlorobenzene

Hexachlorobenzene was occasionally detected only in subsurface soils (Table 7.1) collected from the PACCAR site, but was not detected in waters (Table 7.2). These data are consistent with the high soil:water partition coefficient characteristic of hexachlorobenzene. The maximum soil concentration reported for the PACCAR site is 16 mg/kg.

Hexachlorobenzene is classified as suspected human carcinogen via oral exposure routes, based on animal data. No drinking water MCL has been established by EPA for this compound. Although human evidence is lacking, the potential carcinogenic properties of hexachlorobenzene to the liver form the basis for existing oral exposure criteria of 1.7 $(mg/kg\text{-}day)^{-1}$ (EPA, 1989c). The verified RfD for this compound to prevent chronic liver toxicity via oral exposure routes is 0.8 mg/kg-day. No inhalation criteria have been derived for this compound.

7.2.4 Polychlorinated Biphenyls (PCBs)

Similar to hexachlorobenzene, PCBs (including Aroclors 1254 and 1260) have occasionally been detected in on-site soil samples (Table 7.1), and only on one occasion been detected in waters (Table 7.2). This condition is consistent with the very high soil:water partition coefficient characteristic of PCBs. The maximum measured PCB soil concentration is 24 mg/kg.

The occurrence of PCB as Aroclor 1260 at levels above detection has only been reported for one monitoring well, MW-2S, at 10 ug/L (ppb). This detection occurred during a single limited sampling effort conducted by HNTB in June 1984. Two subsequent samplings of MW-2S in December 1984 and July 1985 and other on-site monitoring well sampling during the same sampling rounds and in February 1986 have not confirmed the presence of PCBs in groundwaters of the PACCAR site.

Overall, the more chlorinated PCBs such as Aroclors 1254 and 1260 are highly stable and persistent within the environment, exhibiting low potential for mobility and degradation. Volatilization may be a significant long-term transport process, although the strong affinity of PCBs for soil tends to retard emission rates. The more chlorinated PCBs also exhibit low rates of biodegradation, and concentrate readily within the fatty tissue of aquatic organisms.

Evidence establishing the carcinogenic potential of PCB administered orally to animals is deemed by EPA to be sufficient. Although human evidence is lacking, the potential carcinogenic properties of PCBs form the basis for existing exposure criteria. The proposed cancer potency slope to evaluate risks from oral exposures to PCBs is 7.7 $(mg/kg\text{-}day)^{-1}$ (EPA, 1989c). For the regulation of drinking water, EPA has proposed an MCL of 0.5 ug/L and an MCLG of 0 ug/L. No inhalation criteria have been proposed.

8.0 CONTAMINANT TRANSPORT

8.1 POTENTIAL ROUTES OF MIGRATION

8.1.1 Air

Many of the contaminants of concern identified in Section 7.0 are present at the PACCAR site in near-surface soils. Although much of the area exhibiting elevated near-surface soil concentrations is covered by foundations, slabs or pavement, some of the site's surface area is covered with clean gravel. Because potential generation of dust from these areas constitutes a potential contaminant migration and exposure route, it is addressed in this Remedial Investigation.

Volatilization of some of the contaminants identified at the PACCAR site is also possible. However, because most of the volatile constituents were rarely detected in near-surface soils (Table 8.1), and because of the low vapor pressure characteristic of the other contaminants (Table 7.3), volatile emission rates are likely to be very low. Preliminary exposure screening analyses based on methods outlined in EPA (1988e) also indicate that vapor emissions are not likely to contribute significantly to overall contaminant migration or site risks. Accordingly, volatilization pathways were not considered further in our analysis.

8.1.2 Surface Water

Surface water transport of site contaminants may occur as a result of erosion of potentially exposed near-surface soils or via surface discharge of groundwater. Most of the stormwater generated on the PACCAR site discharges to the north of the facility into Johns Creek, which eventually discharges into Lake Washington (see Section 4.3). Johns Creek also receives considerable stormwater inputs from the surrounding residential/commercial/ industrial area, including Interstate 405. Stormwater discharged from relatively small areas in the southwest corner of the PACCAR site are conveyed to the Cedar River.

Surface water discharges from the PACCAR site also occur indirectly as result of groundwater transport. Groundwater discharges from the PACCAR facility are oriented predominantly westerly and southerly, with much of this discharge eventually contributing to the Cedar River (see Section 5.2).

Table 8.1 - Summary of Near-Surface Soil Concentration Data

		Near-Surface Soil Concentration in mg/kg (dry weight)	
Parameter	Detection(a)	Average	Upper 95 Percent
Metals:			
Arsenic	48/48	18	65
Chromium	67/67	76	279
Copper	45/45	175	638
Lead	62/69	737	4,811
Nickel	58/58	41	100
Silver	6/9	38	214
Zinc	60/60	328	1,212
Volatile Organics:			
Benzene	0/21	<0.01	<1.0
1,2-Dichlorobenzene	0/38	<0.01	<1.0
1,2-Dichloroethane	0/21	<0.01	<1.0
Eth + Tol + Xyl (ETX)	8/21	0.68	2.4
Vinyl Chloride	0/21	<0.01	<1.0
Extractable Organics:			
Total PAHs	33/38	19	142
Hexachlorobenzene	0/38	<0.01	<1.0
Total PCBs	7/30	0.28	2.0

(a) The first number is the number of detections; the second number is the number of samples analyzed.

8.1.3 Groundwater

As discussed in detail in Section 5.2, part of the PACCAR site is within the potential catchment area of the Renton groundwater supply system. A hydraulic connection is believed to exist between groundwaters beneath the southeast corner of the PACCAR site and the water supply pumping wells. Because of the potential public health risks associated with contaminant transport to the well field, characterization of this pathway was a major focus of this Remedial Investigation.

8.2 TRANSPORT PROCESSES

8.2.1 Dust Generation

Although a variety of analytical models have been developed to estimate dust generation from exposed soils, most of these models suffer from a high degree of predictive uncertainty (EPA, 1988e). Such uncertainty minimizes the potential utility of modeling efforts to assess airborne transport of particulate materials.

A more accurate measure of potential dust suspension in the PACCAR site vicinity is obtained by evaluating ambient particulate concentration data. The Puget Sound Air Pollution Control Agency (PSAPCA) has collected data on total suspended particulate (TSP) concentrations at a site close to the PACCAR facility at monthly intervals since 1978 (PSAPCA, 1988). These data are summarized on Figure 8.1. The average TSP concentration over the 10-year period of record is 58 ug/m^3; five percent of the samples exceeded approximately 120 ug/m^3. For the purposes of estimating potential exposures from contaminated dust, these TSP data were assumed (conservatively) to be representative of the range (and statistical distribution) of potential local dust contributions from on-site soils.

8.2.2 Groundwater Discharge

A large amount of data has been collected on hydrogeologic characteristics of the Renton aquifer system, as discussed in Section 5.2. These data are sufficient to support a detailed evaluation of groundwater flow boundaries and rates, which ultimately form the basis for assessments of potential contaminant exposure at key receptor points (e.g., the Renton well field).

Prior to discussing specific components of the groundwater transport evaluation, it is useful to review the general mass balance modeling framework upon which most assessments of hydrologic contaminant transport are based (EPA, 1988e). In situations where more than one hydraulic source contributes to a given receptor, the concentration of each constituent represents the sum of contributions from the PACCAR site and background sources. The mathematical representation of this condition is as follows:

$$C'_i = f_{i,p} * C'_{i,p} + f_{i,b} * C'_{i,b}$$

where: C'= constituent concentration in ug/L
f = fraction of total discharge
i = indicates a given receptor point
p = indicates PACCAR site contribution
b = indicates background contribution

Using Darcy's Law (Freeze and Cherry, 1979), the PACCAR site contribution of constituents at a given receptor point can be evaluated as:

$$f_{i,p}*C'_{i,p} = C'_{i,p}*k_i*I_i*W_i*D_i/Q_i$$

where: k = hydraulic conductivity in m/sec
I = hydraulic gradient in m/m
W = width of the aquifer catchment in m
D = total aquifer thickness in m
Q = receptor discharge in m^3/sec

Each term of the above formulation is described below:

Groundwater Concentration ($C'_{i,p}$). For the purposes of calculating potential receptor contributions of identified site groundwater contaminants, the range of concentrations reported at on-site and immediately downgradient locations within each catchment boundary (i.e., Renton Well or Cedar River) were considered. In the case of site constituent transport toward the Renton well field, only data collected north of the approximate sand/gravel transition near N. 3rd Street were considered, since hydrogeologic characteristics vary significantly between aquifer materials north and south of this boundary (see Section 5.1). Concentrations of site constituents south of this general boundary are also considerably lower than those reported at on-site locations (Section 6.3).

Although some specific contaminants in groundwater tended to exhibit a characteristic depth distribution of concentrations, in general no consistent vertical distributions of site contaminants was observed (Figures 8.2 through 8.5). Since all of the stratigraphic units which have been monitored at the PACCAR site are believed to be in hydraulic connection with both the Renton well field and the Cedar River, groundwater data collected from various depths within the aquifer were included in evaluations of $C'_{i,p}$.

A summary of the average and upper 95th percentile constituent concentrations observed within on-site catchment areas of the Renton Well and the Cedar River is presented in Table 8.2. Statistical summaries of selected parameters are presented on Figures 8.6 through 8.10. This assessment of concentration ranges made full use of the extensive site monitoring data. This evaluation also assumed (conservatively) that off-site constituent attenuation along the flow path (e.g., due to soil adsorption) was negligible.

Hydraulic Conductivity (k). No statistically significant ($P > 0.10$; ANOVA) variation in hydraulic conductivity was observed either between stratigraphic units or catchment boundaries. Furthermore, no significant ($P > 0.10$; regression) correlation of k with $C'_{i,p}$ was observed for any of the site contaminants. Accordingly, the range of values measured throughout the site vicinity (using slug test methods and excluding wells south of N. 3rd St.) was included in the transport model. The range of hydraulic conductivity estimates is summarized in Table 8.2 and on Figure 8.11.

Hydraulic Gradient (I). Although the hydraulic gradient of different stratigraphic units was similar, the gradient within the Cedar River catchment was significantly ($P < 0.01$) greater than that of the Renton Well catchment zone. The range of gradients determined from water level measurements over the period May 1987 to June 1988 within each catchment is summarized in Table 8.2 and on Figure 8.12 (see also Figure 5.10).

Although hydraulic gradients within the on-site (and slightly downgradient) catchment area of the Renton Well exhibited a slight correlation with pumping rates (Hart Crowser, 1987b), this correlation explained very little of the observed variation in gradients. This correlation was therefore not considered in the transport model, with the result that model

Table 8.2 - Summary of Selected Hydraulic and Water Quality Characteristics of the PACCAR Site

PARAMETER	UNITS	Discharges to Cedar River			Discharges to Renton Water Supply		
		Detection	Mean	Worst 95%	Detection	Mean	Worst 95%
PHYSICAL DATA:							
Hydraulic Conductivity	m/sec	19	2.81E-05	9.42E-05	19	2.81E-05	9.42E-05
Hydraulic Gradient	m/m	42	1.01E-02	1.97E-02	42	5.61E-03	1.12E-02
Aquifer Width	m	42	691	921	42	299	526
Aquifer Thickness	m	5	33	45	5	33	45
Receptor Discharge	m3/sec	-	2.58	1.46	12	0.36	0.22
Receptor Dilution	(by vol)	-	400:1	94:1	-	230:1	41:1
ON-SITE CHEMICAL DATA:	ug/L						
Metals:							
Arsenic		35/37	25	120	11/14	29	100
Chromium		11/56	2	7	3/14	4	20
Copper		19/48	2	10	6/13	6	22
Lead		22/57	7	19	4/14	7	30
Nickel		10/44	3	12	0/9	<2	<5
Silver		1/6	1	<10	0/0	-	-
Zinc		57/57	28	53	14/14	31	100
Volatiles:							
Benzene		10/68	3	19	0/14	<1	<2
1,2-Dichloroethane		1/68	1	3	0/14	<1	<2
Eth + Tol + Xyl (ETX)		10/68	103	1,300	2/14	4	22
Vinyl Chloride		14/69	9	75	0/14	<1	<4
Semivolatiles:							
Total PAHs		0/55	<4	<7	0/10	<4	<7
1,2-Dichlorobenzene		2/55	2	6	0/10	<2	<6
Hexachlorobenzene		0/55	<2	<4	0/10	<2	<4
Total PCBs		0/36	<0.1	<1	0/4	<0.1	<1
RECEPTOR CONTRIBUTIONS:	ug/L						
Metals:							
Arsenic			0.06	0.26		0.12	0.49
Chromium			0.01	0.02		0.02	0.09
Copper			0.00	0.02		0.03	0.12
Lead			0.02	0.06		0.03	0.12
Nickel			0.01	0.04		< 0.01	< 0.02
Silver			0.00	< 0.03		-	-
Zinc			0.07	0.32		0.14	0.57
Volatiles:							
Benzene			0.01	0.04		< 0.002	< 0.010
1,2-Dichloroethane			< 0.01	0.01		< 0.002	< 0.010
Eth + Tol + Xyl (ETX)			0.26	2.15		0.016	0.104
Vinyl Chloride			0.02	0.14		< 0.002	< 0.018
Semivolatiles:							
Total PAHs			< 0.005	< 0.022		< 0.009	< 0.038
1,2-Dichlorobenzene			0.005	< 0.019		< 0.004	< 0.028
Hexachlorobenzene			< 0.003	< 0.012		< 0.004	< 0.021
Total PCBs			< 0.0001	< 0.003		< 0.0002	< 0.004

predictions may conservatively overestimate site constituent contributions. No additional correlations of I with any of the other model parameters were observed.

Aquifer Width (W). Similar to the hydraulic gradient data discussed above, aquifer width was evaluated based on catchment boundaries determined from water level observations over the period May 1987 to June 1989 (Figure 5.10). The range of values is summarized in Table 8.2 and on Figure 8.13.

Aquifer Thickness (D). Aquifer thickness was based on five soil borings available for the site vicinity which encountered a regionally continuous aquitard. Based on these data, the total thickness of the aquifer beneath the PACCAR site is believed to be within the range of 20 meters (65 ft) to 50 meters (160 ft)(Figure 8.14). This range of thickness values was assumed (conservatively) to be representative of groundwaters which may contain elevated levels of identified site contaminants (Table 8.2).

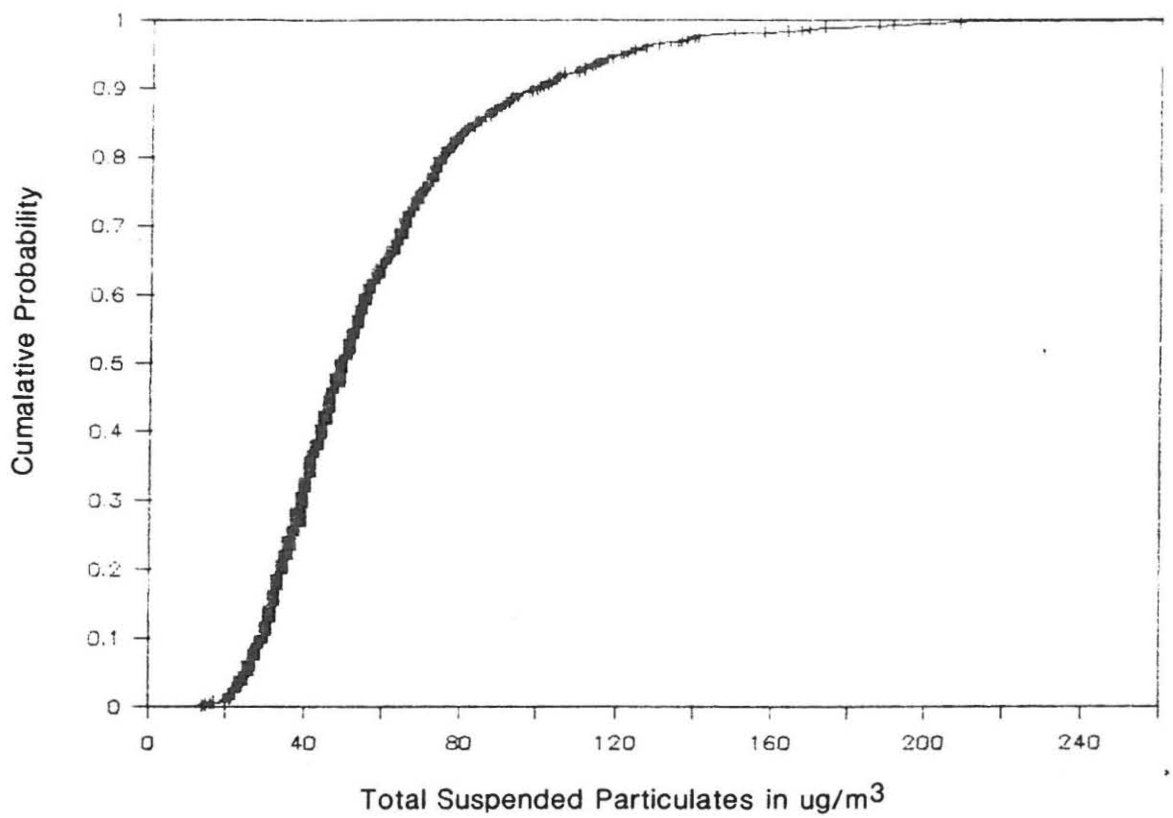
Receptor Discharge (Q). The remaining term of the mass balance formulation is receptor discharge. To assess potential constituent contributions to the Renton water supply system, this flow was based on monthly average pumping rates from the well field over the period July 1987 to June 1989 (Figure 8.15 and Table 8.2). The average pumping rate over this period was approximately half of the existing water right (11,400 gpm) rate.

Discharge in the Cedar River varies widely over the year in response to seasonal runoff patterns, upstream reservoir releases, and water supply withdrawals (primarily from the City of Seattle diversion at Landsburg; METRO, 1982). Because low flow conditions may persist within the river for extended periods, for the purpose of performing conservative exposure estimates the average river flow utilized in the transport model was assumed to equal the historic median annual 1-day low flow at Renton of 2.6 m^3/sec (91 cfs; METRO, 1982). The lower bound (lower 5 percent) flow was based on the 7-day/10-year low flow of 1.5 m^3/sec (52 cfs). Model predictions based on these flows, therefore, refer to seasonal "worst-case" conditions of minimal river dilution.

Based on the parameter values and ranges discussed above, transport model predictions of constituent contributions to the Renton Well catchment and the Cedar River catchment were generated and are summarized in Table 8.2. The statistical range of each parameter value was also propagated through the model using first-order uncertainty methods and further assuming the data could be approximated by a normal (i.e., Gaussian) distribution (Cornell, 1973). The output of the first-order calculations is presented as the upper 95th percentile concentration at each receptor point, and provides a measure of the degree of confidence which can be place on model predictions. The validity of the first-order approximation was verified with Monte Carlo analyses performed on approximately ten percent of the model runs (based on actual data distributions; Shannon, 1975). In all cases the first-order calculations generated similar and conservatively high estimates of the mean and upper 95th percentile values, as defined by the Monte Carlo analyses.

The model predictions summarized in Table 8.2 form the basis for subsequent exposure and risk assessments from the PACCAR site. The calculated statistical range of contributions to the Renton water supply system and the Cedar River were utilized in these assessments, and are discussed in Section 9.0.

Renton Total Airborne Suspended Particulate Data



Plot based on PSAPCA (1988) for 1978 through 1987 data.

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Figure 8.1

Depth Distribution of Arsenic in Groundwater

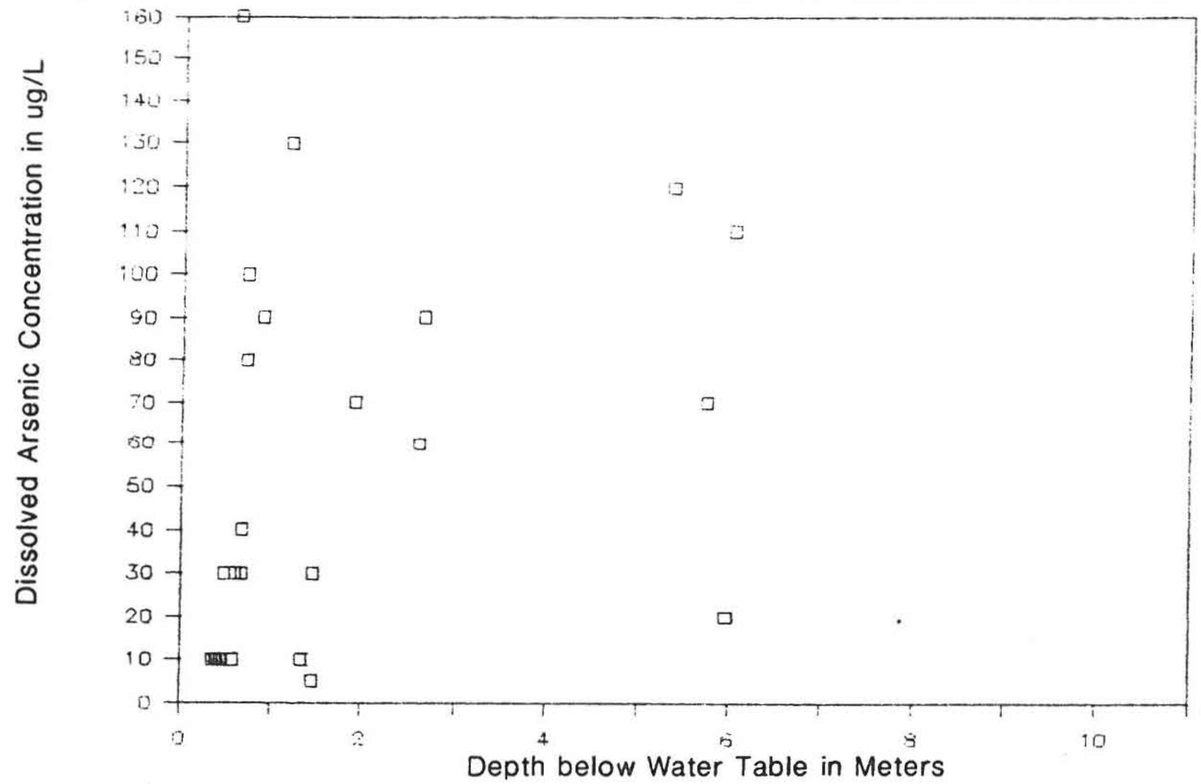

Figure 8.2

Depth Distribution of Lead in Groundwater

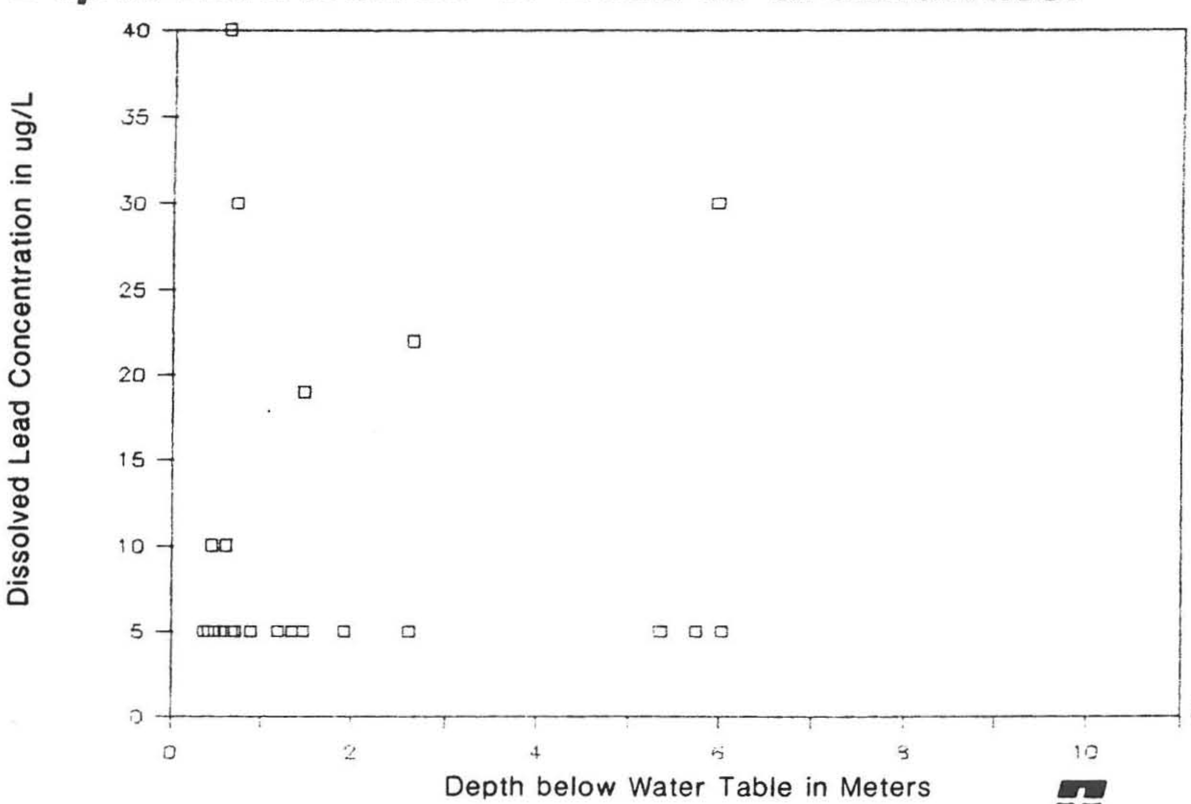

Figure 8.3

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Depth Distribution of Benzene in Groundwater

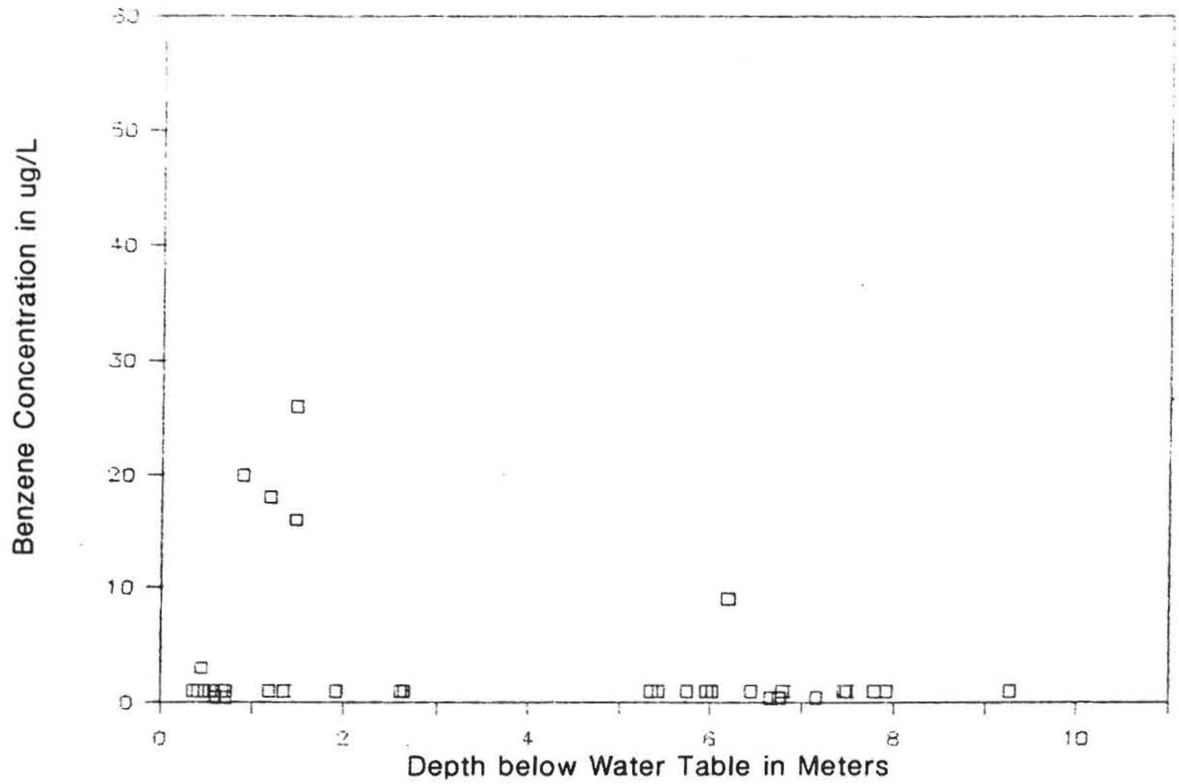

Figure 8.4

Depth Distribution of Vinyl Chloride in Groundwater

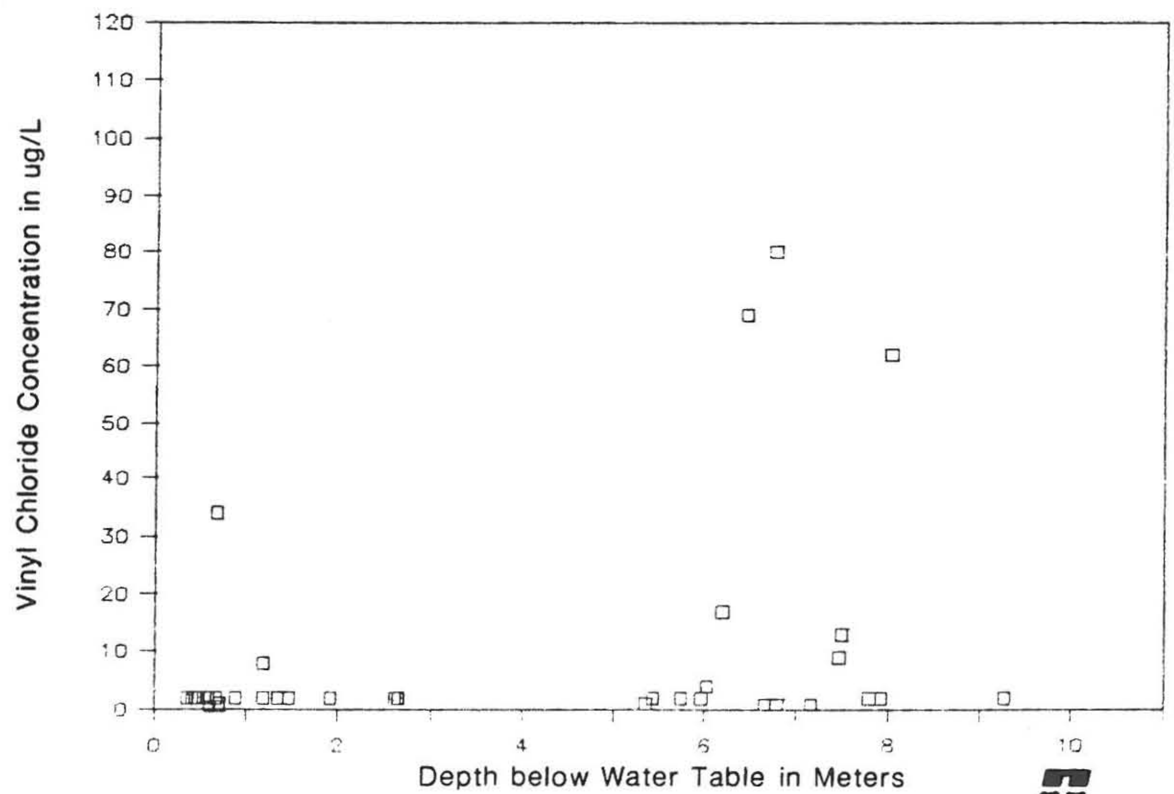

Figure 8.5

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Statistical Summary of Dissolved Arsenic Concentrations in Groundwater

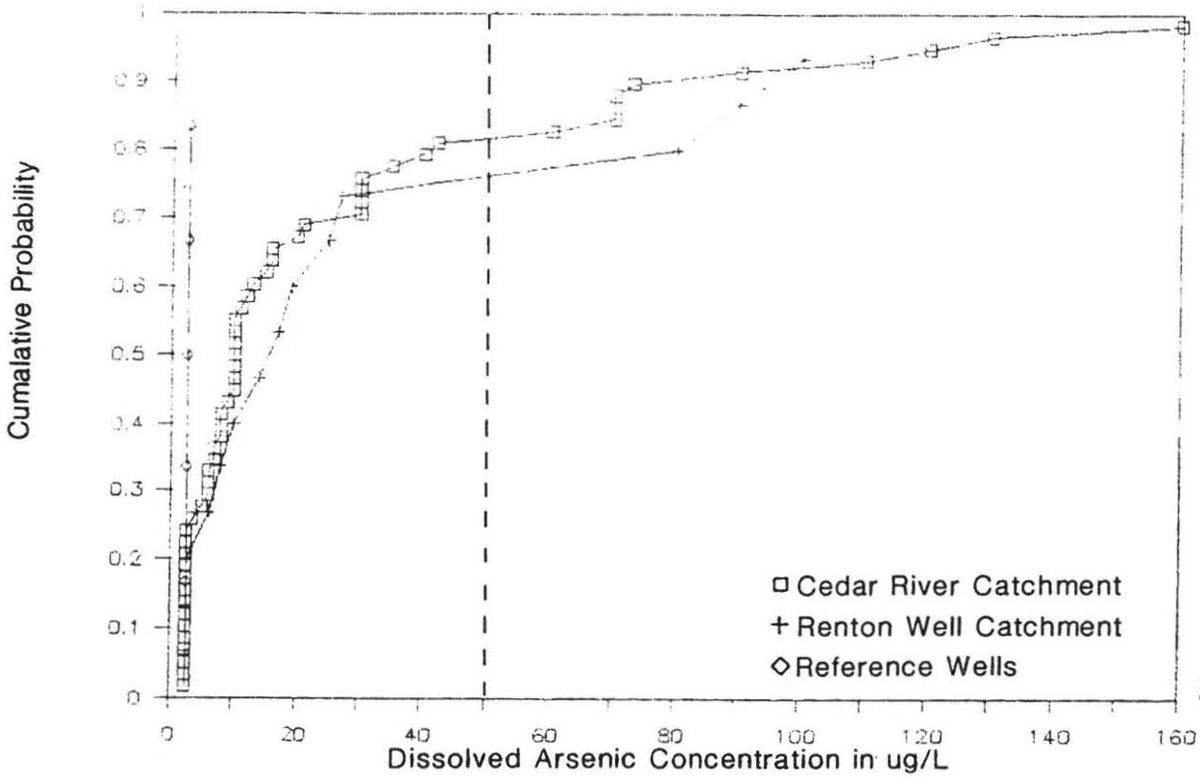

Figure 8.6

Statistical Summary of Dissolved Lead Concentrations in Groundwater

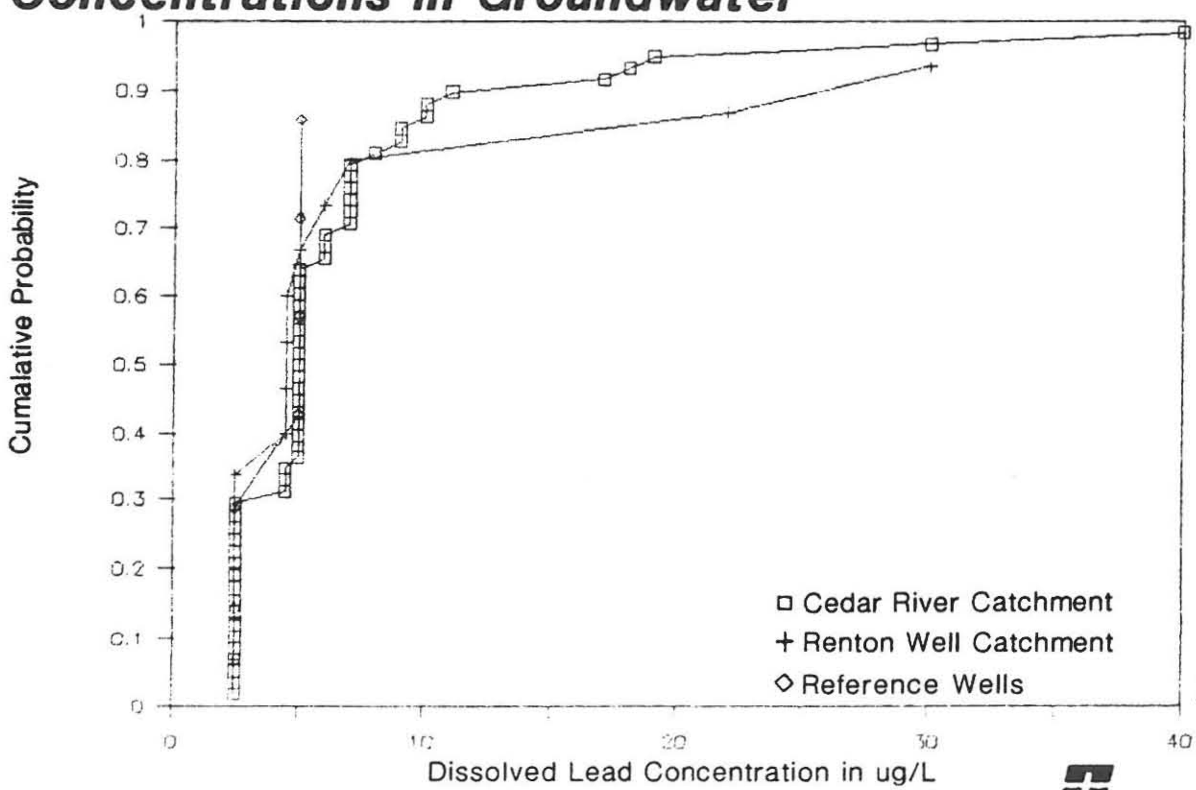

Figure 8.7

Statistical Summary of Benzene Concentrations in Groundwater

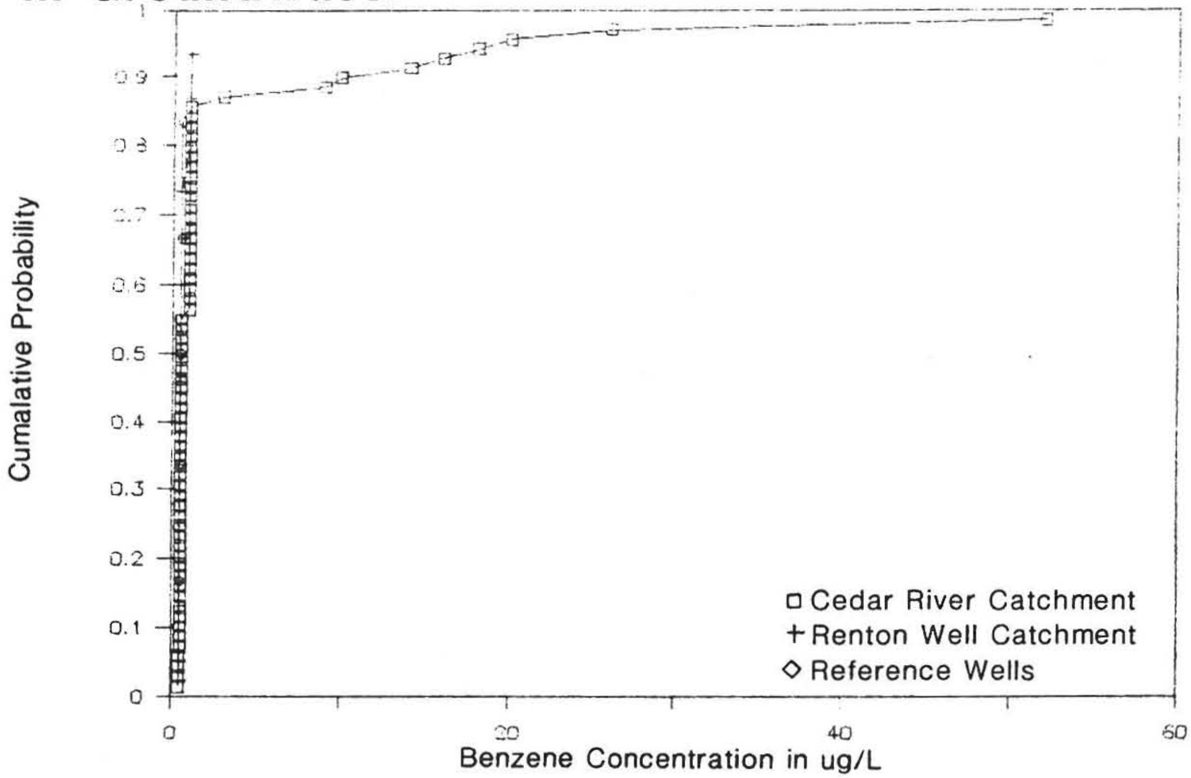

Figure 8.8

Statistical Summary of Toluene +Ethylbenzene +Xylene Concentrations in Groundwater

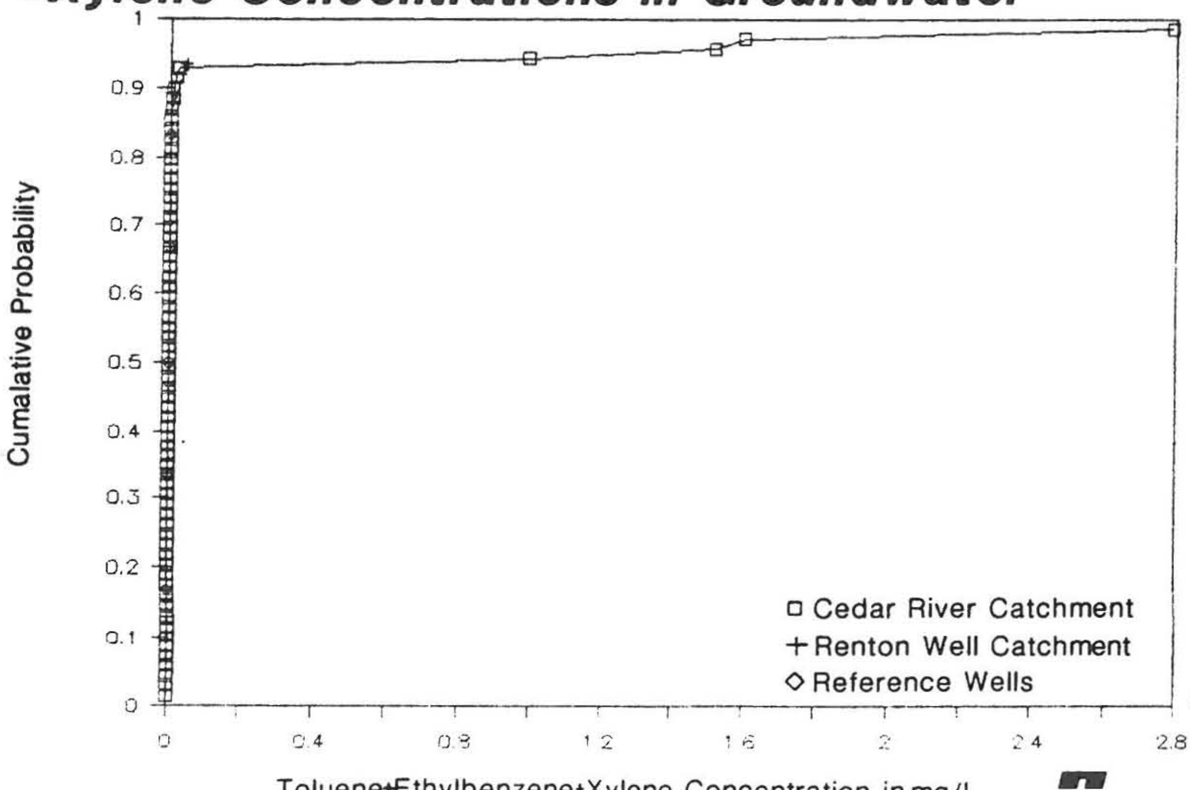

Figure 8.9

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Statistical Summary of Vinyl Chloride Concentrations in Groundwater

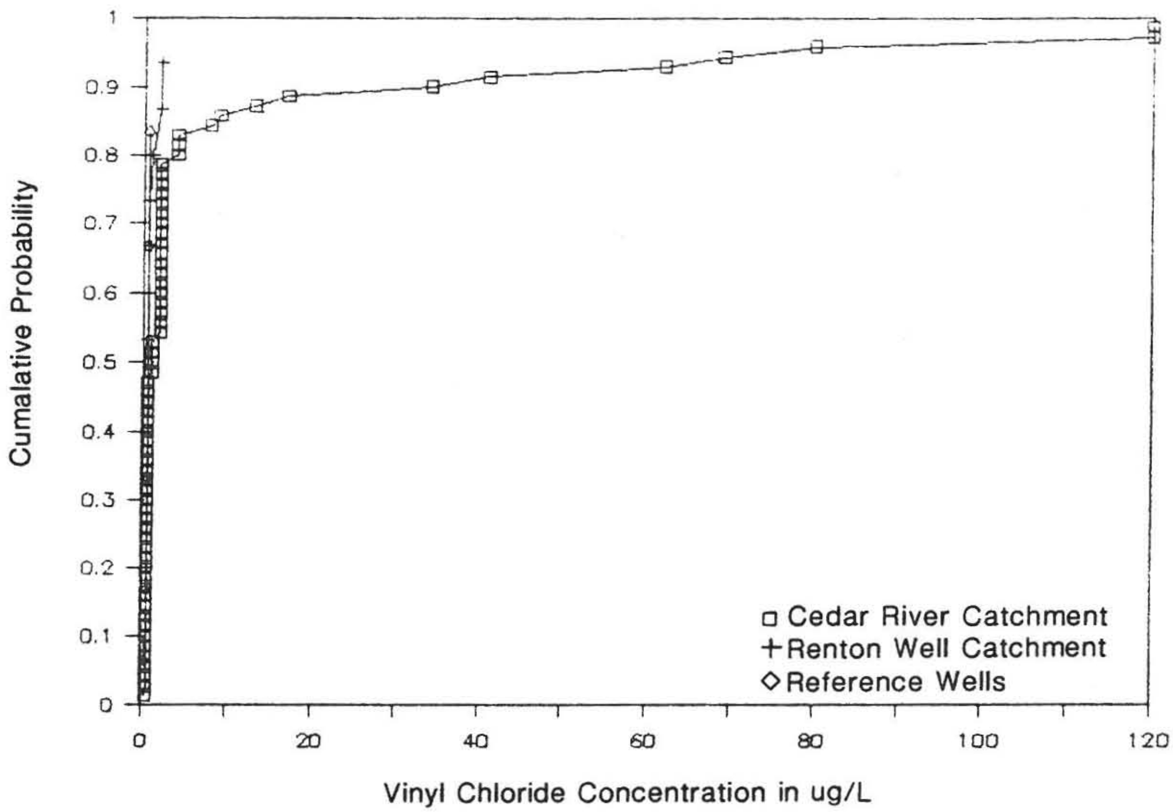

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Figure 8.10

Statistical Summary of Hydraulic Conductivity Data

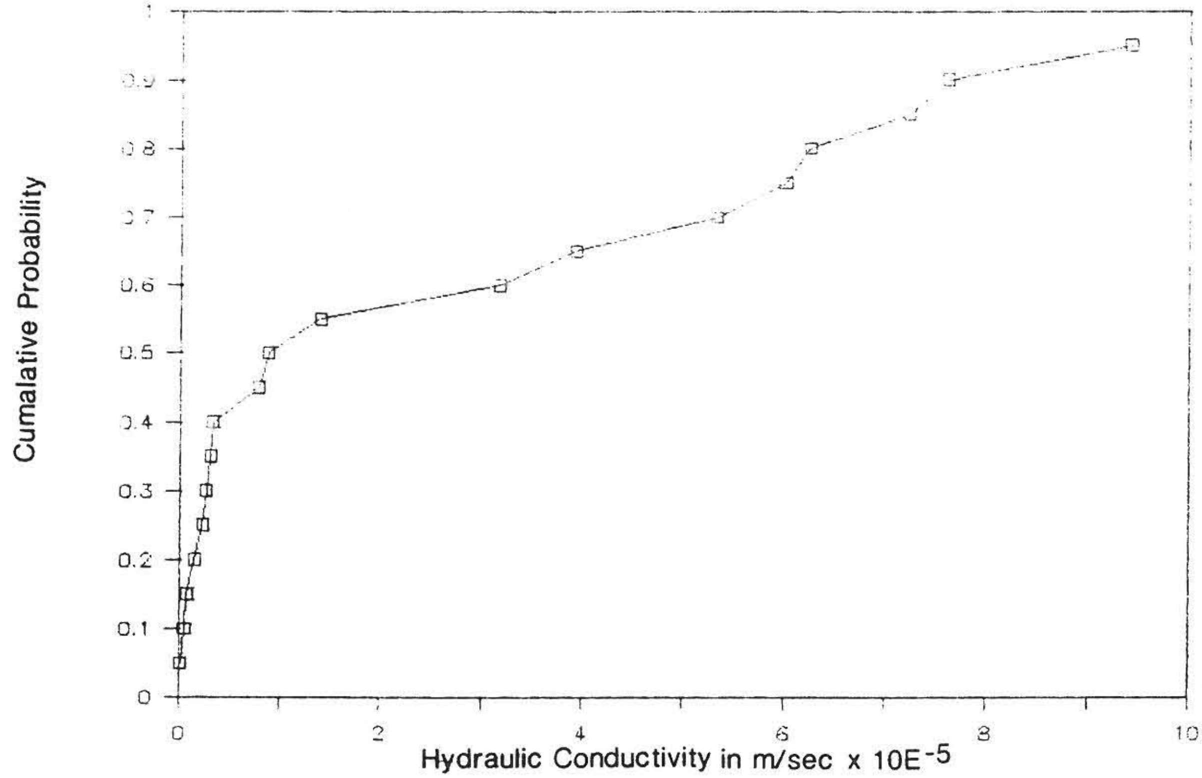

Figure 8.11

Statistical Summary of Hydraulic Gradient Data

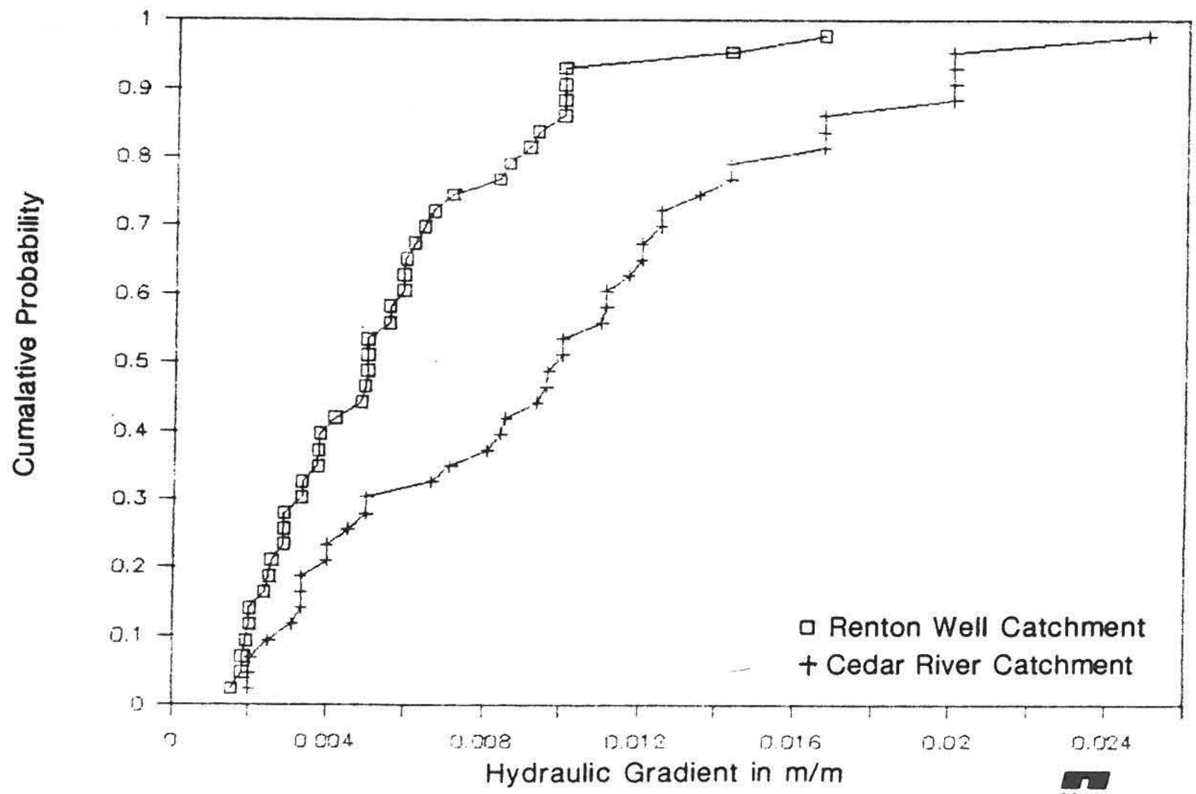

Figure 8.12

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Statistical Summary of Aquifer Width Data

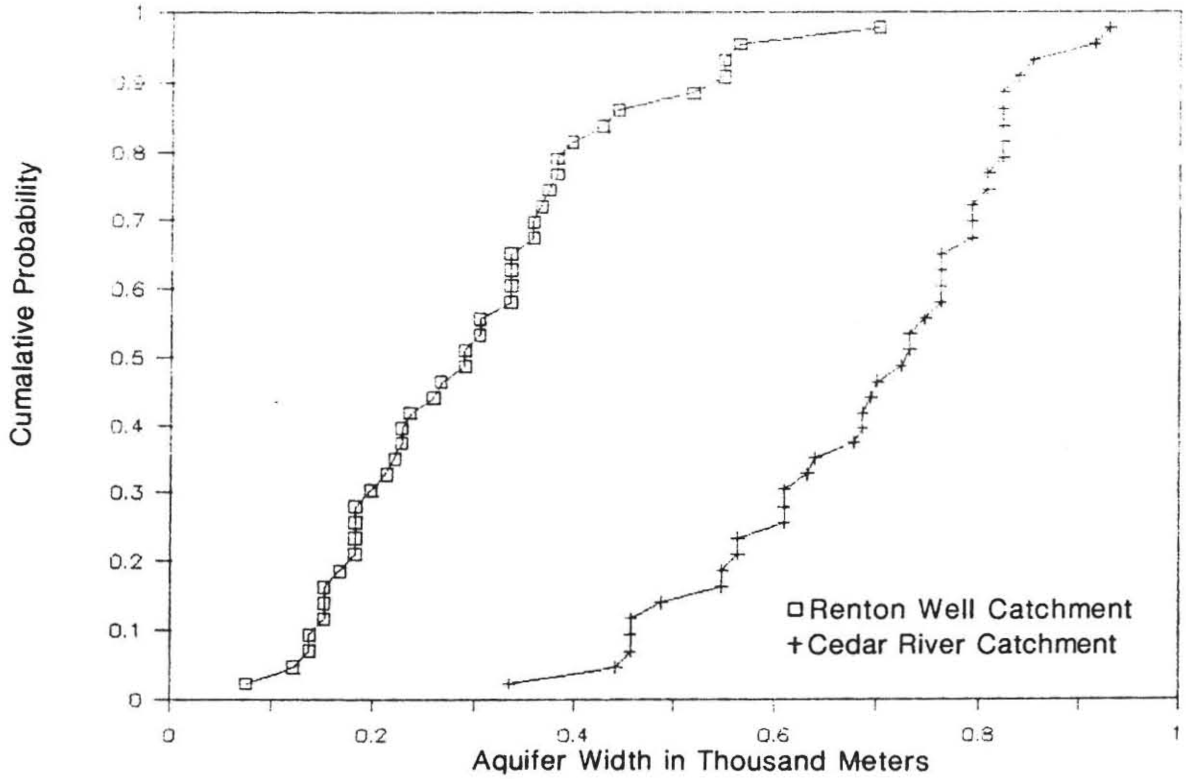


Figure 8.13

Statistical Summary of Aquifer Thickness Data

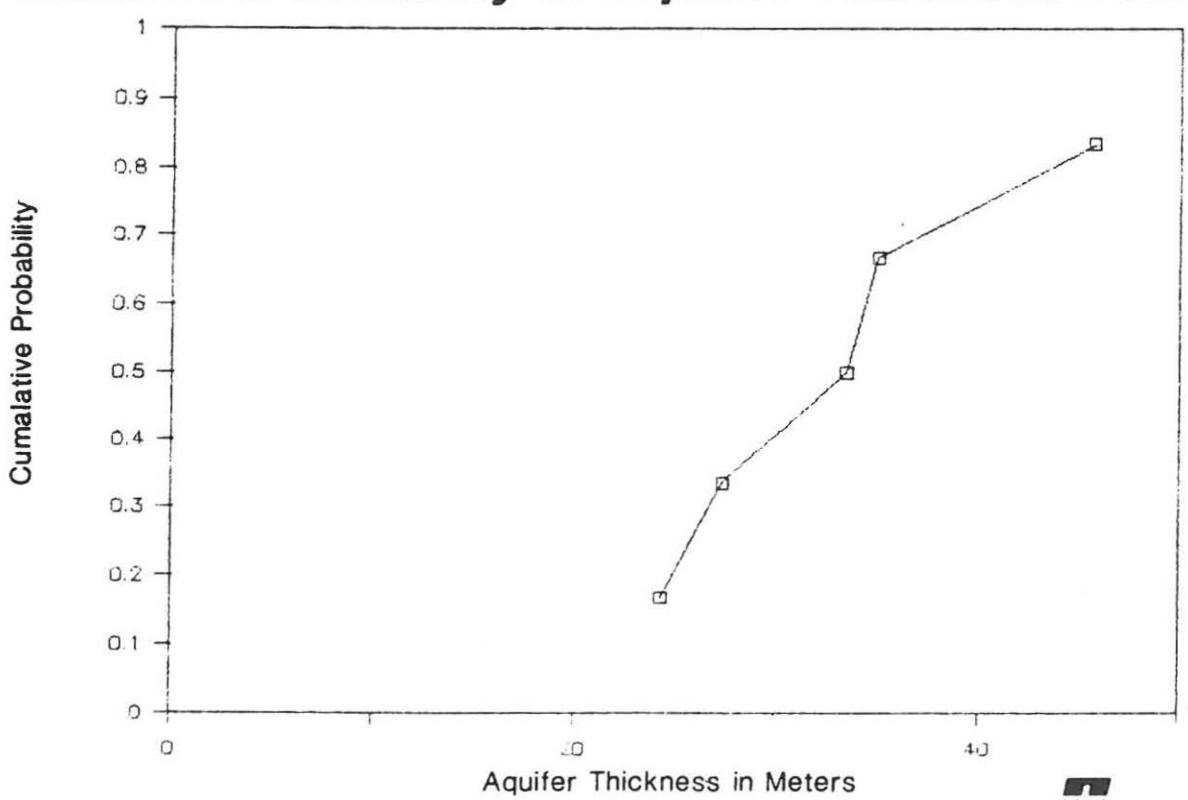
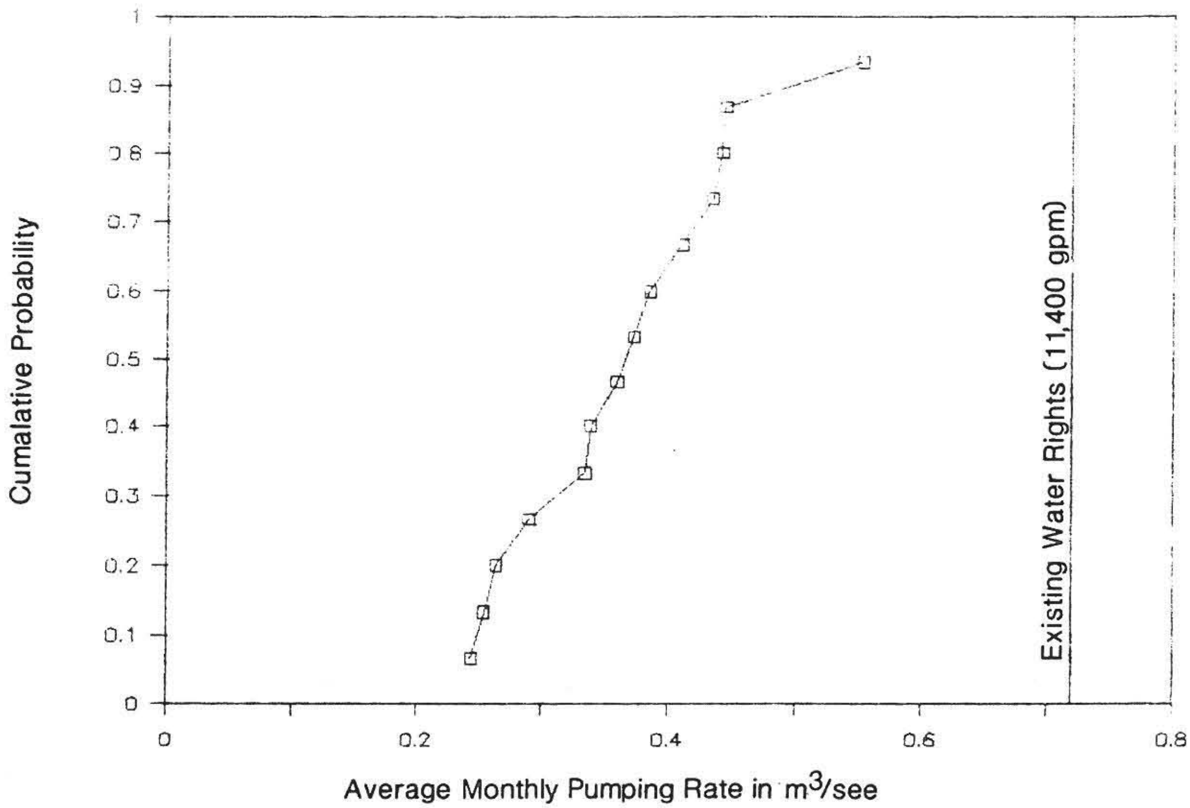


Figure 8.14

Renton Well Field Monthly Pumping Rates



Pumping rate average based on July 1987 through June 1988 data for all wells in Renton well field.

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Figure 8.15

9.0 BASELINE RISK ASSESSMENT

9.1 EXPOSURE ASSESSMENT

In this section, each source, pathway, and receptor of exposure to each indicator chemical is evaluated and compiled to assess the cumulative total potential human exposure to site contaminants of concern. The exposure assessment produces a range of chemical doses to the receptor population which are subsequently compared with available toxicological criteria to evaluate risk.

It should be noted that the identified risks would only be present under the assumed exposure conditions. In many cases the assumed conditions have little realistic chance of occurring. In most cases, the assumed exposure scenarios represent maximum exposure (and risk) conditions. These conservative exposure assumptions were used to be consistent with available EPA guidance and at the request of Ecology. In addition, the assessment is based on assumed conditions if no remediation is conducted. Many risks will be substantially mitigated if remediation takes place.

9.1.1 Populations at Risk

The population which would be at greatest risk from exposure to chemicals of concern, if these chemicals are not properly controlled at the PACCAR site, is made up of individuals who work at the site and/or who live within the vicinity of the facility. Such individuals may potentially be exposed to site contaminants through a variety of pathways, including:

- Dermal (skin) contact;
- Incidental soil ingestion;
- Inhalation of dusts and vapors;
- Consumption of drinking water (from the Renton Aquifer or hypothetical domestic wells);
- Consumption of fish harvested from the Cedar River or Lake Washington; and
- Water-related recreational activities in nearshore areas of Lake Washington.

Each of these pathways are discussed in detail in the following sections.

Because the site was used as an industrial facility and is intended to remain in this land use, adult workers are the primary population of concern. Although children may potentially be exposed to site contaminants through off-site inhalation and water/fish consumption pathways, children and other unauthorized personnel are prevented from access to the site by a perimeter fence. Restricted access to the site facility will continue into the foreseeable future.

This risk assessment follows recent EPA guidance by focusing on the "most exposed individual (MEI)". Specific aspects of the MEI assumption are discussed in more detail below.

9.1.2 Exposure Factors

This section presents the development of each exposure factor used in the risk assessment. The MEI is identified, and the equation for calculating exposure presented. The statistical derivation of exposure values is discussed.

Statistical Considerations

This section follows EPA (1986a, 1988e, 1989b) recommendations by calculating exposure for target MEI populations under average as well as upper-bound conditions. Upper-bound exposures were evaluated using the predicted probabilistic upper 95th percentile condition. The probabilistic upper-bound represents a statistical estimate of the upper 95th percentile exposure, out of a distribution of potential exposures, based on methodologies outlined in Appendix I.

For screening purposes, "Theoretical" upper bound exposure was also estimated which assumed that the maximum of all measurements which formed the basis of the exposure calculations occur to the MEI simultaneously. After this screening analysis, selected parameters were further evaluated using the average and upper-bound probabilistic conditions.

Calculations of exposure require as input, information on the arithmetic average, probable upper-bound, and data distribution of a wide variety of exposure factors. For factors such as on-site chemical quantifications (e.g, surficial soil concentrations), these data are obtained directly from the Remedial

Investigation data presented earlier in this report. Data on factors such as soil adherence to skin are obtained from published investigations in the scientific literature. For still other factors (e.g., dermal absorption), sufficient data to define statistical characteristics are lacking, necessitating the use of data approximations or best professional judgement to proceed with the calculations. These "judgement factors" are recognized by EPA as necessary to construct the quantitative risk assessment required under CERCLA (EPA, 1986a, 1988e, 1989a, 1989b).

The present quantitative limitations of the exposure and risk assessment need to be understood by those involved with the decision making process. EPA recognizes these limitations in the available guidance documents (EPA, 1986a, 1988e, 1989a, and 1989b), and recommends that uncertainty analyses be included as a component of every risk assessment. This risk assessment goes beyond the standard **qualitative** uncertainty analyses required by EPA, and includes **quantitative** measures of variability and uncertainty of the exposure and risk estimates.

In all cases, the first step in the exposure assessment (and associated uncertainty analysis) is the determination of the probable range of each exposure factor utilized in the assessment. This information is developed and presented in the sections below, organized by exposure pathway. A discussion of the algebraic or computational methods used to propagate the various identified uncertainties through the exposure assessment is discussed in Subsection 9.1.3 of this report, and also in Appendix I.

Dermal Contact

Dermal absorption resulting from skin contact with soils may be a potentially important exposure pathway for some chemicals, particularly organic compounds. We have included this route in the PACCAR Renton site risk assessment, incorporating conservative assumptions to account for uncertainties in exposure estimates.

Most Exposed Individual (MEI). As discussed above, exposure conditions assumed in this risk assessment were based on a MEI scenario. For the adult MEI who works at the site, activities leading to potential soil contact (e.g., trenching operations) were assumed, although highly unlikely, to be a major and regular component of that individual's occupational responsibilities. For the childhood MEI, no dermal contact exposures were assumed to occur, due to restricted site access under the present and planned future facility operations.

In deriving estimates of dermal exposure, consideration is given to the following parameters specific to the MEI scenario: frequency and duration of soil contact, exposed dermal surface area, soil adherence rate, soil contaminant concentration, and dermal absorption rate. These factors, with their associated uncertainty, provide the basis for exposure estimates via the dermal route. The equation which describes dermal contact exposures is discussed by EPA (1989a) and may be generalized as follows:

DERMAL = FREQ x AREA x ADHERE x CONC x ABSORP

where:

DERMAL = Dermal Contaminant Exposure in mg/day
FREQ = Contact Frequency in hours/day
AREA = Exposed Skin Area in cm^2
ADHERE = Soil Adherence Rate in mg/cm^2-hour
CONC = Soil Contaminant Concentration (by wt)
ABSORP = 24-hour dermal absorption (by wt)

Dermal exposure estimates are converted into lifetime dose equivalents using the following equation:

DOSE = DERMAL x TIME / (WEIGHT x LIFE)

where:

DOSE = Lifetime Contaminant Dose in mg/kg-day
TIME = Duration of Exposure in years
WEIGHT = Body Weight of the Individual in kg
LIFE = Lifetime of the Individual (75 years)

The rationale for selection of each numeric factor used in the exposure calculation (including the statistical range) is discussed below.

Frequency of Soil Contact. The adult MEI scenario was based upon the assumption that an individual's occupational responsibilities include regular exposure to site soils. Estimates of the frequency of such soil contact were based on published estimates of work activity patterns (EPA, 1989a). These estimates also considered a compiled summary of soil contact frequencies for standard industrial activities, as recommended for use in risk assessment by EPA Region 10 (EPA, 1989b).

The average amount of time that adult males between the ages of 18 and 44 engage in normal occupational work activities is 40.5 hours per week (EPA, 1989a - citing University of Michigan, 1976). Based on the reported Gaussian standard deviation for such activities of 14.5 hours/week, the upper 95th percentile work week for this group of individuals is 64.3 hours/week. These data are equivalent to average and 95th percentile daily (uncontrolled) exposure frequencies of 5.8 hours/day (24 percent) and 9.2 hours/day (38 percent), respectively. These values may be used as conservative statistical estimates of potential soil contact frequency, assuming that all work activities of the MEI may lead to soil contact. Based on actual maintenance excavation operations at Renton and other truck plants, soil excavations are sporadic and would not exceed an average of 2 to 4 hours per week for any single individual. The potential exposure frequency data summarized by EPA, therefore, represents a conservative overestimate of actual exposures to site soils.

Based primarily on a consideration of activity patterns as summarized by EPA (1989a; and discussed above), EPA Region 10 developed estimates of potential soil contact exposure frequencies for use in risk assessment (EPA, 1989b). For an industrial site use scenario, the recommended average and upper-bound exposure frequencies were 25 percent and 40 percent, respectively. These percentages are similar to the average and upper 95 percentile values discussed above.

The assumed lifetime duration of dermal exposures under the adult MEI scenario was based on EPA Region 10 compilations for an industrial site use condition (EPA, 1989b). Based on an assessment of data available on the mobility of the U.S. work force, EPA (1989b) concluded that the average length of time that an individual may be employed at a given job is approximately 10 years. The upper-bound duration recommended for risk assessment purposes is approximately 40 years, assuming that the MEI remains employed at that job from age 20 to age 60. Again, under the MEI scenario, this individual is conservatively assumed to regularly and continually perform activities in the course of this work which would lead to soil contact. Assuming that the underlying distribution of exposure duration is normal (Gaussian), and that EPA's (1989b) upper-bound estimate of 40 years approximates the upper 95th percentile condition, the resultant standard deviation for duration of exposure is approximately 18 years. The current life expectancy for an individual born today is approximately 75 years (EPA, 1989a - citing U.S. Bureau of Census, 1986).

Exposed Dermal Surface Area. Exposed surface area has been relatively well characterized for adults (and children) by total body area and individual body parts (EPA, 1989a). For the average exposure condition, we assumed soil contact with the head, hands, and forearms of the adult MEI. This scenario is based on the condition that a worker wears a short-sleeved shirt, no gloves or hat, and that the clothing worn gives complete protection to the skin areas covered (Hawley, 1985). Based on data summarized by EPA (1989a), the average exposed skin area under this condition is 0.33 m^2. A similar estimate was recommended by EPA (1989b) to calculate risks associated with average dermal exposures to contaminated soil under an industrial site use condition.

For the upper-bound exposure scenario, exposure of the head, hands, arms (total), lower legs, and feet is assumed for the adult MEI, as recommended by EPA (1989b). The exposed skin area under such a conservative condition is 0.83 m^2 (EPA, 1989a). Assuming that the underlying distribution of exposed skin area is normal (Gaussian), and that the 0.83 m^2 upper-bound estimate approximates the upper 95th percentile condition, the resultant standard deviation for exposed skin area of the MEI is approximately 0.30 m^2.

Soil Adherence Rate. The adherence of soil onto skin is necessary to facilitate the dermal transfer of contaminants. This adherence is known to be dependent upon a variety of factors, including particle size and moisture content of the soil material (Hawley, 1985; EPA, 1988e; Versar, 1989). Generally, smaller sized particles such as clays exhibit a greater tendency for adherence to the skin than coarser particles such as sands. Behavioral patterns such as hand washing and showering also determine the soil adherence rate, since such activities reduce the amount of time that soil is in contact with the skin.

Two different types of soil and dust adherence factors have been reported in the available literature. The first type of observation is a simple "adherence factor" measurement of total particulate material removed from a known area of skin. Only data for hand areas have been reported in the literature. Measurements have been conducted on children in uncovered dirt playgrounds (Lepow et al., 1974; Roels et al., 1980; Que-Hee, 1985), and for adults handling various soil materials (e.g., potting soil and kaolin; EPA, 1988e - citing Harger, 1979; Versar, 1989). Reported soil adherence factors range from 0.2 to 2.8 mg/cm^2.

A second type of adherence estimate is available from studies of solids accumulation on the skin of workers in highly dusty environments (e.g., total suspended particulate levels above roughly 10,000 ug/m^3). These studies have reported dust accumulation rates on head, hand, and forearm areas of workers. The reported measurements range from less than 0.006 to 0.032 mg/cm^2-hour (based on Hawley, 1985 - citing Wolfe and Armstrong, 1971 and Wolfe et al., 1978). Although the dust adherence data do not specifically address primary contact exposures (e.g., to hands in contact with soil), these data do provide a reasonable estimate of secondary soil adherence to other body parts (e.g., head areas) resulting from soils suspended into the air during exposure activities.

To permit an evaluation of soil adherence rates using all available data, the adherence factor estimates (first type) discussed above must be adjusted by the exposure period which preceded the measurements. Unfortunately, these data were not generally reported in the original articles and reports. For the purposes of this risk assessment, and to be consistent with the average 8-hour per day exposure period discussed above for the MEI, an average antecedent exposure period of 8 hours was assumed for all reported field adherence factor data and laboratory data collected under simulated field conditions (Lepow et al., 1974: Roels et al., 1980; Que-Hee, 1985; Versar, 1989). The field accumulation rates normalized in this manner ranged from 0.025 to 0.0.075 mg/cm^2-hour, and were generally somewhat higher than the reported dust accumulation rates discussed above. Results of laboratory studies performed under aqueous conditions (i.e., Harger, 1979) were not considered comparable to the field adherence rate estimates.

Based on the average values derived from the six different field studies discussed above, and presented on Figure 9.1, the arithmetic average *in situ* adherence rate is approximately 0.039 mg/cm^2-hr. The six data points approximate a normal (Gaussian) distribution, although too few data exist to reliably assess the best fit of the underlying distribution. Using Gaussian t-statistic methods as described in Appendix I, the estimated upper 95th percentile rate is 0.093 mg/cm^2-hr. These data represent the best information available at the time of this report, and were therefore utilized in the PACCAR baseline risk assessment.

Soil Concentration. The chemical concentration assumed to be present in adhered soils, and thus available for dermal absorption, was based on analyses of potentially exposed near-surface soils collected over the top 2.5 feet of the PACCAR site. These data were presented previously (Sections 6 and 8). Overall, use of potentially exposed near-surface soil data results in (conservatively) higher exposure estimates than if the calculations were performed including data from deeper strata or covered areas.

The statistical distribution of soil concentration data for the constituents of concern identified at the PACCAR Renton site was generally log-normal (Figure 9.2). Accordingly, the upper 95th percentile values were calculated based on the **higher** of the log-normal (t-statistic) or empirical estimates, as discussed in Appendix I. Mean concentration values were calculated directly as arithmetic averages of the data. For indicator chemicals which were not detected in at least one on-site soil sample, the average concentration was assumed to be zero, and the upper-bound value was estimated at the maximum reported detection limit.

Dermal Absorption. Dermal absorption of chemicals is a relatively complex area of exposure assessment. A number of complexities are involved in this route of exposure which have not yet been clearly delineated. Thus, this exposure factor has a higher level of associated uncertainty than other factors. We have used absorption factors based on empirical studies of chemical behavior wherever possible. Theoretical modifications of these estimates for individual compounds using physical or chemical properties such as molecular weight, lipophilicity, and octanol/organic carbon partitioning data have not been well developed at this time.

The reported dermal absorption of chemicals applied directly to the skin of humans and other mammals span a wide range. Absorption rates of 21 pure organic compounds were shown to range over one-thousand fold (Feldman and Maibach, 1970). Compounds with the highest reported absorption rates include benzoic acid and caffeine. Bartek et al. (1972) correlated differences in skin absorption to the heptane:water partition coefficient of the compounds. However, caffeine was an exception to this pattern, as it readily penetrated the skin despite its lower partition coefficient. Caffeine is an example of a highly lipophilic and water soluble compound.

Dermal absorption of chemicals present in a soil or dust matrix on the skin spans an even greater range than direct absorption of pure chemicals. Chemical bonding and physical incorporation of compounds with the soil matrix complicates the analysis of dermal transfer. As a result, compounds with a known direct dermal absorption rate may be absorbed from soils at a very different rate. A summary of dermal absorption rates reported for various types of soil contaminants is presented below.

Metals. Metals in the soil matrix are primarily present in a complexed form which provides relatively strong, stable bonds. EP Tox tests can provide an estimate of the amount of non-complexed metal (acid extractable) which is potentially bioavailable for dermal absorption (Ryan et al., 1987). In addition, because of the relatively high solids affinity and low fat solubility of metals, the dermal transfer rate is generally much lower than those of organics (liquid mercury is an exception).

Based on a review of available data, Ryan et al. (1987) concluded that dermal absorption rates of soil-bound metals may range from approximately 0.1 to 1.0 percent. The time period allowed for absorption was 24 hours or greater, which would provide a conservative estimate of actual absorption under field conditions (e.g., due to washing). EP Tox measurements performed at the PACCAR Renton site indicate that this range of absorption rates is conservative, since less than 0.1 percent of all metals analyzed were extractable under EP Tox conditions (see Section 7).

An approximate average 24-hour dermal absorption rate based on data reviewed by Ryan et al. (1987) is roughly 0.2 percent. Assuming that the underlying distribution of these data is normal (Gaussian), and that the 1.0 percent upper-bound estimate approximates the upper 95th percentile condition, the resultant standard deviation for dermal absorption of metals is approximately 0.5 percent.

Volatile Organics. Volatile organics do not exhibit much affinity to organic matter and thus tend to be more "available" in the soil matrix. In addition, volatile organics have relatively high lipid solubilities and corresponding high reported direct dermal absorption rates.

Ryan et al. (1987) suggests a range of absorption of volatile organics from the soil matrix of 10 to 25 percent based on pharmacokinetic data. We have adopted this range, estimating an average of 15 percent. The corresponding standard deviation of these data is 6 percent.

Semivolatile Organics. For general semivolatile organic chemicals and pesticides, the rate of dermal absorption from soil is dependent upon the physical/chemical characteristics which define the propensity of a given compound to desorb from the soil and enter the skin. In general, lipid soluble compounds exhibit a greater degree of dermal absorption, although the "competitive" effect of soil bonding may complicate this relationship.

The effect of the chemical matrix on dermal absorption rates was observed in studies by Poiger and Schlatter (1980). They demonstrated that mixtures of organic chemicals within an activated carbon/water paste reduced the absorption rate by over 97 percent. Their work also demonstrated the difference between dermal absorption from a methanol solution and absorption from a soil/water paste. Chemical sorption of non-polar organic chemicals to the soil complex resulted in an 85 percent reduction in the measured dermal absorption rate.

Dermal absorption of soil-bound chemicals over a 24-hour period has been reported for several semivolatile organic chemicals. For a variety of semivolatile organic compounds, the range of absorption is estimated to be 1 to 10 percent (Kimbrough et al., 1984; and Ryan et al., 1987). Dermal transfer of PCBs under average and reasonable worst-case scenarios were estimated at 1 percent and 5 percent, respectively (EPA, 1986e). Similarly, HPAHs have been estimated to have an upper-bound absorption rate from dusts and soils of approximately 6 percent (Heidelberger and Weiss, 1951 and Poiger and Schlatter, 1980).

Based on the available empirical and theoretical data, the arithmetic average and upper 95th percentile absorption rates for semivolatile organic compounds were estimated at 2 percent and 10 percent, respectively. Assuming that the underlying distribution of these data is normal (Gaussian), the resultant standard deviation for dermal absorption of these compounds is approximately 5 percent.

Body Weight. The final term of the exposure and dose equation presented above is body weight. For the adult MEI, body weight was based on statistical summaries of adults between the years of 18 and 75 (EPA, 1989a). Based on these data, the average adult weighs 71.8 kg (158 lbs). The lower 5th percentile body weight of approximately 52.2 kg (115 lbs) was used to describe worst-case conditions leading to a higher chemical dose (see equation presented above). The body weight data are normally distributed (Figure 9.3).

Soil Ingestion

Incidental ingestion of soil is often a primary route of exposure to chemicals in soil. The adult MEI may ingest small amounts of soil as a result of hand-to-mouth behavioral patterns which may follow earth moving or other soil contact activities. We have included this route in the PACCAR Renton site risk assessment, incorporating conservative assumptions to account for uncertainties in exposure estimates.

Most Exposed Individual (MEI). The MEI scenario for soil ingestion was assumed to be identical to that described above for dermal absorption exposures.

In deriving estimates of soil ingestion exposures, consideration is given to the following parameters specific to the MEI scenario: frequency and duration of soil exposure, soil ingestion rate, soil contaminant concentration, and internal (gastrointestinal) absorption rate. These factors, with their associated uncertainty, provide the basis for exposure estimates via this route. The equation which describes soil ingestion exposures is discussed by EPA (1989a) and may be generalized as follows:

INGEST = FREQ x CONSUM x CONC x ABSORP

where:

INGEST = Soil Ingestion of Contaminant in mg/day
FREQ = Exposure Frequency in hours/day
CONSUM = Soil Ingestion Rate in mg/hour
CONC = Soil Contaminant Concentration (by wt)
ABSORP = gastrointestinal absorption (by wt)

Soil ingestion exposure estimates are converted into lifetime dose equivalents using the following equation:

DOSE = INGEST x TIME / (WEIGHT x LIFE)

where:

DOSE = Lifetime Contaminant Dose in mg/kg-day
TIME = Duration of Exposure in years
WEIGHT = Body Weight of the Individual in kg
LIFE = Lifetime of the Individual (75 years)

The rationale for selection of each numeric factor used in the exposure calculation (including the statistical range) is discussed below.

Frequency of Soil Exposure. The daily frequency and lifetime duration of soil ingestion exposures under the MEI scenario was assumed to be identical to that described above for dermal absorption exposures. The average and upper 95th percentile exposure frequencies for the MEI are 5.9 hr/day and 9.2 hr/day, respectively. The average and upper 95th percentile duration of such exposures was assumed to be 10 years and 40 years, respectively.

Soil Ingestion Rate. Empirical data on the ingestion rate of soil have only been reported for young children between the ages of 1 to 6, since such children are considered most likely to ingest soil (Binder et al., 1986; Clausing et al., 1987; EPA, 1989a - citing numerous other literature sources). Soil ingestion by adults is generally considered to occur at some fraction of the rate of young children.

Of the two empirical studies reviewed by EPA (1989a) which have examined soil ingestion rates of nursery school-aged children, the investigation reported by Clausing et al. (1987) is considered the most defensible, since the authors examined both test and control populations in their study. A statistical summary of their results (corrected for controls) is presented on Figure 9.4. The average and upper 95th percentile soil ingestion rates based on their data are 130 mg/day and 610 mg/day, respectively. The data approximate a log-normal distribution. If these data are adjusted to account for an approximate average 8-hour period that children of this age class may play outdoors (Hawley, 1985; EPA, 1989a), the resultant average and upper 95th percentile *in situ* hourly soil ingestion rates for children are 16 mg/hr and 76 mg/hr, respectively.

Although no empirical investigations of adult soil ingestion rates have apparently been conducted to date, several studies have estimated a range of potential ingestion rates which may apply to adults involved in a variety of activities (Hawley, 1985; LaGoy, 1987; EPA, 1989a - citing Calabrese, et al., 1987). These estimates have been based primarily on considerations of soil adherence to hands (see Dermal Contact Exposure discussion above) and hand-to-mouth behavioral characteristics.

Hawley (1985) reasoned that an adult working outdoors for an extended period (8 hours) may be assumed to ingest a quantity of soil corresponding to the inside surface of the fingers and thumbs of both hands. Given a surface area of these extremities of approximately 150 cm^2, and the average soil adherence to hands of 0.42 mg/cm^2 under field and simulated field conditions (Lepow et al., 1974; Roels et al., 1980; Que-Hee, 1985; Versar, 1989), the resultant soil ingestion rate is approximately 62 mg/day, or 7.8 mg/hr. LaGoy (1987) and Calabrese et al. (1987) argue that this rate should be viewed as an upper-bound (worst-case) value, and not representative of average ingestion.

For the purposes of this assessment, the 7.8 mg/hr rate derived above was assumed to represent the upper 95th percentile value of adult soil ingestion. If a similar data distribution is assumed between adult and childhood soil ingestion rates (see Figure 9.4), then the average adult soil ingestion rate would be equal to 7.8 mg/hr x (16/76) = 1.6 mg/hr. The average and upper-bound adult soil ingestion rates derived in this manner are similar to values recommended by EPA Region 10 for use in risk assessment (EPA, 1989b).

In addition to the direct soil ingestion rates discussed above, this assessment also considered the quantity of dust-borne contamination which enters the gastrointestinal tract indirectly via pulmonary movement. The rate of such soil ingestion is discussed in the section *Dust and Vapor Inhalation* below.

Soil Concentration. Similar to the calculated dermal contact exposures discussed above, assumed chemical concentrations in ingested soils were based on analyses of exposed surficial soils collected over the top 2.5 feet of the PACCAR Renton site. The upper 95th percentile values were calculated based on the **higher** of the log-normal (t-statistic) or empirical estimates. Mean concentration values were calculated directly as arithmetic averages of the data.

Gastrointestinal Absorption. Internal absorption of chemicals ingested in a soil matrix has been somewhat better studied than that of dermal absorption, permitting estimates of the probable range of values which may occur. Chemical bonding and physical incorporation of compounds with the soil matrix is known to reduce the absorption of some contaminants within the gastrointestinal tract, relative to pure substances. A summary of internal absorption rates reported for various types of soil contaminants is presented below, based on an assessment of available data.

Metals. Toxicological criteria for oral exposures to metals are based on ingestion of the metal through a relatively "available" pathway such as drinking water (EPA, 1988a; EPA, 1989c). However, the relative gastrointestinal absorption of lead consumed in water is expected to be higher than that in soil, due to soil bonding. Summarizing the available data, Goyer (1986) and Klassen (1986) reported that healthy adults absorb from approximately 5 to 15 percent of the lead ingested with soil, relative to that in water. (Lower adult absorption rates of 1 to 2 percent have been reported for other metals such as cadmium and chromium).

Relative to the adult values summarized above, lead absorption is known to be much greater in children, and in adults with certain nutritional deficiencies (Goyer, 1986). Relative lead absorption as high as 40 to 50 percent has been reported for these individuals.

In order to provide a conservative estimate of metal absorption from ingested soils, the average relative absorption assumed for all metals was 50 percent. The upper 95th percentile absorption was assumed to be 100 percent.

Volatile Organics. Volatile organics do not exhibit much affinity to soil matter and thus tend to be "available" within the soil matrix. We have assumed that volatiles ingested with soil are equally as available for absorption as by other oral routes (e.g., drinking water). Therefore, the average and upper 95th percentile relative absorption values are both 100 percent.

Semivolatile Organics. For general semivolatile organic chemicals and pesticides, a lower gastrointestinal absorption rate has been reported, relative to other oral routes of administration. The effect of the soil matrix on internal absorption rates was observed in studies of tetrachlorodibenzodioxin (TCDD) conducted by Poiger and Schlatter (1980). They demonstrated that chemical sorption of TCDD from a soil complex ranged from 20 to 26 percent, or an approximate 50 percent reduction in the measured internal absorption rate relative to the pure substance.

Similar relative absorption rates have been reported for other compounds. EPA (1986e) estimated that PCBs ingested with soil were absorbed at a rate approximately 30 percent that of pure product or the product in an oil matrix. The relative absorption of benzo(a)pyrene administered orally in a soil matrix has been reported at approximately 50 percent that of the pure substance (Chang, 1943).

Based on the available data, the arithmetic average and upper 95th percentile relative internal absorption rate for semivolatile organic compounds was conservatively estimated at 50 percent and 100 percent, respectively.

Body Weight. The statistical range of body weight for the MEI was assumed to be identical to that described above for dermal absorption exposures. The average and lower 5th percentile body weights are 71.8 kg (158 lbs) and 52.2 kg (115 lbs), respectively.

Dust and Vapor Inhalation

Exposure to chemicals present in soil may also result from inhalation of dust and vapors generated at the PACCAR Renton site. We have included this route of exposure in the risk assessment, incorporating conservative assumptions to account for uncertainties in exposure estimates.

Most Exposed Individual (MEI). For the adult MEI who works at the site and also resides adjacent to the facility, inhalation exposures could result from that individual's on-site occupational responsibilities as well as off-site residential activities. Therefore, both on-site and off-site exposure routes were considered in this assessment.

For the childhood MEI, only off-site residential exposures were assumed, due to restricted site access under the present and planned future facility operations. Because of varying exposure characteristics and sensitivity of children in different age classes, this risk assessment considered separately young children aged 0 to 6 years, and older children aged 6 to 18 years.

In deriving estimates of inhalation exposures, consideration is given to the following parameters specific to the adult and childhood MEI scenarios: frequency and duration of exposure, air ventilation rate, predicted airborne contaminant concentration, and internal (pulmonary) absorption rate. These factors, with their associated uncertainty, provide the basis for exposure estimates via this route. The equation which describes inhalation exposures is discussed by EPA (1989a) and may be generalized as follows:

INHALE = FREQ x VENT x CONC x ABSORP

where:

INHALE = Inhalation of Contaminant in mg/day
FREQ = Exposure Frequency in hours/day
VENT = Air Ventilation Rate in m^3/hour
CONC = Air Contaminant Concentration in mg/m^3
ABSORP = pulmonary absorption (by wt)

Inhalation exposure estimates are converted into lifetime dose equivalents using the following equation:

DOSE = INHALE x TIME / (WEIGHT x LIFE)

where:

DOSE = Lifetime Contaminant Dose in mg/kg-day
TIME = Duration of Exposure in years
WEIGHT = Body Weight of the Individual in kg
LIFE = Lifetime of the Individual (75 years)

The rationale for selection of each numeric factor used in the exposure calculation (including the statistical range) is discussed below.

Frequency of Exposure. The daily frequency and lifetime duration of combined on-site and off-site inhalation exposures under the adult MEI scenario was based on activity patterns of the general U.S. adult population. The on-site exposure frequency was discussed in the dermal absorption section above, with an average and upper 95th percentile frequency for the MEI of 5.9 hr/day and 9.2 hr/day, respectively.

The average adult male spends approximately 98 hours per week at his place of residence (EPA, 1989a - citing Hill, 1985). This value equates to an average of 14.0 hr/day, or 58 percent of the time. The upper 95th percentile domestic (off-site) exposure frequency for the MEI was conservatively assumed to be 24.0 hr/day, or 100 percent of the time.

The on-site and off-site exposure frequencies discussed above were summed to obtain the **total** exposure frequency of the adult MEI. Based on these data, the cumulative average and upper 95th percentile frequencies are 19.9 hr/day and 24.0 hr/day, respectively.

For the childhood MEI, exposure frequency estimates were based on the average and upper-bound period of time spent at home. Since children spend an approximately equal period of time at home as adults (EPA, 1989a), the domestic frequencies summarized above were also applied to the childhood MEI. The average and upper 95th percentile frequencies for the childhood MEI are thus 14.0 hr/day and 24.0 hr/day, respectively. Similar exposure frequencies have been recommended by EPA Region 10 for risk assessment purposes (EPA, 1989b).

The assumed lifetime duration of inhalation exposures under the childhood and adult MEI scenario was based on EPA Region 10 compilations for the conservative residential site use condition (EPA, 1989b). Based on an assessment of data available on the mobility of the U.S. population, EPA (1989b) concluded that the average length of time that an individual may reside at a given residence is approximately 35 years, or 47 percent of a lifetime. The upper-bound duration recommended for risk assessment purposes is the average life expectancy of 75 years. Assuming that the underlying distribution of exposure duration is normal (Gaussian), and that EPA's (1989b) upper-bound estimate approximates the upper 95th percentile condition, the resultant standard deviation for duration of exposure is approximately 24 years. The duration of exposure was assumed to be independent of age class.

Air Ventilation Rate. The pulmonary ventilation rate is the mass movement of air in and out of the lungs in a given period of time. Although the ventilation rate is known to vary somewhat with an individual's age, weight, sex, physical condition, and activity level, the latter factor (activity level) appears to account for most of the total reported variation of this parameter (based on EPA, 1985b). Age differences are relatively minor. Accordingly, for this risk assessment the ventilation rate is assumed to be only a function of activity.

A statistical summary of ventilation rates under four activity classes (resting, light, moderate, and heavy) is presented in Table 9.1, based on EPA (1985b). Average values range from 0.51 m^3/hr during resting, to 3.95 m^3/hr during periods of heavy activity. The data within each activity class are reported to approximate a normal (Gaussian) distribution, with coefficients of variation of roughly ± 40 to ± 60 percent.

The relative frequencies of the four activity classes under both indoor and outdoor conditions have been summarized by EPA (1985b and 1989a). The estimated average and upper-bound activity frequencies are summarized in Table 9.1. Based on this compilation, the average individual spends less than 10 percent of his or her time at the moderate or heavy activity level. Under upper-bound (worst-case) conditions, however, as much as half of his or her time may be spent at a moderate or heavy activity level.

Table 9.1 – Summary of Air Inhalation Factors Developed for the PACCAR Renton Risk Assessment

Source: EPA, 1985a

PARAMETER	Ventilation Rate in Liters per Minute Resting	Light	Moderate	Heavy
Sample Size	1,049	1,321	208	478
Minimum	2.3	2.3	14.4	23.4
Arithmetic Mean	8.5	10.4	33.6	65.8
Maximum	18.8	27.6	78.0	183.4
Std. Dev. (Est.*)	3.3	5.4	17.2	41.0
Upper 95 percent	14.0	19.4	61.8	133.3
Coef. Variation	39%	52%	51%	62%

* Notes: Standard deviation estimated based on a normal distribution between the average and maximum values.

Source: EPA, 1989a

PARAMETER	Activity Pattern in Hours per Day Resting	Light	Moderate	Heavy
Indoors:				
Arithmetic Mean	9.82	9.82	0.71	0.10
Upper-bound	19.64	19.64	2.04	1.02
Outdoors:				
Arithmetic Mean	1.37	1.37	0.70	0.12
Upper-bound	2.73	2.73	4.00	4.00
Total:				
Arithmetic Mean	11.19	11.19	1.41	0.22
Std. Dev. (Est.*)	7.73	7.73	2.78	3.11
Upper 95 percent	23.91	23.91	5.98	5.33
Coef. Variation	69%	69%	197%	1419%

* Notes: Standard deviation estimated based on a normal distribution between the arithmetic mean and maximum or upper-bound values. The upper-bound estimates given in EPA (1989a) were assumed to represent the 90th percentile value.

	Calculated Ventilation Rate in m3/hour
Arithmetic Mean	0.68
Standard Deviation *	0.65
Upper 95 percent	1.75
Coef. Variation	95%

* Notes: Standard deviation calculated based on first-order uncertainty, assuming independent variables.

In order to derive a cumulative average and upper 95th percentile ventilation rate appropriate to the MEI, the statistical rate and frequency data summarized in Table 9.1 were applied to a first-order error propagation (uncertainty) model (Cornell, 1973; see Appendix I). The results of these calculations suggest that the overall average ventilation rate is approximately 0.68 m^3/hr, with a standard deviation of 0.65 m^3/hr. The estimated upper 95th percentile ventilation rate is 1.75 m^3/hr. These values were used in the PACCAR Renton site risk assessment to calculate potential inhalation exposures for all MEI age groups.

Air Concentration. The air concentration used to calculate potential inhalation exposures at the PACCAR Renton site represents the sum of particulate and vapor phases of contaminants predicted to be released from exposed surficial soils of the site. Surficial soils were assumed to be represented by samples collected from the top 2.5 feet of soil within uncovered areas of the site, as discussed previously.

The airborne concentration estimates represent the output of conservative models of atmospheric emissions from the site, as discussed in Section 8. Separate models were used to compute fugitive dust and volatilization releases. Data and modeling uncertainties were propagated through the predictive equations to estimate the probable range of outcomes. These uncertainties are reflected in the upper 95th percentile concentration estimates.

Pulmonary Absorption. Different relative pulmonary absorption rates were assumed in this risk assessment, depending upon whether the ventilated contaminant was present in a vapor or dust matrix. Because of the high chemical and biological availability of vapors, absorption of chemical vapors ventilated into the lungs was assumed to be 100 percent, relative to toxicological criteria for inhalation exposures.

Not all of the fugitive dust ventilated into the lungs is expected to be available for internal absorption. Based on a review of available data conducted by EPA (Schaum, 1984) and Ecology (D. Bradley, written communication, 1989), we have assumed the following:

- o An average of 20 percent of the inspired particulates are expired from the lungs with little or no absorption;
- o An average of 40 percent of the inspired particulates are transported from the lungs to the gastrointestinal tract with little or no pulmonary absorption (gastrointestinal absorption is accounted via the soil ingestion pathway);
- o An average of 40 percent of the inspired particulates are retained within the lungs with complete absorption of contaminants; and
- o The upper 95th percentile absorption is equivalent to 100 percent of the total quantity of inspired particulates.

The absorption values summarized above were applied to all dust-borne contaminants ventilated into the lungs. Chemical groupings were not differentiated in this assessment.

Body Weight. The statistical range of body weight for the adult MEI was assumed to be identical to that described above for dermal absorption exposures. The average and lower 5th percentile body weights are 71.8 kg (158 lbs) and 52.2 kg (115 lbs), respectively.

For the 0 to 6 year and 6 to 18 year age classes, body weight estimates were based on EPA (1989a). The average and lower 5th percentile body weights of 0 to 6 year children are 14 kg (32 lbs) and 9 kg (20 lbs), respectively. The average and lower 5th percentile body weights of 6 to 18 year children are 44 kg (97 lbs) and 19 kg (42 lbs), respectively.

Drinking Water Consumption

Human exposure to chemicals present at the PACCAR Renton site may occur via hydrologic releases into the local groundwater, and subsequent transport to the drinking water aquifer. We have included this route of exposure in the risk assessment, incorporating conservative assumptions to account for uncertainties in exposure estimates.

Hydrogeologic analyses presented in previous sections of this report reveal that site groundwaters may discharge in a southwesterly or westerly direction from the PACCAR site. Since the City of Renton water system obtains its water supply from wells located approximately 2,000 feet downgradient from a portion of the PACCAR site, drinking water is considered a potential exposure pathway for the MEI.

All residences and businesses located potentially downgradient of the PACCAR site are served by the Renton water supply system. No existing drinking water wells (other than the Renton municipal wells) have been identified within the site vicinity which may be affected by site discharges. Although future domestic well installations within a zone immediately downgradient of the PACCAR site are possible, such installations are considered highly unlikely within this developed commercial/industrial area. Low production rates caused by fine-grained soils in the immediate downgradient area also make installation of production wells near the site very unlikely. Nevertheless, at Ecology's direction (D. Bradley, personal communication, 1989), the hypothetical worst-case scenario evaluated in this risk assessment considered the possible consumption of these waters.

Most Exposed Individual (MEI). For the adult MEI who works at the site and also resides adjacent to the facility, potential drinking water exposures could result from that individual's on-site occupational responsibilities as well as off-site residential activities. Therefore, both on-site and off-site exposure routes were considered in this assessment. For the childhood MEI, only off-site residential exposures were assumed, as discussed previously.

In deriving estimates of potential drinking water exposures, consideration is given to the following parameters specific to the adult and childhood MEI scenarios: frequency and duration of exposure, tap water consumption rate, aquifer contaminant concentration, and internal (gastrointestinal) absorption rate. These factors, with their associated uncertainty, provide the basis for exposure estimates via this route. The equation which describes drinking water exposures is discussed by EPA (1989a) and may be generalized as follows:

DRINK = FREQ x WATER x CONC x ABSORP

where:

DRINK = Ingestion of Contaminant in mg/day
FREQ = Exposure Frequency in hours/day
WATER = Tap Water Consumption Rate in m^3/hour
CONC = Aquifer Contaminant Concentration in mg/m^3
ABSORP = Gastrointestinal absorption (by wt)

Drinking water exposure estimates are converted into lifetime dose equivalents using the following equation:

DOSE = DRINK x TIME / (WEIGHT x LIFE)

where:

DOSE = Lifetime Contaminant Dose in mg/kg-day
TIME = Duration of Exposure in years
WEIGHT = Body Weight of the Individual in kg
LIFE = Lifetime of the Individual (75 years)

The rationale for selection of each numeric factor used in the exposure calculation (including the statistical range) is discussed below.

Frequency of Exposure. The daily frequency and lifetime duration of combined on-site and off-site drinking water exposures under the adult MEI scenario were equivalent to those described above for the inhalation pathway. The cumulative average and upper 95th percentile exposure frequencies are 19.9 hr/day and 24.0 hr/day, respectively. Exposure frequencies for the childhood MEI were assumed to be identical to those of the adult.

The assumed lifetime duration of drinking water exposures under the childhood and adult MEI scenario was also similar to the inhalation pathway. The average and upper 95th percentile duration of exposure is 35 years and 75 years, respectively. The duration of exposure was assumed to be independent of age class.

Tap Water Consumption Rate. A variety of studies have been conducted on drinking water consumption rates for adults. Most of the reported studies have been based on large population surveys and other scientifically based data. The available data have been summarized by EPA (1989a).

One of the best available studies of drinking water consumption was conducted by the National Academy of Sciences (NAS, 1977). The results of this study, which have formed a basis for many drinking water regulations such as Maximum Contaminant Levels (MCLs), suggest that the average adult consumes approximately 1.63 liters per day (6.8×10^{-5} m^3/hr) of tap water and water-based drinks (e.g., coffee).

Statistical upper-bound rates were not reported in the NAS (1977) study. However, based on data reported by Gillies and Paulin (1983), the upper 95th percentile water consumption rate for adults is estimated at approximately 2.21 liters/day (9.2×10^{-5} m^3/hr). The distribution of adult water consumption rates are reportedly normal (i.e., Gaussian; based on Gillies and Paulin, 1983; and Cantor et al., 1987; Figure 9.5).

Data on the statistical range of water consumption rates of children have been summarized by EPA (1989a - citing EPA, 1984b). Based these data, the average and upper 95th percentile consumption rates for children aged 0 to 6 years are approximately 0.71 liter/day (3.0×10^{-5} m^3/hr) and 1.02 liters/day (4.3×10^{-5} m^3/hr), respectively. The average and upper 95th percentile consumption rates for children aged 6 to 18 years are approximately 1.00 liter/day (4.2×10^{-5} m^3/hr) and 1.28 liters/day (5.3×10^{-5} m^3/hr), respectively.

Some researchers have reported that dermal contact and inhalation exposures to contaminated water during showering activities may be as important as exposure via ingestion, particularly for volatile compounds (Brown et al., 1984). Recently, EPA has developed simple models which compare the level of exposure of volatiles via these "secondary" pathways with "primary" exposure via ingestion (Vanderslice and Ohanian, 1989). However, none of these models have presently been approved by EPA for use in risk assessment.

Based on a review of the available data and modeling approximations, EPA Region 10 assumed that average and upper-bound risks associated with such "secondary" water exposure pathways can be approximated as a percentage of the calculated drinking water consumption risk (EPA, 1989b). The assumed average and upper-bound (worst-case) values for volatile compounds were 100 percent and 200 percent, respectively. These values were assumed to represent the average and upper 95th percentile "secondary" exposures to volatiles in water attributable to the PACCAR site. This adjustment was not performed for non-volatile chemicals.

Aquifer Concentration. The aquifer concentration used to calculate potential drinking water exposures represents the predicted contribution of site contaminants to the local water supply system(s). As discussed above, two drinking water exposure scenarios were considered in this assessment. The first scenario was based on predicted contributions to the Renton well field which supplies water to nearly all of the local community. The second scenario considered a hypothetical future drinking water well installed at the southwest boundary of the site where groundwater concentrations of site indicator chemicals are highest (see Section 6). The two scenarios were considered separately in the risk assessment. Aquifer concentrations assumed under both of the scenarios are discussed below.

The contributions of identified indicator chemicals to the Renton water supply system were calculated using a groundwater transport and dilution model calibrated to local hydrogeologic conditions. The calculation procedures and assumptions are discussed in Section 8. The hydrologic transport model employed in this analysis conservatively assumed that chemical attenuation during transport from the site to the well field was negligible. Additional data and modeling uncertainties were propagated through the predictive equations to estimate the probable range of outcomes. These uncertainties are reflected in part by the upper 95th percentile concentration estimates.

Drinking water concentrations under a worst-case scenario were based on a hypothetical future well installed at the southwest boundary of the site. The worst-case concentration estimates were compiled using data collected from on-site and off-site monitoring wells within this downgradient groundwater "plume" region of the site. Water quality data collected from shallow and deep zones of wells LW-6, LW-9, LW-12, OSP-4, OSP-5, OSP-6, and OW-4 were compiled for this worst-case analysis (see Figure 5.1).

These data were summarized statistically as the arithmetic mean, upper 95th percentile, and "adjusted" standard deviation of log-normally distributed data, as described in Appendix I. The original data values used in this analysis are presented on Figures 6.70 to 6.81. Because of uncertainties regarding the validity of pre-1988 arsenic data (see discussion in Subsection 6.3.4), only data collected during the 1988 - 1989 Hart Crowser study period were utilized in this analysis.

Gastrointestinal Absorption. Water-borne chemicals are often relatively available for internal absorption. Furthermore, many of EPA's toxicological criteria for oral exposures were developed using drinking water administration of the chemical dose. Accordingly, both the average and upper-bound relative internal absorption of drinking water contaminants were assumed to be 100 percent.

Body Weight. The statistical range of body weight for the adult MEI was assumed to be identical to that described above for dermal absorption exposures. The average and lower 5th percentile body weights are 71.8 kg (158 lbs) and 52.2 kg (115 lbs), respectively.

For the 0 to 6 year and 6 to 18 year age classes, body weight estimates were based on EPA (1989a). The average and lower 5th percentile body weights of 0 to 6 year children are 14 kg (32 lbs) and 9 kg (20 lbs), respectively. The average and lower 5th percentile body weights of 6 to 18 year children are 44 kg (97 lbs) and 19 kg (42 lbs), respectively.

Fish Consumption

Besides the Renton water supply system, the other major receptor of site groundwater discharges is the Cedar River. A relatively small quantity of surface water also discharges from the site to the Cedar River. Since many of the indicator chemicals identified at the PACCAR site are known to bioconcentrate in fish tissue (Table 7.1), and because the Cedar River and adjacent waters of Lake Washington support a rather large recreational fishery (METRO, 1982), the potential for chemical exposure via local fish harvesting was considered in this risk assessment. We have included this route of exposure in the risk assessment, incorporating conservative assumptions to account for uncertainties in exposure estimates.

Most Exposed Individual (MEI). For the adult MEI, potential fish consumption exposures could result from that individual's off-site recreational fishing activities. Similar potential exposures apply to the childhood MEI.

In deriving estimates of potential fish ingestion exposures associated with the PACCAR site, consideration is given to the following parameters specific to the adult and childhood MEI scenarios: frequency and duration of exposure, consumption rate of fish, predicted water contaminant concentration within the Cedar River, fish bioconcentration, and internal (gastrointestinal) absorption rate. These factors, with their associated uncertainty, provide the basis for exposure estimates via this route. The equation which describes fish consumption exposures is discussed by EPA (1989a) and may be generalized as follows:

FMEAL = FREQ x FISH x RIVER x BCF x ABSORP

where:

FMEAL = Consumption of Contaminant in mg/day
FREQ = Exposure Frequency (source percentage)
FISH = Recreational Fish Consumption in mg/day
RIVER = Cedar River Concentration (by wt)
BCF = Fish Bioconcentration Factor (by wt)
ABSORP = Gastrointestinal absorption (by wt)

Fish consumption exposure estimates are converted into lifetime dose equivalents using the following equation:

DOSE = FMEAL x TIME / (WEIGHT x LIFE)

where:

DOSE = Lifetime Contaminant Dose in mg/kg-day
TIME = Duration of Exposure in years
WEIGHT = Body Weight of the Individual in kg
LIFE = Lifetime of the Individual (75 years)

The rationale for selection of each numeric factor used in the exposure calculation (including the statistical range) is discussed below.

Frequency of Exposure. The daily frequency of recreational fishing exposures under both the adult and childhood MEI scenarios were based on the assumption that an average of 25 percent of the total amount of fish caught recreationally by the MEI was obtained from the Cedar River. This value has been recommended by EPA (1989b) for the proportion of a variety of foodstuffs which are derived from a single source. For the upper 95th percentile condition, 100 percent of the recreational fish consumed were assumed to be obtained from the Cedar River.

The assumed lifetime duration of fish consumption exposures under the childhood and adult MEI scenario was equivalent to the inhalation and drinking water pathways discussed above. The average and upper 95th percentile duration of exposure is 35 years and 75 years, respectively. The duration of exposure was assumed to be independent of age class.

Recreational Fish Consumption Rate. Using the results of a nationwide survey of nearly 25,000 fish-eaters and nonfish-eaters, Javitz (1980) estimated that the average rate of consumption of fish and shellfish in the U.S. is 14.3 gm/day. Average consumption of fish alone was 6.5 gm/day. These consumption rates have formed the basis for a variety of water quality criteria developed by EPA (1986b).

Certain individuals, particularly recreational fishermen, consume much larger quantities of fish than the national average. Based on a survey of 300 sport fishermen in Commencement Bay (Puget Sound, WA), Pierce et al. (1981) estimated that the upper 95th percentile fish consumption rate of recreational fishermen was approximately 194 gm/day. Similar upper-bound rates were reported by Puffer (1981) for the Los Angeles area. The data distribution of recreational fish consumption rates is approximately log-normal (Figure 9.6).

For the MEI scenario appropriate to the PACCAR Renton site, the average and upper 95th percentile fish consumption rates were estimated at 14.3 gm/day and 194 gm/day, respectively, based on the data cited above. Similar average and upper-bound values were recommended by EPA (1989a) for risk assessment purposes.

Cedar River Concentration. Similar to the Renton aquifer calculations, the contributions of identified indicator chemicals to the Cedar River were calculated using a groundwater transport and dilution model calibrated to local hydrogeologic conditions. The calculation procedures and assumptions are discussed in Section 8. The predicted concentrations of indicator chemicals during seasonal low flow conditions within the Cedar River were presented in Section 8.2. The predicted mixed river concentrations are only a small fraction of the ambient concentrations reported for the Cedar River (METRO, 1982; City of Seattle, unpublished data).

The hydrologic transport model employed in this analysis conservatively assumed that chemical attenuation during transport from the site to the river was negligible. Additional data and modeling uncertainties were propagated through the predictive equations to estimate the probable range of outcomes. These uncertainties are reflected in part by the upper 95th percentile concentration estimates.

Fish Bioconcentration. The residue concentrations of indicator chemicals in fish of the Cedar River were computed as the product of the low-flow river concentration discussed above, and the reported aquatic bioconcentration factor (BCF) in edible freshwater fish tissue. Lower biotic residue concentrations of site contaminants are expected in nearshore and open-water areas of Lake Washington.

The average fish BCFs utilized in this risk assessment were taken directly from EPA (1980) water quality criteria documents. These values formed a basis for EPA's prior derivation of water quality criteria to protect human health due to consumption of contaminated fish and shellfish. Use of EPA-derived BCFs thus provides consistency with existing regulatory criteria on fish consumption uses of water. The average BCFs derived by EPA (1980) are summarized in Table 9.2.

Table 9.2 - Bioconcentration Factors for Contaminants of Concern
PACCAR Site

CONTAMINANT OF CONCERN	Average BCF value (a)	Upper Bound BCF value (b)
Arsenic	44	440
Chromium	16	160
Copper	290	2,900
Lead	45	67 (c)
Nickel	47	1,233 (c)
Silver	1	10
Zinc	51	456 (c)
Benzene	5	50
1,2-dichloroethane	NA	NA
Ethylbenzene	38	380
Toluene	11	110
Xylenes	NA	NA
Vinyl chloride	1	10
Polynuclear aromatic hydrocarbons	30	300
1,2-dichlorobenzene	56	236 (c)
Hexachlorobenzene	8,690	86,900
PCBs	31,200	312,000

FOOTNOTES

(a) Adopted from the most recent EPA Ambient Water Quality Criteria Documents (EPA, 1980, 1986b). Values for the development of criteria were used wherever available, otherwise average values compiled for freshwater fish were used.

(b) The upper bound was determined by multiplying the average values by 10 except where noted.

(c) For values where the data were available, the upper bound values were determined by plotting data from EPA, 1980; EPA, 1986b; Callahan, 1979; Verschueren, 1983; assuming a log-normal distribution

NA - bioconcentration factors have not been developed by EPA at this time.

The upper 95th percentile BCFs utilized in this risk assessment were also based on data compiled by EPA (1980) for water quality criteria. For each indicator chemical, the reported BCFs for edible tissue of freshwater fish were compiled. Since these data typically approximated a log-normal distribution (Figure 9.7), the upper 95th percentile value was based on either the log-normal t-statistic or the empirical value, as discussed in Appendix I. For chemicals with very little BCF data (i.e., less than 4 data values), the upper-bound BCF was conservatively assumed at 10 times the average reported by EPA. The upper 95th percentile BCFs derived in this manner are summarized in Table 9.2.

Gastrointestinal Absorption. Similar to chemicals present in drinking water, biological residues of contaminants are often relatively available for internal absorption. Furthermore, many of EPA's toxicological criteria for oral exposures were developed using dietary administration of the chemical dose. Accordingly, both the average and upper-bound relative internal absorption of fish tissue contaminants was assumed to be 100 percent.

Body Weight. The statistical range of body weight for the adult MEI was assumed to be identical to that described above for dermal absorption exposures. The average and lower 5th percentile body weights are 71.8 kg (158 lbs) and 52.2 kg (115 lbs), respectively.

For the 0 to 6 year and 6 to 18 year age classes, body weight estimates were based on EPA (1989a). The average and lower 5th percentile body weights of 0 to 6 year children are 14 kg (32 lbs) and 9 kg (20 lbs), respectively. The average and lower 5th percentile body weights of 6 to 18 year children are 44 kg (97 lbs) and 19 kg (42 lbs), respectively.

Water Contact Recreation

Potential exposure to site contaminants could also occur as a result of water-related recreational activities. Local swimming and other primary contact activities occur primarily in nearshore areas of Lake Washington, including a major park facility located near the Johns Creek discharge into the lake. Although dermal absorption and incidental ingestion of nearshore lake waters may represent potential contaminant exposure pathways, this exposure route is expected to be much smaller than those discussed previously (e.g., on-site soil ingestion or drinking water consumption). This conclusion is based on several factors, including:

- The water quality of Johns Creek is typical of regional stormwaters (see Table 6.13);
- Surface water discharged from the PACCAR site is largely restricted to wet weather storm events when water-related recreation is minimal; and
- Dispersion and dilution of the Johns Creek discharge in the nearshore area of Lake Washington is likely to be quite large (generally more than a ten-fold dilution; Pelletier et al., 1984).

Other concerns such as the general lack of reliable data on water-related dermal absorption rates for the identified contaminants of concern limit assessments of risk via this exposure route. For these reasons, exposure to site contaminants during water contact recreation activities was not specifically addressed in this risk assessment.

9.1.3 Dose Calculations

Average Exposures

The exposure factor data developed and presented in the previous section form the basis for calculations of the cumulative daily and lifetime dose of each indicator chemical via the various potential routes of exposure. A tabular summary of each exposure factor is presented in Table 9.3. This risk assessment follows conservative EPA guidance (EPA, 1986a, 1988e, and 1989b) by assuming that the dose from all routes of exposure (i.e., dermal, oral, and inhalation) may be additive. Accordingly, the cumulative average dose is calculated simply as the sum of individual average doses derived from each of the five pathways identified and quantified for the MEI. For chemicals such as PAHs where different toxicological criteria have been developed for specific exposure routes (e.g., oral versus inhalation), separate dose calculations were performed for these exposure routes.

Table 9.3 – Summary of Most Exposed Individual (MEI) Parameters for PACCAR Renton Site

Exposure Factor	Units	Average Condition	Upper–Bound Condition (a)	General Data Distribution	Statistical Dependence
I. Dermal Absorption:					
a. Frequency	hrs/day	5.8	9.2	Normal	II.a./III.a.
b. Duration	years	10	40	Normal	II.b./III.b.
c. Surface Area	cm2	3,300	8,300	Normal	
d. Soil Adherence Rate	mg/cm2–hr	0.039	0.093	Normal	
e. Soil Concentration	ppm	(b)	(b)	Log–normal	II.d./III.d.
f. Dermal Absorption:					
Metals	by wt.	0.2%	1.0%	Unknown	
Volatiles	by wt.	15.0%	25.0%	Unknown	
Semi–volatiles	by wt.	2.0%	10.0%	Unknown	
g. Body Weight	kg	72	52	Normal	II.f./III.f.
II. Soil Ingestion:					
a. Frequency	hrs/day	5.8	9.2	Normal	I.a./III.a.
b. Duration	years	10	40	Normal	I.b./III.b.
c. Ingestion Rate	mg/hr	1.6	7.8	Log–normal	
d. Soil Concentration	ppm	(b)	(b)	Log–normal	I.e./III.d.
e. Internal Absorption:					
Metals	by wt.	50%	100%	Unknown	
Volatiles	by wt.	100%	100%	Unknown	
Semi–volatiles	by wt.	50%	100%	Unknown	
f. Body Weight	kg	72	52	Normal	I.g./III.f.
III. Inhalation:					
a. Frequency	hrs/day	19.9	24.0	Normal	I.a./II.a.
b. Duration	years	35	75	Normal	I.b./II.b.
c. Ventilation Rate	m3/hr	0.68	1.75	Normal	
d. Air Concentration	mg/m3	(b)	(b)	Log–normal	I.e./II.d.
e. Internal Absorption:					
Metals	by wt.	40%	100%	Unknown	
Volatiles	by wt.	100%	100%	Unknown	
Semi–volatiles	by wt.	50%	100%	Unknown	
f. Body Weight:					
0 to 6 years	kg	14	9	Normal	
6 to 18 years	kg	44	19	Normal	
18 to 75 years	kg	72	52	Normal	I.g./II.f.
IV. Drinking Water:					
a. Frequency	hrs/day	19.9	24.0	Normal	
b. Duration	years	35	75	Normal	
c. Consumption Rate:					
0 to 6 years	m3/hr	3.0E–05	4.3E–05	Normal	
6 to 18 years	m3/hr	4.2E–05	5.3E–05	Normal	
18 to 75 years	m3/hr	6.8E–05	9.2E–05	Normal	
d. Aquifer Concentration	mg/m3	(b,c)	(b,c)	Log–normal	
e. Internal Absorption	by wt.	100%	100%	Unknown	
f. Body Weight:					
0 to 6 years	kg	14	9	Normal	
6 to 18 years	kg	44	19	Normal	
18 to 75 years	kg	72	52	Normal	
V. Fish Consumption:					
a. Frequency	by source	25%	100%	Normal	
b. Duration	years	35	75	Normal	
c. Fish Consumption Rate	mg/day	14	194	Log–normal	
d. River Concentration	mg/m3	(b)	(b)	Log–normal	
e. Bioconcentration	by wt.	(b,d)	(b,d)	Log–normal	
e. Internal Absorption	by wt.	100%	100%	Unknown	
g. Body Weight:					
0 to 6 years	kg	14	9	Normal	
6 to 18 years	kg	44	19	Normal	
18 to 75 years	kg	72	52	Normal	

a) When statistical data for a given exposure parameter exist, the upper–bound condition represents the 95th percentile "worst–case" value. In the absence of statistical data, the upper–bound value is based on an assessment of available data.

b) Soil, air, and water data based on site quantifications and modelling; see text.

c) Groundwater wells at the site boundary are assessed in a separate risk scenario.

d) Fish concentrations calculated based on transport modelling and bioconcentration factors.

Theoretical Upper-bound Exposures

In addition to the average exposure scenario discussed above, EPA Region 10 recommends that calculations of theoretical upper-bound exposures be performed for the risk assessment. Under such a worst-case scenario, all of the exposure factors are set at their upper-bound limits. For example, the dermal contact dose received by the MEI is calculated based upon simultaneous occurrence of the upper 95th percentile contact frequency, the upper 95 percent exposed skin area, the upper 95 percent soil adherence rate, the upper 95 percent surficial soil concentration, the upper 95 percent dermal absorption rate, the upper 95 percent exposure duration, and the lower 5 percent body weight. In addition, all theoretical upper-bound exposures for all five pathways are also assumed to occur simultaneously, with additive doses.

The theoretical upper-bound condition is therefore calculated assuming that every factor used in the exposure assessment reaches its worst-case value simultaneously. However, a number of investigators (e.g., Burmaster and Stackelberg, 1989; Roscoe, 1989) have noted that this assumption is not realistic, and may not be meaningful in a risk assessment context.

Although the probability of occurrence for the upper-bound of an individual factor is set in this assessment at 0.05 (i.e., 5 percent), the probability of simultaneous "worst case" occurrence of all 37 exposure factors is typically much lower, and could approach 10^{-10} to 10^{-50}. (For perspective, 10^{-30} is equivalent to a ratio of one drop of water in the entire earth's ocean.) Clearly, upper-bound exposures calculated in this manner represent rare occurrences, and are unlikely to represent realistic chemical doses associated with the site.

The limitations of the theoretical upper-bound estimates are obvious. Nevertheless, such calculations may be used for preliminary screening of the exposure data to determine if the potential for risk at a given site may exist. Since the calculations are relatively simple to perform, we included the theoretical upper-bound estimates in the PACCAR risk assessment as such a screening tool. More detailed analyses of probabilistic exposure conditions were performed if the results of the initial screening indicated that risks above general regulatory guidelines were possible (i.e., Hazard Index greater than 1.0 or cancer risk greater than 10^{-6}).

Probabilistic Upper-bound Exposures

Monte Carlo Simulation

Methods for calculating upper-bound exposure estimates for risk assessments based on detailed probabilistic computations have been investigated and discussed by EPA (1988e, 1989a, and 1989b; Roscoe, 1989) and Burmaster and Stackelberg (1989). The method generally utilized by EPA to perform such a quantitative assessment is Monte Carlo simulation. This method consists of performing a large number of iterations (e.g., 1,000+) of the cumulative exposure equations discussed above. The input data are based on random "sampling" from the data distribution of each of the 37 individual factors (e.g., Figure 9.2). The output of the calculations are then compiled into a cumulative distribution to determine statistical properties of the calculated exposures. The upper 95th percentile exposure value is one such statistical estimate obtained from the Monte Carlo simulation. An example of the Monte Carlo output is presented on Figure 9.8, based on conditions discussed in Appendix I (and Figure 9.2).

One of the key limitations of the general Monte Carlo approach is that all of the individual exposure factors are assumed to be independent. Some of the exposure factors, however, may not be independent. For example, it is reasonable to expect that the combined exposures resulting from dermal contact and soil ingestion are dependent. Such exposures would likely occur to the same individual who comes in regular contact with site soils. The dependence between these two exposure pathways affects the frequency, duration, soil concentration, and body weight factors of the MEI.

As another example, many of the different indicator chemicals present at the PACCAR site are spatially correlated, and thus not independent from one another. In these example cases, consideration of the dependence between exposure pathways and indicator chemicals has the effect of **increasing** the predicted magnitude of the upper 95th percentile dose and risk estimates. Under these conditions, the Monte Carlo output would **underestimate** the true probabilistic risks posed by the PACCAR site. In part because of this limitation, EPA (1989b) has remained tentative in the acceptance of Monte Carlo analyses for risk assessment (J. Yearsley, EPA Region 10, personal communication).

First-order Uncertainty Analysis

An alternative approach to probabilistic risk assessment which is not limited by the assumption of independence is first-order uncertainty analysis (Cornell, 1973). Although the method provides statistical information similar to the Monte Carlo simulation, first-order analysis is mathematical in nature, and is based on the truncated first-order terms of the Taylor polynomial expansion.

The utility and validity of first-order analysis has been well documented in the engineering and systems ecology literature (Lettenmaier and Richey, 1979; Ayyub and Haldar, 1984; Yen and Cheng, 1986; Melching et al., 1987). However, to date its use in risk assessment has been limited. A description of the theory and mechanics of the first-order methodology applied to risk assessment is presented in Appendix I.

The first-order analysis assumes that each data distribution can be approximated by an arithmetic average and Gaussian standard deviation in lieu of information on the complete probability distribution. In most cases, this assumption is entirely consistent with the available data (Table 9.3). However, for those factors characterized by distinctly non-normal distributions, the standard deviation must be "normalized" using first-order approximations. For the strongly log-normal (and worst-case) condition of the PACCAR soil lead concentration data (Figure 9.2), conservative methods are applied to derive the standard deviation (see Appendix I for a complete description of the methods).

The results of the first-order approximations of a worst-case example condition are compared with the "non-normalized" Monte Carlo calculations on Figure 9.8. For the range of the distribution of primary interest in this risk assessment (i.e., 0.50 to 0.95 probability), the dose calculated with the first-order model was **higher** than the Monte Carlo output. This result is due to the conservative methods utilized to compute the standard deviation (Appendix I). This conservative tendency is considered acceptable in a risk assessment. The conservative nature of the first-order model was also verified with Monte Carlo simulations performed on a subset of the calculations.

As discussed above, one of the key parameters involved in the assessment of probabilistic upper-bound exposures is the independence of the individual exposure factors. A summary of dependency characteristics of each exposure factor is presented in Table 9.3. The dependence between exposure factors was incorporated into the first-order calculations of the upper 95th percentile dose.

Dose Estimates

A summary of average and probabilistic 95th percentile upper-bound chemical doses of the fifteen (15) indicator chemical groupings is presented for the young childhood (0 to 6 yr) and adult (18 to 75 yr) age classes in Table 9.4 and 9.5, respectively. Calculated doses for the older childhood age class (6 to 18 yr) were lower than the other two age groups.

The calculated chemical doses presented in Tables 9.4 and 9.5 refer to the City of Renton drinking water source scenario, since this scenario is the most realistic condition for drinking water risks, as discussed in Subsection 9.1.2. A discussion of risks associated with consumption of drinking water derived from a hypothetical future well which may be installed immediately downgradient of the site is presented later in this section.

For the childhood exposures, off-site inhalation of contaminated dust emissions from the site generally represented the predominant calculated exposure pathway for site contaminants (Table 9.4). The subsequent ingestion of some of these dust particles as a result of pulmonary movement also represented a quantitative exposure pathway (see discussion above on air inhalation factors for additional explanation).

Table 9.4 - Summary of PACCAR Renton Site Potential Exposure Calculations for Young Childhood (0 to 6 Year) Exposure

CONTAMINANT	CALCULATED EXPOSURE in mg/kg-day Arithmetic Average	Upper 95% Percentile	PERCENT OF TOTAL EXPOSURE Soil Ingestion Average	Dermal Contact Average	Air Inhalation Average	Drinking Water* Average	Fish Ingestion Average
METALS:							
Arsenic	1.35E-06	6.39E-06	14%	0%	14%	56%	16%
Chromium	1.96E-06	9.97E-06	41%	0%	41%	17%	0%
Copper	4.36E-06	2.26E-05	42%	0%	42%	12%	4%
Lead	1.63E-05	1.13E-04	48%	0%	48%	4%	1%
Nickel	8.98E-07	5.00E-06	48%	0%	48%	0%	5%
Silver	8.06E-07	5.40E-06	50%	0%	50%	0%	0%
Zinc	1.01E-05	4.58E-05	34%	0%	34%	27%	4%
VOLATILE ORGANICS:							
Benzene	4.62E-09	3.04E-05	0%	0%	0%	0%	100%
1,2-Dichloroethane	7.83E-09	2.70E-05	0%	0%	0%	0%	100%
Eth + Tol + Xyl (ETX)	3.23E-04	2.36E-03	0%	0%	100%	0%	0%
Vinyl Chloride	2.80E-09	8.36E-04	0%	0%	0%	0%	100%
EXTRACTABLE ORGANICS:							
Total Carcinogenic PAHs	5.10E-07	3.94E-06	50%	0%	50%	0%	0%
1,2-Dichlorobenzene	3.16E-08	5.74E-05	0%	0%	0%	0%	100%
Hexachlorobenzene	0.00E+00	2.55E-05	0%	0%	0%	0%	0%
Total PCBs	8.69E-09	9.96E-06	50%	0%	50%	0%	0%

* Existing City of Renton Wells

Table 9.5 - Summary of PACCAR Renton Site Potential Exposure Calculations for Adult (18 to 75 Year) Exposures

CONTAMINANT	Calculated Exposure in mg/kg-day Arithmetic Average	Calculated Exposure in mg/kg-day Upper 95% Percentile	Percent of Total Exposure: Soil Ingestion Average	Dermal Contact Average	Air Inhalation Average	Drinking Water* Average	Fish Ingestion Average
METALS:							
Arsenic	4.73E-07	2.06E-06	2%	10%	8%	71%	9%
Chromium	5.56E-07	2.60E-06	8%	37%	28%	27%	0%
Copper	1.19E-06	5.68E-06	8%	40%	30%	19%	3%
Lead	4.21E-06	2.77E-05	10%	47%	36%	7%	0%
Nickel	2.24E-07	1.22E-06	10%	49%	37%	0%	4%
Silver	2.03E-07	1.32E-06	11%	51%	39%	0%	0%
Zinc	3.03E-06	1.23E-05	6%	29%	22%	40%	3%
VOLATILE ORGANICS:							
Benzene	8.98E-10	5.96E-06	0%	0%	0%	0%	100%
1,2-Dichloroethane	1.52E-09	5.71E-06	0%	0%	0%	0%	100%
Eth + Tol + Xyl (ETX)	6.30E-05	4.59E-04	0%	0%	99%	0%	0%
Vinyl Chloride	5.45E-10	1.63E-04	0%	0%	0%	0%	100%
EXTRACTABLE ORGANICS:							
Total Carcinogenic PAHs	5.85E-07	5.14E-06	2%	89%	8%	0%	0%
1,2-Dichlorobenzene	6.15E-09	7.79E-06	0%	0%	0%	0%	100%
Hexachlorobenzene	0.00E+00	4.96E-06	0%	0%	0%	0%	0%
Total PCBs	8.63E-09	1.95E-06	3%	88%	10%	0%	0%

* Existing City of Renton Wells

For the adult MEI exposure scenario, all five exposure pathways were quantitatively important in the dose calculations (Table 9.5). Metal intake was primarily attributable to dermal contact and air inhalation exposures, although potential arsenic doses from drinking water contributions to the aquifer were also important. Dermal contact exposures to semivolatile compounds such as HPAHs and PCBs were the primary exposure route identified for the MEI.

It is important to note that these assumed exposure scenarios are not representative of exposures which would likely occur. They would only occur if the site were uncontrolled and no remedial actions are implemented to protect human health and the environment. The conservation baseline exposure scenario further assumes that contaminants have migrated to existing wells, the Cedar River, and/or into off-site air. As discussed in Section 8.0, the assumed off-site exposure concentrations generally represent worst-case conditions.

The potential significance of these exposures is evaluated in the following sections.

9.2 TOXICITY ASSESSMENT

This section summarizes the toxicity criteria of the indicator chemicals, based on the MEI dose calculations presented above. Brief summaries of pertinent toxicology information for the site indicator chemicals were presented previously in Section 7.2. The reader is referred to the various EPA documents (e.g., Health Effects Assessments; HEA) and on-line databases (e.g., Integrated Risk Information System; IRIS; EPA, 1988a) for a more comprehensive discussion of the available toxicology literature.

The toxicity criteria utilized in this risk assessment were obtained from the most current source of EPA-approved criteria, based primarily on the IRIS on-line database. The most recent HEA documents, Drinking Water Criteria (DWC), and Risk Assessment Forum documents available from EPA were also reviewed to obtain toxicity criteria, and particularly those which formed the basis for previous regulatory decisions. In cases where the regulatory status of a given chemical is in revision (based on IRIS), EPA was contacted directly to obtain the most recent toxicological summary.

Toxicity and risk assessments vary for different chemicals depending upon whether non-carcinogenic or carcinogenic toxicity criteria are used to assess potential risks. Some chemicals of concern may result in both non-carcinogenic and carcinogenic effects, although in most cases the EPA has published toxicity criteria for only the most sensitive type of health effect leading to the most restrictive toxicological criteria.

The Acceptable Intake value for Chronic (AIC) exposure is a numerical value that describes a chemical's chronic toxicity. AIC values are based on long-term animal or human studies. When EPA completes verification of the chronic toxicity of a specific chemical, it establishes a "reference dose", or RfD. If the RfD for a chemical has been established, then the RfD is used as the AIC for evaluating long-term non-carcinogenic risks at the site. This "acceptable" dose is compared to the dose calculated from the exposure assessment to determine whether adverse effects might occur. If predicted exposure concentrations are below the level of the regulatory criteria, then no adverse health effects are expected.

The risk of chemicals classified (by EPA) as potential human carcinogens is evaluated differently. The upper-bound cancer risk associated with a given dose is calculated by multiplying the dose from a given route of exposure by a cancer potency factor or potency slope. EPA derives potency values from the upper 95th percentile confidence limit of the slope of an extrapolated dose-response curve, and is denoted q_1*. The curve is fitted as a linearized multistage (i.e., non-threshold) relationship between a given dose and the observed experimental tumor incidence. Both because of the non-threshold assumption and the 95th percentile confidence limit, the use of published q_1* values gives a conservative upper bound estimate of potential risks associated with exposure.

The oral and inhalation RfD and q_1* values used in this risk assessment are summarized in Table 9.6. As discussed above, toxicity data

Table 9.6 – Summary of Toxicity Criteria for Indicator Chemicals
Source: EPA (1989d)

CONTAMINANT	Reference Dose (mg/kg-day) Oral	Reference Dose (mg/kg-day) Inhalation	Potency Factor (mg/kg-day)-1 Oral	Potency Factor (mg/kg-day)-1 Inhalation
METALS:				
Arsenic	1.0E-03	(a)	1.5E+00	5.0E+01
Chromium	5.0E-03	(a)		4.1E+01
Copper	3.7E-02 (b)	(a)		
Lead	1.4E-03 (b)	4.3E-04 (b)		
Nickel	2.0E-02	(a)		8.4E-01
Silver				
Zinc	2.1E-01	(a)		
VOLATILE ORGANICS:				
Benzene			2.9E-02	2.9E-02
1,2-Dichloroethane			9.1E-02	9.1E-02
Eth + Tol + Xyl (ETX)	1.0E-01 (c)	4.0E-01 (d)		
Vinyl Chloride			2.3E+00	2.9E-01
EXTRACTABLE ORGANICS:				
Total Carcinogenic PAHs			1.2E+01	6.1E+00
1,2-Dichlorobenzene	4.0E-01	4.0E-02		
Hexachlorobenzene	8.0E-04	(a)	1.7E+00	1.7E+00
Total PCBs			7.7E+00	7.7E+00

(a) Where no RfD or AIC value is available for inhalation exposures, the corresponding oral value was utilized as a surrogate toxicity criteria.
(b) Value presented is an Acceptable Intake value for Chronic (AIC) exposure; no verified reference dose is available for this chemical.
(c) Based on ethylbenzene.
(d) Based on xylene.

for the indicator chemicals were generally obtained directly from EPA through either IRIS, HEA, or DWC sources. The basis for these criteria are discussed within the various EPA references and are not reproduced in this report. A brief summary of pertinent toxicologic information, which discusses the source of the toxicity criteria, for the chemicals was presented in Section 7.2.

9.3 RISK CHARACTERIZATION

The exposure and toxicity assessments presented above form the basis for the characterization of chemical risks posed by the PACCAR site. For carcinogens, the risk is presented as the upper-bound risk of contacting some form of cancer given continuous exposure over a 75-year lifetime. Guidelines of "acceptable" upper-bound cancer risks to protect the health of the public, including sensitive individuals, normally range from approximately 10^{-4} to 10^{-7}, or a chance of 1 in 10,000 to 1 in 10,000,000 of developing cancer due to lifetime exposure to a carcinogen (EPA, 1988f; Travis and Hattemer-Frey, 1988). Risk of 10^{-6} to 10^{-5} are most often used by EPA, Ecology, and other agencies as a guideline for "acceptable" risk to protect public health. A target risk range of 10^{-4} to 10^{-6} has been suggested in the most recent proposed draft of the National Contingency Plan (NCP) which guides work being completed under CERCLA.

It should be noted that the calculated lifetime cancer risk is that risk where long-term exposure could result in up to one additional case of cancer per the referenced population under the assumed exposure assumptions. The actual risk ranges between zero to 1 case.

Non-carcinogenic risk is evaluated differently. In this case, the daily dose resulting from site exposure is divided by the available RfD or AIC values to compute the Hazard Index. The Hazard Index was developed by EPA to assess the overall potential for non-carcinogenic effects posed by multiple chemicals (EPA, 1986a). The index is not a mathematical prediction of the severity or incidence of the non-carcinogenic effects, rather it is an indication of potential exposure. If the hazard index is less than 1 then non-carcinogenic adverse health effects are not expected.

The preliminary evaluation of the Hazard Index assumes that all effects are additive. However, if the cumulative risk index exceeds 1.0, the contaminants may be grouped by similar "critical effects". For compounds with different "critical effects" (or target organ toxicity on which the most sensitive federal criteria are based), Hazard Indices are recalculated after the compounds are grouped by critical effects in order to derive a better estimate of the additivity of the non-carcinogenic effects (EPA, 1986a). If the Hazard Index calculated in this manner does not exceed 1.0, then non-carcinogenic adverse health effects are not expected.

Because of the long-term exposure period assumed in the evaluation of cancer risks, and also because of the upper 95th percentile confidence bound employed (by EPA) in determining q_1*, the estimated <u>average</u> exposure condition reported in Tables 9.4 and 9.5 generally provides a measure of exposure for carcinogenic risk characterization. Conversely, because non-carcinogenic effects may occur over shorter exposure periods, the upper-bound exposure values generally form the basis for assessments of non-carcinogenic risks. The use of these statistical exposure estimates for risk characterization calculations is generally consistent with EPA guidelines (EPA, 1986a, 1988f).

For the purposes of this risk assessment, the potency of dermal contact exposures were assumed to be roughly equivalent to oral exposures, when such exposures are corrected for absorption. The assumption of similar potency is somewhat supported by the observation that toxic effects due to oral exposure of the identified indicator compounds tend to be systemic in nature. In few cases do such chemicals appear to target a specific organ proximal to the point of exposure (e.g., lung cancer due to inhalation exposure).

Consistent with EPA guidelines, both carcinogenic and non-carcinogenic risks associated with all routes of exposure for each indicator chemical were initially assumed to be additive. Individual pathway risks were therefore summed to obtain an estimate of the cancer risk and Hazard Index associated with each chemical.

Preliminary Screening of Risks

As discussed in Section 9.1.3 above, the theoretical upper-bound chemical doses calculated for the PACCAR site were evaluated relative to toxicity criteria as a preliminary screening of potential chemical risks. The theoretical maximum risks calculated in this manner represent very rare risk outcomes, with an estimated probability of occurrence approaching 10^{-10} to 10^{-50} (10^{-30} is equivalent to a ratio of much approximately one drop of water in the earth's ocean). The preliminary screening was performed only to identify whether a more detailed probabilistic assessment of risks was warranted.

The preliminary risk screening reveals the possibility that site risks may exceed general regulatory guideline levels under theoretical maximum exposure conditions. However, because of the very conservative method of calculation, the risks computed under such theoretical upper-bound conditions do not represent realistic risk outcomes.

Accordingly, a more detailed probabilistic assessment of site risks was conducted for the PACCAR site. As discussed in Section 9.1.3, the risk outcomes considered in this assessment span a range from the arithmetic average to the estimated 95th percentile condition (i.e., the upper 95th percentile risk out of a distribution of possible risks). The 95th percentile condition is generally recognized as a reasonable upper-bound estimate for use in risk assessment, given the variety of data uncertainties and conservative assumptions which form the basis for risk characterization (EPA, 1986a, 1988e, 1989a, and 1989b; Burmaster and Stackelberg, 1989; Roscoe, 1989).

9.3.1 Hazard Index Calculations

Tables 9.7 through 9.9 presents the non-carcinogenic Hazard Index calculations for the PACCAR site. Use of the Hazard Index was discussed earlier. Adverse health effects are not expected under the assumed conservative exposure conditions if the Index is less than 1.0.

Under the baseline condition evaluated, soil exposure via dust inhalation contributed most to the upper-bound Hazard Index. Young children are predicted to be the sub-population at greatest risk from lead exposure. However, the calculated cumulative upper-bound Hazard Index for young children is only 0.18, and indicative of little or no potential risk.

It should be noted that there are currently no verified toxicity criteria available from EPA to evaluate lead toxicity. The risk calculations presented in Tables 9.7 through 9.9 were based on the use of **previous** criteria developed by that agency. These criteria are presently undergoing revisions by EPA.

In this interim period prior to development of the new lead toxicity criteria, EPA and DSHS recommend that risk characterization of lead exposures associated with site soils also be performed based on a simple comparison of on-site soil concentrations with the 500 to 1,000 mg/kg criterion developed by CDC (1985). Elevated blood lead levels have been reported in children exposed to soils exceeding this general range. Since childhood access is restricted at the site, the 1,000 mg/kg lead criterion may be appropriate to evaluate potential risks at the PACCAR facility. Lead concentrations above 1,000 mg/kg in near-surface soils of the PACCAR site occur in isolated locations (Figure 6.22).

9.3.2 Cancer Risk Calculations

The predicted lifetime (upper-bound) cancer risks under the baseline (i.e., before remediation) exposure condition at the PACCAR site are summarized in Table 9.10. The cumulative average lifetime cancer risk calculated for the PACCAR site is 1.8×10^{-5}, or 1 in 55,000 using the conservative exposure assumptions discussed earlier in this report and assuming no remedial action is taken at the site. This value exceeds the general "target" level of 10^{-6}, but falls within the guideline range of 10^{-4} to 10^{-7} (EPA, 1986a, 1988f).

The upper 95th percentile lifetime risk associated with the PACCAR site is calculated at 8.9×10^{-5}, or 1 in 11,000 (Table 9.10). This calculated risk value is similar to the general upper-bound risk guideline of 10^{-4} (EPA, 1988f).

Table 9.7 - Summary of Non-Carcinogenic Risk Characterization at the PACCAR Renton Site

AGE CLASS OF EXPOSURES: 0 TO 6 YEARS

	Non-Carcinogenic Hazard Index			
	Arithmetic Average		Probabilistic Upper-bound	
CONTAMINANT	Oral/Dermal	Inhalation	Oral/Dermal	Inhalation
METALS:				
Arsenic	0.00		0.01	
Chromium	0.00		0.00	
Copper	0.00		0.00	
Lead	0.01	0.02	0.05	0.16
Nickel	0.00		0.00	
Silver				
Zinc	0.00		0.00	
VOLATILE ORGANICS:				
Benzene				
1,2-Dichloroethane				
Eth + Tol + Xyl (ETX)	0.00	0.00	0.00	0.01
Vinyl Chloride				
EXTRACTABLE ORGANICS:				
Total Carcinogenic PAHs				
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00
Hexachlorobenzene	0.00		0.03	
Total PCBs				
	0.01 (a)	0.02 (a)	0.06 (b)	0.16 (b)
CUMULATIVE HAZARD INDEX		0.03 (a)		0.18 (b)

Notes:

(a) The cumulative average Hazard Index was computed assuming simple additivity of risks from individual chemicals.

(b) The cumulative probabilistic upper 95th percentile Hazard Index (HI) was not calculated as the simple sum of individual component risks. The upper-bound HI was computed based on a first-order uncertainty propagation model, using the assumed exposure correlation matrix (Table 9.3) and simple additivity of risks from individual chemicals; see text.

Table 9.8 – Summary of Non-Carcinogenic Risk Characterization at the PACCAR Renton Site

AGE CLASS OF EXPOSURES: 6 TO 18 YEARS

	Non-carcinogenic Hazard Index			
	Arithmetic Average		Probabilistic Upper-bound	
CONTAMINANT	Oral/Dermal	Inhalation	Oral/Dermal	Inhalation
METALS:				
Arsenic	0.00		0.00	
Chromium	0.00		0.00	
Copper	0.00		0.00	
Lead	0.00	0.01	0.02	0.05
Nickel	0.00		0.00	
Silver				
Zinc	0.00		0.00	
VOLATILE ORGANICS:				
Benzene				
1,2-Dichloroethane				
Eth + Tol + Xyl (ETX)	0.00	0.00	0.00	0.00
Vinyl Chloride				
EXTRACTABLE ORGANICS:				
Total Carcinogenic PAHs				
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00
Hexachlorobenzene	0.00		0.01	
Total PCBs				
	0.00 (a)	0.01 (a)	0.02 (b)	0.05 (b)
CUMULATIVE HAZARD INDEX		0.01 (a)		0.06 (b)

Notes:

(a) The cumulative average Hazard Index was computed assuming simple additivity of risks from individual chemicals.

(b) The cumulative probabilistic upper 95th percentile Hazard Index (HI) was not calculated as the simple sum of individual component risks. The upper-bound HI was computed based on a first-order uncertainty propagation model, using the assumed exposure correlation matrix (Table 9.3) and simple additivity of risks from individual chemicals; see text.

Table 9.9 – Summary of Non-Carcinogenic Risk Characterization at the PACCAR Renton Site

AGE CLASS OF EXPOSURES: 18 TO 75 YEARS

	Non-carcinogenic Hazard Index			
	Arithmetic Average		Probabilistic Upper-bound	
CONTAMINANT	Oral/Dermal	Inhalation	Oral/Dermal	Inhalation
METALS:				
Arsenic	0.00		0.00	
Chromium	0.00		0.00	
Copper	0.00		0.00	
Lead	0.00	0.00	0.01	0.03
Nickel	0.00		0.00	
Silver				
Zinc	0.00		0.00	
VOLATILE ORGANICS:				
Benzene				
1,2-Dichloroethane				
Eth + Tol + Xyl (ETX)	0.00	0.00 U	0.00	0.00 U
Vinyl Chloride				
EXTRACTABLE ORGANICS:				
Total Carcinogenic PAHs				
1,2-Dichlorobenzene	0.00	0.00	0.00	0.00
Hexachlorobenzene	0.00		0.01	
Total PCBs				
	0.00 (a)	0.00 (a)	0.02 (b)	0.03 (b)
CUMULATIVE HAZARD INDEX		0.01 (a)		0.04 (b)

Notes:

(a) The cumulative average Hazard Index was computed assuming simple additivity of risks from individual chemicals.

(b) The cumulative probabilistic upper 95th percentile Hazard Index (HI) was not calculated as the simple sum of individual component risks. The upper-bound HI was computed based on a first-order uncertainty propagation model, using the assumed exposure correlation matrix (Table 9.3) and simple additivity of risks from individual chemicals; see text.

Table 9.10 – Summary of Lifetime Cancer Risk Estimates at the PACCAR Renton Site

	Lifetime Cancer Risk			
	Arithmetic Average		Probabilistic Upper-bound	
CONTAMINANT	Oral/Dermal	Inhalation	Oral/Dermal	Inhalation
METALS:				
Arsenic	7.5E-07	2.7E-06	2.7E-06	1.3E-05
Chromium		9.2E-06		4.5E-05
Copper				
Lead				
Nickel		1.0E-07		4.6E-07
Silver				
Zinc				
VOLATILE ORGANICS:				
Benzene	3.7E-11	0.0E+00	4.8E-09	1.5E-07
1,2-Dichloroethane	2.0E-10	0.0E+00	1.5E-08	4.3E-07
Eth + Tol + Xyl (ETX)				
Vinyl Chloride	1.8E-09	0.0E+00	4.4E-07	4.3E-05
EXTRACTABLE ORGANICS:				
Total Carcinogenic PAHs	4.6E-06	4.3E-07	4.3E-05	2.7E-06
1,2-Dichlorobenzene				
Hexachlorobenzene	0.0E+00	0.0E+00	7.6E-06	3.9E-09
Total PCBs	3.6E-07	9.3E-09	1.4E-05	5.2E-08
	5.9E-06 (a)	1.2E-05 (a)	4.7E-05 (b)	7.0E-05 (b)
CUMULATIVE CANCER RISK		1.8E-05 (a)		8.9E-05 (b)

Notes:

(a) The cumulative average lifetime cancer risk was computed assuming simple additivity of risks from individual chemicals.

(b) The cumulative probabilistic upper 95th percentile lifetime cancer risk was not calculated as the simple sum of individual component risks. The upper-bound cancer risk estimate was computed based on a first-order uncertainty propagation model, using the assumed exposure correlation matrix (Table 9.3) and simple additivity of risks from individual chemicals; see text.

To provide perspective on this level of risk, the current expectation of lifetime cancer risk for the general U.S. population is 1 in 4 (Crouch and Wilson, 1984). As an individual contributor to this risk, daily consumption of diet soda containing saccharin is associated with an average lifetime cancer risk of approximately 1 in 1,400. Consumption of charcoal broiled steak (two servings per week) is associated with a calculated cancer risk due to HPAH exposure of 1 in 14,000.

Most of the calculated average and upper-bound lifetime cancer risks at the PACCAR site are attributable to potential arsenic, chromium, and HPAH exposures (Table 9.10). Uncertainties in upper-bound exposures to vinyl chloride and hexachlorobenzene (estimated conservatively using sample detection limits), also contributed to the risk calculations. The principal factors contributing to site cancer risks are discussed below.

The largest single cancer risk component was attributable to the potential inhalation of chromium dusts (Table 9.10). However, these calculated risks are attributable to potential dust emissions from the site, and the potentially carcinogenic effects of inhalation exposures (see Table 9.6). The calculations also conservatively assume that all of the chromium present in site soils is hexavalent chromium. The limited on-site determinations of hexavalent chromium, however, suggest that this species represents only a very small fraction of the total. Furthermore, the average concentration of total chromium in surficial site soils (76 mg/kg; Table 8.1) is similar to concentrations reported in background areas of Puget Sound (10 to 70 mg/kg; METRO, 1985). Based on these data, the potential significance of the chromium risk is greatly diminished.

The calculated average arsenic risk is largely due to a predicted input of 0.04 ug/L arsenic into the water supply system (see Tables 8.2, 9.4, and 9.5). This value is well below the existing Maximum Contaminant Level (MCL) for arsenic of 50 ug/L, and also well below the proposed MCL of 30 ug/L. Put in this perspective, the significance of the arsenic input is also diminished. Furthermore, as discussed in Section 7.0, the carcinogenicity of low-level arsenic exposures is considered questionable, since such low doses may actually have nutritional benefits.

The average lifetime risk associated with cumulative HPAH exposure is approximately 5.0 x 10^{-6}, or 1 in 200,000, while the probabilistic (95 percent) upper-bound risk is 4.5 x 10^{-5}, or 1 in 20,000 (Table 9.10). The calculated HPAH risks exceed the general average risk target of 10^{-6} (EPA, 1988f).

Much of the uncertainty in the HPAH risk estimate (expressed as the large range between average and upper-bound estimates) is due to uncertainties in the dermal absorption rate, and also to other related factors which determine dermal contact exposures. The upper-bound estimates generally reflect a worst-case combination of all such factors.

Considerable uncertainties are associated with evaluation of mixtures of HPAHs. For example, given the toxicological criteria of an "alternative" toxicity and carcinogenicity model presented in Table 7.4, a second estimate of HPAH risks can be derived. For the average exposure condition, the computed cumulative lifetime cancer risk from HPAHs is approximately 1.4 x 10^{-7}, or 1 in 7,000,000. This value is nearly 40 times lower than the cumulative risk estimate presented in Table 9.10, and also lower than the general risk goal of 10^{-6}. Similar reductions in risk estimates occur for the upper-bound exposure (e.g., 95 percentile) conditions.

9.3.3 Drinking Water Risks

As discussed in Section 9.1, two drinking water exposure scenarios were considered in this risk assessment. The first scenario was based on predicted contributions to the Renton well field which supplies water to nearly all of the local community. The second scenario considered a hypothetical future drinking water well installed at the southwest boundary of the site within the Cedar River catchment area, where groundwater concentrations of site indicator chemicals are highest (see Section 6). No such boundary well has been identified to currently exist. The risk calculations summarized in Tables 9.7 through 9.10 were based on the (first) Renton water supply scenario.

The individual and cumulative risks associated with consumption of drinking water under both exposure scenarios is summarized in Table 9.11. The methods used to compute these risks were equivalent to those described previously.

As expected, the risk of consumption of groundwater obtained from the downgradient boundary well are higher than those of within the Renton water supply system. The average cancer risk associated with consumption of downgradient waters from the hypothetical well is 5.0×10^{-4}, or 1 in 2,000, as compared to 5.5×10^{-7} (1 in 1,800,000) in the Renton supply. Calculated risks to the Renton supply are much lower because the Renton analysis considered the finding that only a small portion of the water pumped from the wells is derived from beneath the PACCAR site.

Nearly all of the calculated drinking water risks under both the existing Renton supply and the hypothetical downgradient boundary well scenario are attributable to arsenic and vinyl chloride (Table 9.11). Only vinyl chloride, however, exceeds existing MCLs for the regulation of drinking water quality. As discussed above, a considerable degree of uncertainty surrounds cancer risk estimates associated with low-level arsenic exposures, like those depicted in Table 9.11.

Minor non-carcinogenic risks could also occur as a result of regular consumption of water obtained from the hypothetical downgradient boundary well. Although the calculated Hazard Index associated with such consumption is 0.40 under average exposure conditions, the index is 1.58 under probabilistic upper-bound (95th percentile) conditions (Table 9.11). An index value above 1.0 is indicative of potential risk.

Uncertainties in Risk Estimates

As discussed in the previous sections, considerable uncertainties exist in the estimated human health risks posed by chemical contaminants present at the PACCAR site. These uncertainties generally result in an over-estimation of the actual risks posed by the PACCAR Site due to the conservative assumptions that were employed when insufficient data were

Table 9.11 - Comparison of Calculated Drinking Water Risks in Existing and Potential Future Water Supplies

A. CALCULATED EXISTING RISKS WITHIN THE RENTON WATER SUPPLY SYSTEM

CONTAMINANT	Water Concentration (ug/L) a Average	Water Concentration (ug/L) a Upper 95%	Maximum (0 to 6 year age class) Non-Carcinogenic Hazard Ind Average	Maximum (0 to 6 year age class) Non-Carcinogenic Hazard Ind Upper 95%	Lifetime Cancer Risk Average	Lifetime Cancer Risk Upper 95%
METALS:						
Arsenic	0.04	0.18	0.00	0.00	5.5E-07	2.2E-06
Chromium	0.02	0.09	0.00	0.00		
Copper	0.03	0.12	0.00	0.00		
Lead	0.03	0.12	0.00	0.00		
Nickel	0.00	0.02 U	0.00	0.00		
Silver	0.00	0.00				
Zinc	0.14	0.57	0.00	0.00		
VOLATILE ORGANICS:						
Benzene	0.00	0.01 U			0.0E+00	1.7E-09
1,2-Dichloroethane	0.00	0.01 U			0.0E+00	5.2E-09
Eth + Tol + Xyl (ETX)	0.02	0.10	0.00	0.00		
Vinyl Chloride	0.00	0.02 U			0.0E+00	2.6E-07
EXTRACTABLE ORGANICS:						
Total Carcinogenic PAHs	0.00	0.03 U			0.0E+00	2.4E-06
1,2-Dichlorobenzene	0.00	0.02 U	0.00	0.00		
Hexachlorobenzene	0.00	0.02 U	0.00	0.00	0.0E+00	1.9E-07
Total PCBs	0.00	0.00 U			0.0E+00	2.2E-07
CUMULATIVE TOTAL RISK			0.00	0.01	5.5E-07 (c)	3.5E-06 (c)

B. CALCULATED POTENTIAL FUTURE RISKS IN WELLS AT SOUTHWEST PROPERTY BOUNDARY

CONTAMINANT	Water Concentration (ug/L) b Average	Water Concentration (ug/L) b Upper 95%	Maximum (0 to 6 year age class) Non-Carcinogenic Hazard Ind Average	Maximum (0 to 6 year age class) Non-Carcinogenic Hazard Ind Upper 95%	Lifetime Cancer Risk Average	Lifetime Cancer Risk Upper 95%
METALS:						
Arsenic	14	43	0.27	0.96	2.0E-04	5.6E-04
Chromium	2	8	0.01	0.03		
Copper	3	21	0.00	0.01		
Lead	7	30	0.09	0.45		
Nickel	4	49	0.00	0.05		
Silver	3	10				
Zinc	18	37	0.00	0.00		
VOLATILE ORGANICS:						
Benzene	3	26			9.3E-07	5.6E-06
1,2-Dichloroethane	1	3			8.9E-07	2.4E-06
Eth + Tol + Xyl (ETX)	106	1,600	0.02	0.32		
Vinyl Chloride	14	120			3.0E-04	2.1E-03
EXTRACTABLE ORGANICS:						
Total Carcinogenic PAHs	0	7 U			0.0E+00	5.7E-04
1,2-Dichlorobenzene	2	6	0.00	0.00		
Hexachlorobenzene	0	4 U	0.00	0.10	0.0E+00	4.8E-05
Total PCBs	0	1 U			0.0E+00	5.4E-05
CUMULATIVE TOTAL RISK			0.40	1.58	5.0E-04 (c)	2.4E-03 (c)

NOTES:

a) Potential site contributions to the Renton water supply system are presented in Table 8.2.

b) Based on data from monitoring wells LW-6, LW-9, LW-12, OSP-4, OSP-5, OSP-6, and OW-4.

c) See footnotes on Table 9.10 for a discussion of cumulative risk calculations.

available. These uncertainties result from the exposure assumptions and toxicity criteria which form the basis of the risk assessment. The major identified uncertainties associated with the risk estimates are discussed below.

Exposure Uncertainty

The exposure assumptions utilized in this risk assessment are generally regarded as conservative. For example, in the absence of sufficient data from which to base the exposure estimates, the more conservative values available from the literature and EPA guidance were applied to the PACCAR site.

Conservative assumptions utilized in this risk assessment include access and contact with site soils, which are generally assumed to occur daily for the Most Exposed adult Individual (MEI) working at the facility. No health and safety precautions were assumed to occur for the MEI (e.g., no gloves on hands). Other similar assumptions include the nearly continuous long-term duration of such exposures. Given normal site working conditions, the probability that even one person would meet the stated exposure MEI criteria is considered remote.

Another key assumption contributing to the calculated site risk is the rate of dermal absorption of soil-bound contaminants which may adhere to the skin of site workers. Since quantitative data to define absorption rates are generally lacking, this assessment conservatively assumed rates based either on the highest reported measurement or on theoretical maximum conditions.

The uncertainty introduced by use of these conservative values results in an overestimation of actual site risk. Although such an approach is recommended by EPA and Ecology for risk assessment purposes, it should be recognized that the calculated risks derived from such procedures will generally overestimate actual conditions.

Carcinogenicity Uncertainty

One of the other significant sources of uncertainty in the estimation of human health risks at the PACCAR site is the cancer potency slope used to relate chemical doses to possible cancer endpoints. Several factors contribute to this uncertainty.

The potency slope for HPAHs used in this assessment is perhaps one of the more significant toxicological criteria, since much of the total cumulative cancer risk at the site is attributable to HPAH exposure (see Table 9.10 and discussion above). However, depending upon which cancer model is selected to represent the potency of HPAH (i.e., surrogate two-stage versus equivalent multi-stage), the calculated risks of HPAH exposure at PACCAR may vary by up to 40-fold (see discussion, above and in Section 7.2.3).

The risk calculations presented in Table 9.10 refer to the most conservative HPAH potency model (equivalent multi-stage) based on EPA guidance. However, as discussed by Clements and Associates (1988), the alternative surrogate two-stage model of HPAH carcinogenicity has a stronger scientific basis, and likely represents a more "realistic" estimate of actual cancer risks. If the surrogate two-stage model were utilized, the cumulative risk of HPAHs under average exposure conditions at the PACCAR site would be approximately 1×10^{-7}, or indicative of little public health risk, even under the assumed conservative exposure conditions.

One of the other significant sources of uncertainty in the estimation of cancer risks is the linearized (i.e., non-threshold) model of carcinogenesis developed by EPA for risk assessment. The non-threshold assumption of carcinogenesis is recognized as a conservative approach given our present understanding of cancer mechanisms, but may not represent actual conditions (e.g., see discussion of arsenic carcinogenicity in Section 7.2.1). Furthermore, since the potency slope values were calculated by EPA as upper-bound statistical estimates, use of these values would be expected to overestimate cancer risks, particularly under lower exposure conditions. Considering this information, the actual range of cancer risk outcomes resulting from site exposures may range from a low of zero to an upper limit defined by the EPA potency model.

9.4 POTENTIAL ENVIRONMENTAL RISKS

Potential environmental risks associated with the PACCAR site include toxicity to aquatic life in Johns Creek, the Cedar River, and nearshore Lake Washington. While impacts to terrestrial wildlife are possible at the site, the industrial/commercial nature of the surrounding area generally precludes significant access by wildlife. Furthermore, exposure and risk assumptions utilized in the preceding public health evaluation would generally apply to wildlife gaining access to the site. The cancer risk characterizations presented above should result in conservative overestimates of potential risks to wildlife, since carcinogenesis is not normally considered in environmental risk evaluations. Remediation efforts which address potential human health risks, therefore, should adequately protect wildlife. For these reasons, risks to terrestrial wildlife were not explicitly considered in this risk assessment.

Potential aquatic life impacts associated with site discharges can be assessed by comparing observed and predicted water quality data with applicable state and EPA criteria (EPA, 1986b). A summary of measured concentrations in site stormwater discharged to Johns Creek, and predicted concentration increases in the Cedar River, are presented in Table 9.12, based on evaluations presented in Sections 6 and 8. Relative to the most restrictive aquatic life chronic toxicity values, very few criteria exceedences in local receiving water are expected under the baseline (current) condition. The few elevations of contaminant concentrations attributable to the PACCAR site occur only in Johns Creek. In this case several metals, particularly copper and zinc, may periodically exceed both chronic and acute toxicity criteria to protect sensitive aquatic life.

As discussed in Section 6, the quality of stormwater runoff from the PACCAR site is similar to or better than the quality of typical urban runoff from local residential areas. Based on this correspondence, potential impacts associated with the discharges should be similar.

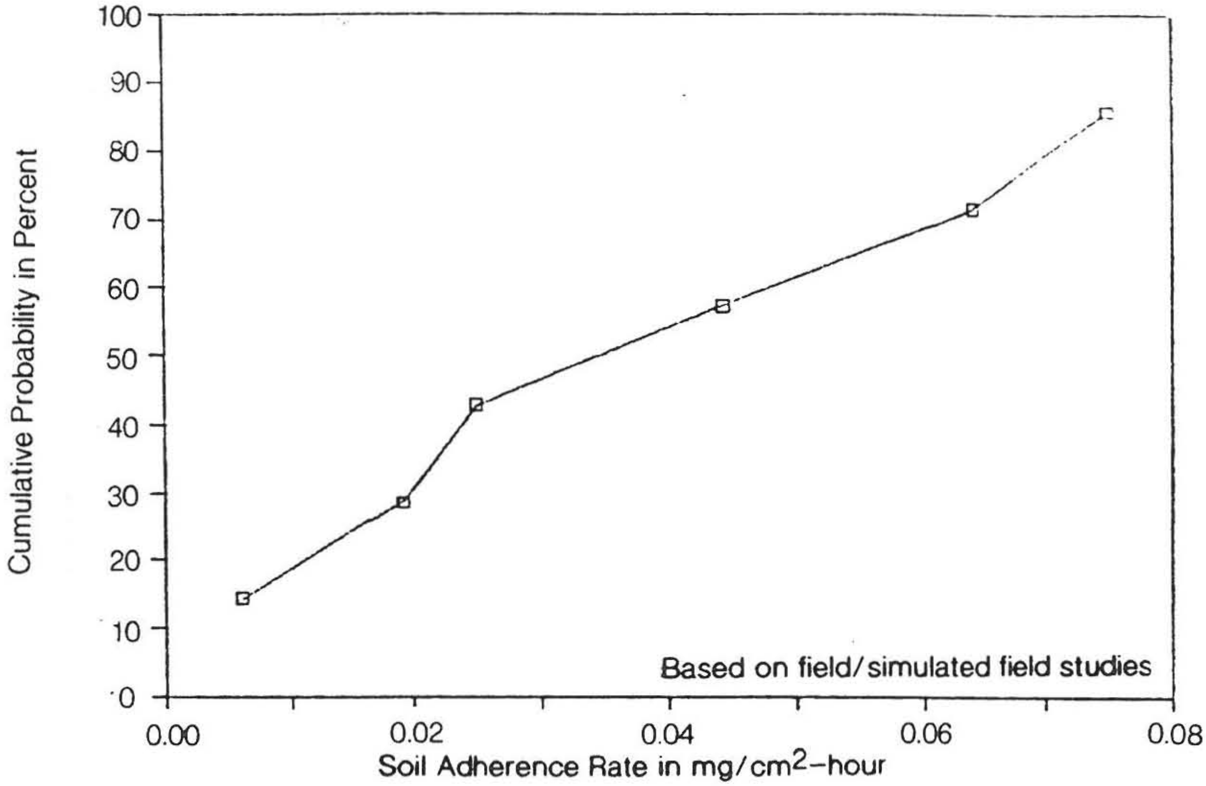
Table 9.12 - Comparison of Surface Water Quality Characteristics with Aquatic Life Criteria; All Units in ug/L.

Site Contaminant of Concern	On-Site Surface Water Discharge to Johns Creek			Site Contributions to Cedar River (a)		Freshwater Aquatic Life Criteria (b)	
	Detection	Mean	Worst 95%	Mean	Worst 95%	Chronic Toxicity	Acute Toxicity
Arsenic	2/14	2	7	0.06	0.26	48	360
Chromium	3/14	2	8	0.01	0.02	11	16
Copper	11/14	19	43	0.00	0.02	7	9
Lead	3/14	4	15	0.02	0.06	1	34
Nickel	2/13	8	22	0.01	0.04	56	1,100
Silver	0/12	< 1	< 5	0.00	< 0.03	0.1	1
Zinc	11/13	77	234	0.07	0.32	47	180
Benzene	0/10	< 1	< 5	0.01	0.04	-	5,300
1,2-Dichloroethane	0/10	< 1	< 5	< 0.01	0.01	20,000	118,000
Eth + Tol + Xyl (ETX)	1/10	2	5	0.26	2.15	-	17,500
Vinyl Chloride	0/10	< 1	< 5	0.02	0.14	-	-
Total PAHs	0/6	< 4	< 10	< 0.005	< 0.022	-	-
1,2-Dichlorobenzene	0/10	< 1	< 2	0.005	< 0.019	763	1,120
Hexachlorobenzene	0/10	< 2	< 4	< 0.003	< 0.012	-	-
Total PCBs	0/12	< 0.1	< 1	< 0.0001	< 0.003	0.01	2

a. See Table 7.2 for derivation of site contributions to the Cedar River.
b. Aquatic life criteria based on EPA (1986b), assuming a local water hardness of 50 mg/L as CaCO3.

The impacts of residential runoff in the Seattle metropolitan area were studied extensively by Galvin and Moore (1982). These investigators concluded that while subtle chronic effects were possible, no acute toxicity problems were encountered at any of the stream sites studied. Based on the similarity of chemical concentrations and habitats, a similar condition of little or no impact is expected in Johns Creek. In any event, since Johns Creek receives the bulk of its hydraulic input from surrounding residential and commercial areas which likely exhibit similar water quality characteristics, impacts attributable to the PACCAR site are diminished.

In Situ Dermal Exposure to Soil



SUMMARY OF IN SITU DERMAL CONTACT EXPOSURES

Average Measured Skin Accumulation of Dust (a) (mg/hr)	Average Measured Unit Dust Adherence (mg/cm2)	Adult Skin Surface Area (a) (m2)	Exposure Duration (b) (hr)	Average In-Situ Soil Adherence Rate (mg/cm2-hr)	Source
64		0.33		0.019	Hawley, 1985– citing Wolfe and Armstrong, 1971
20		0.33		0.006	Hawley, 1985 – citing Wolfe et al., 1978
	0.4		8	0.044	Hawley, 1985 – citing Roels et al., 1980
	0.5		8	0.064	Lepow et al., 1974
	0.2		8	0.025	Que-Hee, 1985
	0.6		8	0.075	Versar, 1989 (simulated field conditions)
			Average	0.039	
			Std. dev.	0.027	
			CV	69%	
			T-value	2.02	
			Adj. SD	0.033	
			95%-tile	0.093	

NOTES:

a) Average exposed body area based on hands, forearms, and head.

b) Potential exposure duration based on an average 8 hour period each day that the skin is not washed.

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Figure 9.1

Soil Lead Concentrations
Cumulative Probability Distribution

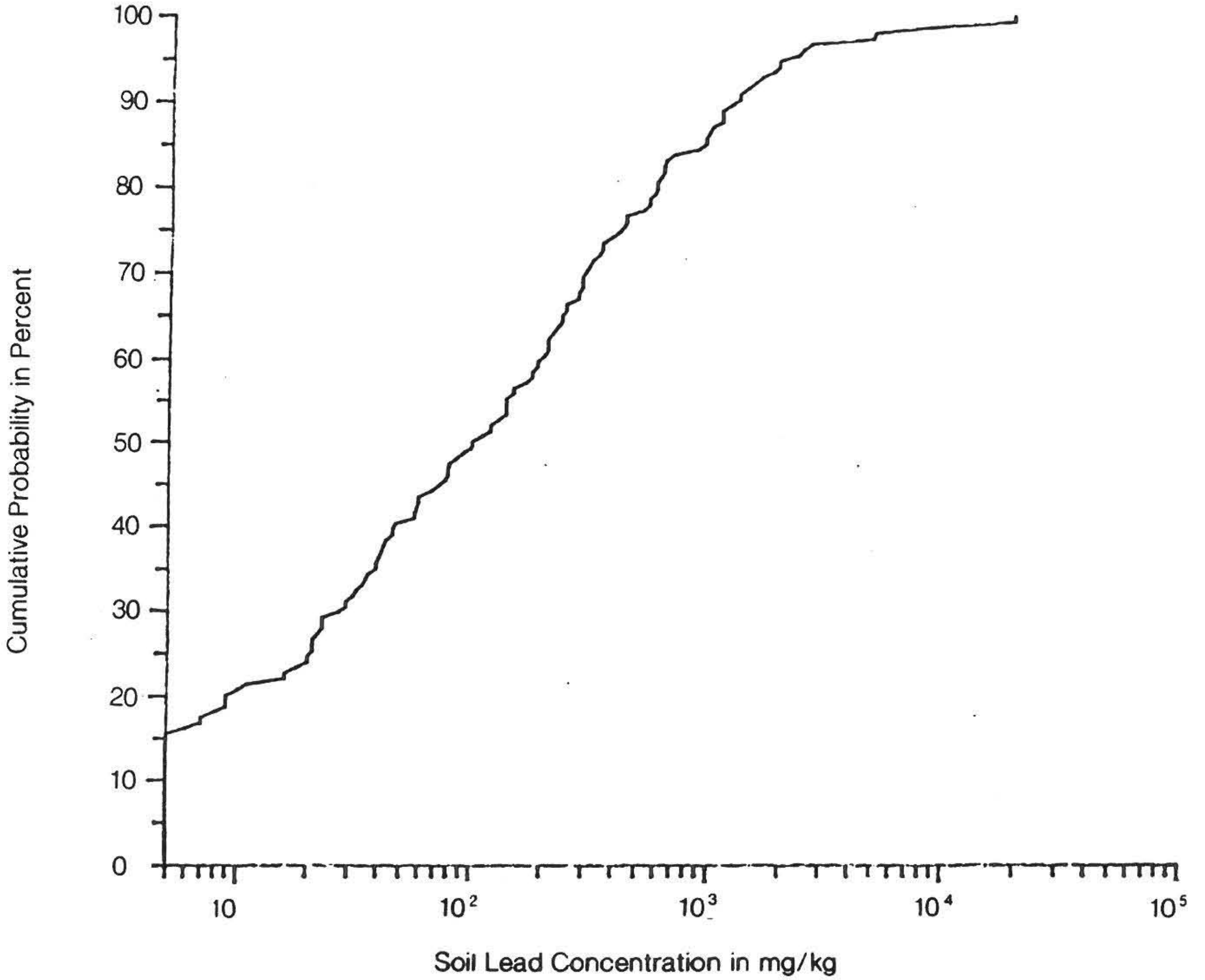

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Figure 9.2

Adult (18 to 75 yrs.) Body Weight

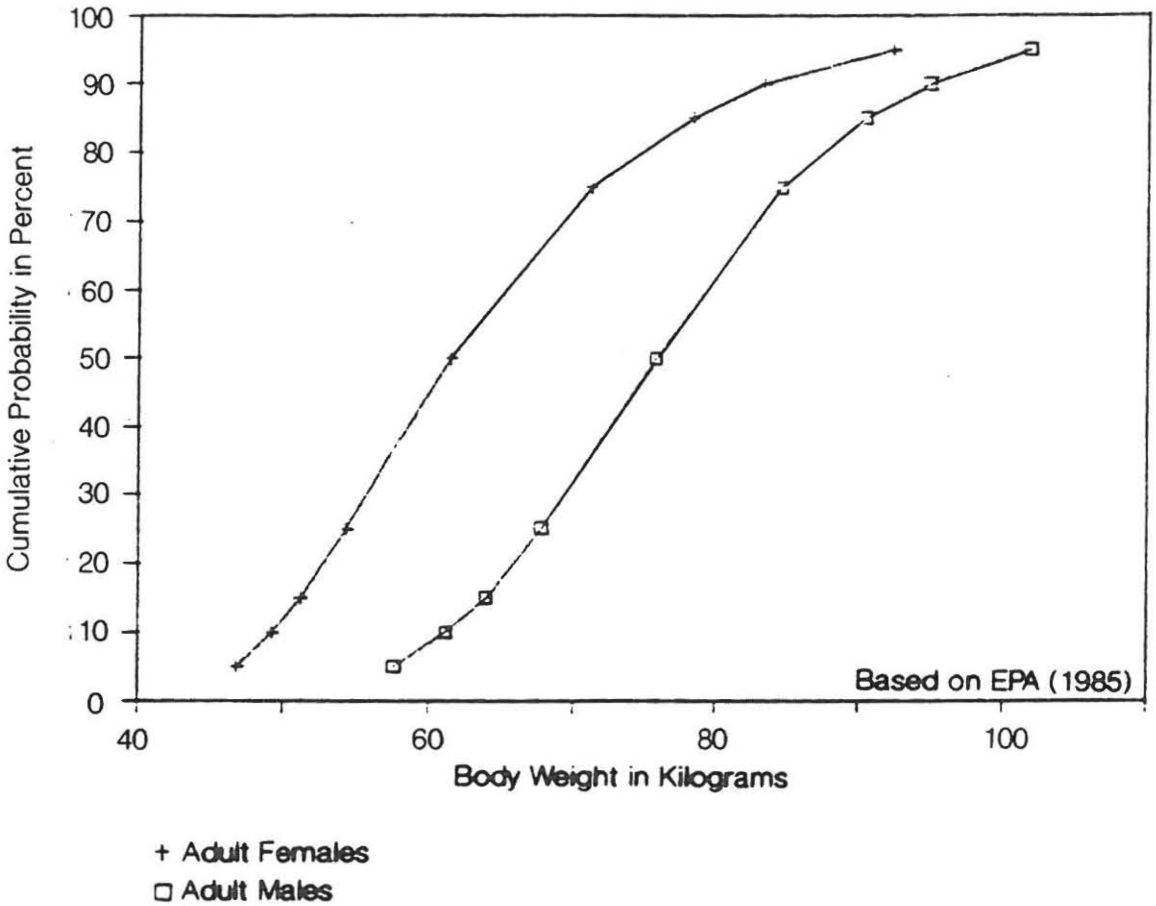

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Figure 9.3

Soil Ingestion Rates for Children

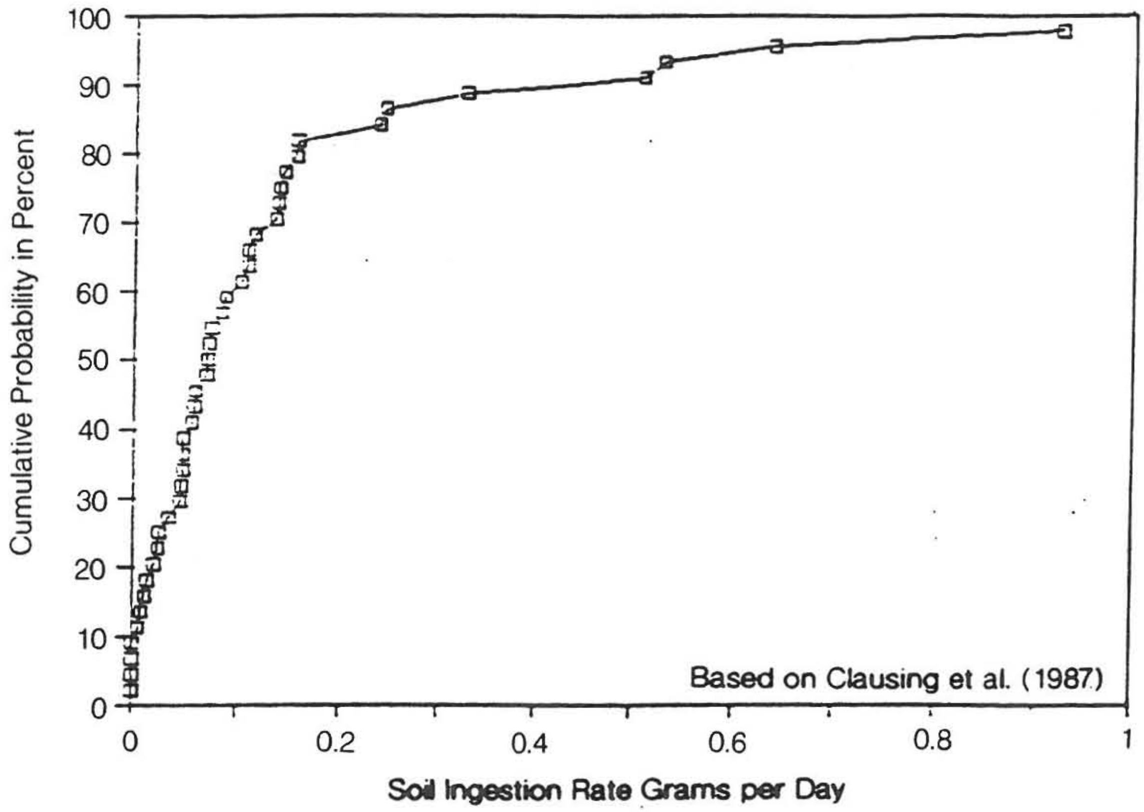

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Figure 9.4

Drinking Water Consumption Rate

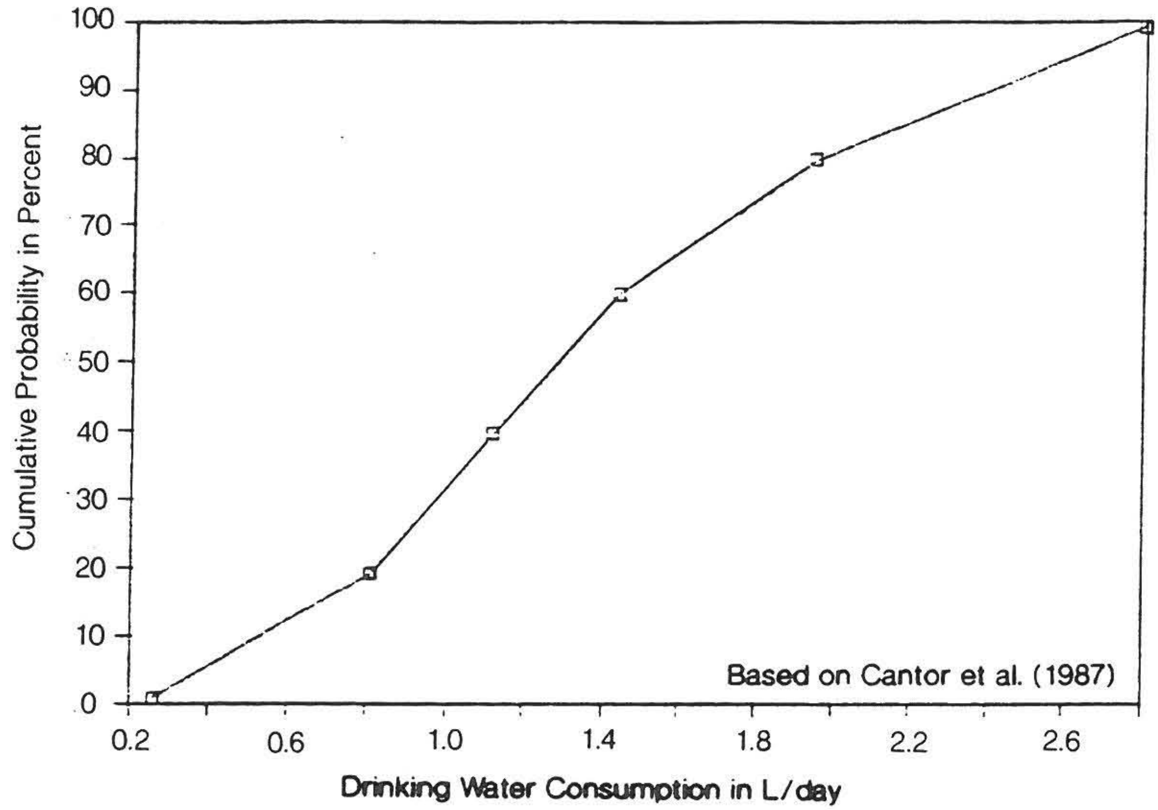

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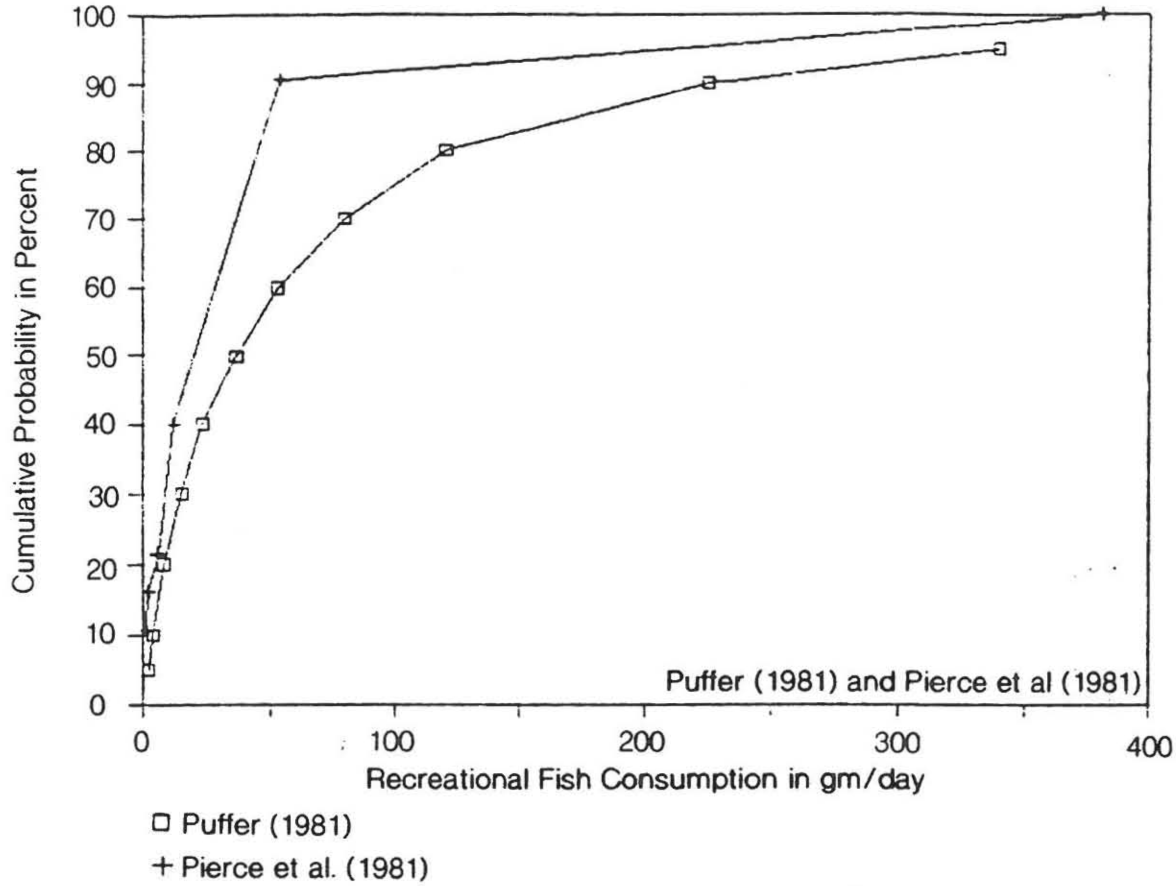
Figure 9.5

Recreational Fish Consumption Rate



SUMMARY OF FISH CONSUMPTION DATA:

	Puffer (1981)	Pierce et al. (1981)	Javitz (1980)	This study
Sample Size	1,059	304	24,652	
Median	37 g/d	21 g/d		
Arithmetic Mean	80 g/d	45 g/d	14 g/d	14 g/d
Upper 95 percent	339 g/d	194 g/d	42 g/d	194 g/d
Data Distribution	Log-normal	Log-normal	Log-normal	Log-normal
Normalized Data:				
Adj. Std. Deviation	158 g/d	91 g/d	17 g/d	109 g/d
Coef. of Variation	198%	201%	116%	766%

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Figure 9.6

BCF Values for Dichlorobenzenes

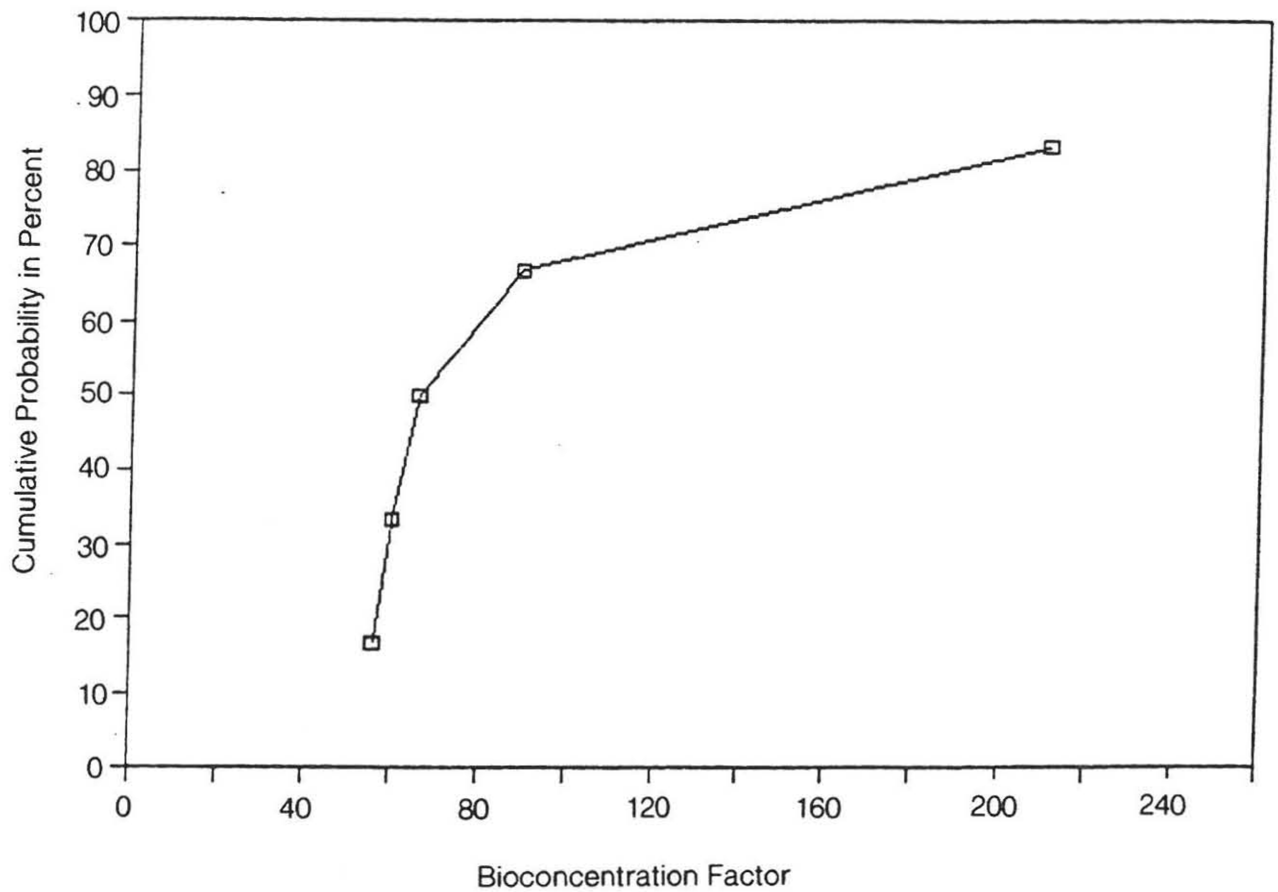

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Figure 9.7

Monte Carlo Simulation for Daily Lead Intake Cumulative Probability Distribution

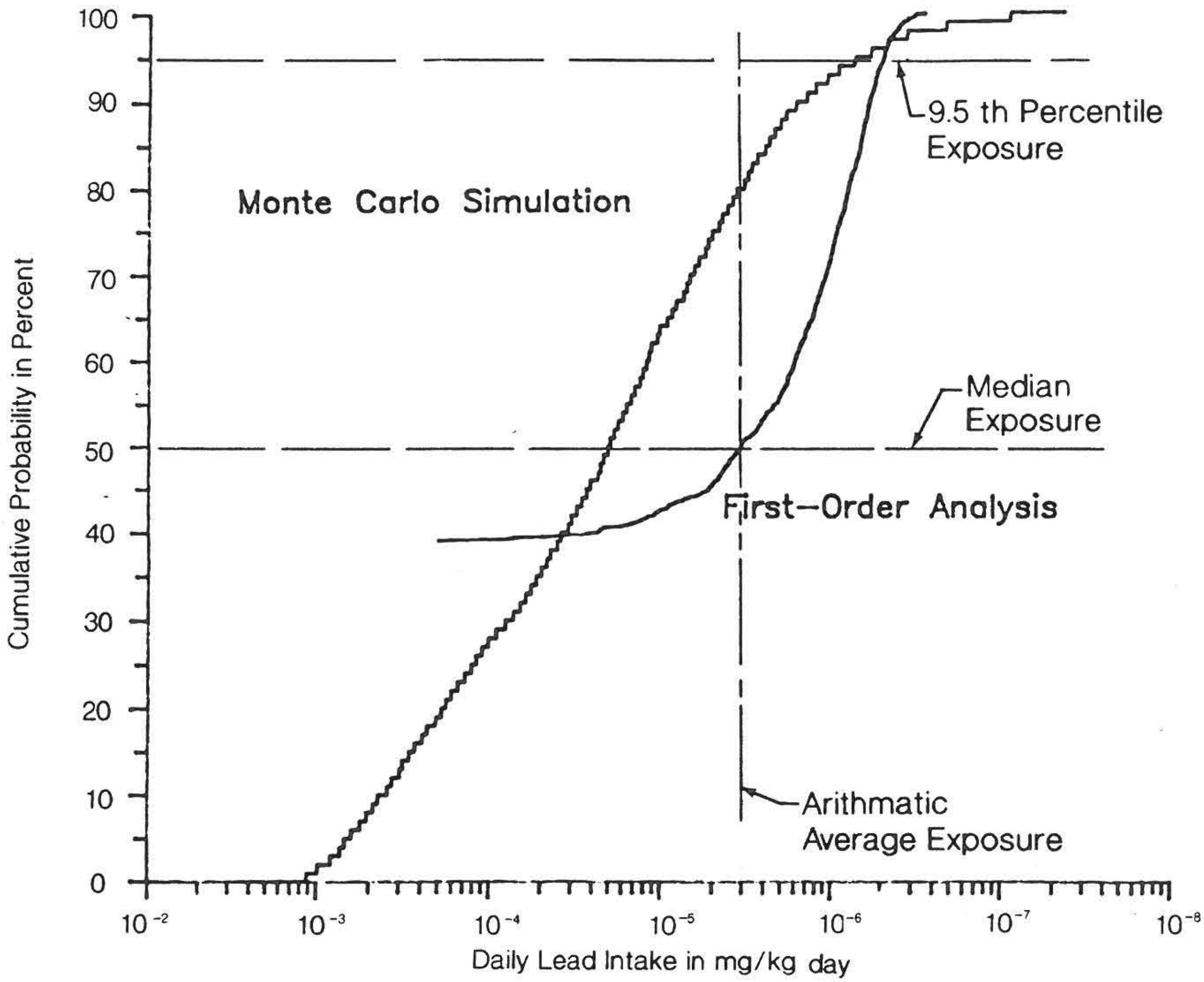

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Figure 9.8

10.0 REFERENCES

AWWA Research Foundation, (1983). Occurrence and Removal of Volatile Organic Chemicals from Drinking Water, Denver, Colorado, 29 p.

Bartek, M. J., J. A. Labudd, and H. I. Maibach, (1972). Skin permeability in vivo: Comparison in rat, rabbit, pig and man. The Journal of Investigative Dermatology. 58(3):114-123.

Bingham, E., and H.L. Falk, (1969). The modifying effect of carcinogens on the threshold response. Arch. Environ. Health 19:779-783.

Brown, R.A, and F.T. Weiss, (1978). Fate and Effects of Polynuclear Aromatic Hydrocarbons in the Aquatic Environment, American Petroleum Institute, Publication No. 4297, 23 p.

Callahan, M. A., M. W. Slimak, and N. W. Gabel, (1979). Water-Related Environmental Fate of 129 Priority Pollutants, Volume 1. EPA Office of Water Planning and Standards and Office of Water and Waste Management. EPA 440/4-79-029.

CH2M Hill, (1984). Report on Well Field Protection Study, City of Renton, Washington.

CH2M Hill, (1986). Well Field Monitoring Well Installation Report (Letter Report No. 1).

CH2M Hill, (1988a). Well Field Monitoring Study, Prepared for City of Renton, March 1988.

CH2M Hill, (1988b). Technical Memorandum - Results of Monitoring Well Installation and Pumping Test, December 15, 1988, Prepared for City of Renton.

CH2M Hill, (1989). Results of Monitoring Well Installation Pump Test, prepared for City of Renton (February 9, 1989).

City of Renton, (1988). North Renton Basin Interim Drainage Study to Address Development West of I-405 (Garden Plaza - Park Plaza), City of Renton Stormwater Utility, May 1988.

City of Renton, (Undated). Selected Well Logs and Well Construction Features.

Clausing, P., B. Brunckreef, and J. H. van Wijnen, (1987). A method for estimating soil ingestion by children. Int. Arch. Occup. Environ. Health 59:73-82.

Clement Associates, (1988). Comparative potency approach for estimating the cancer risk associated with exposure to mixtures of polycyclic aromatic hydrocarbons. Interim Final Report, Contract No. 68-02-4403.

Cornell, C. L., (1973). First-order analysis of model and parameter uncertainty. In: International Symposium on Uncertainties in Hydrologic and Water Resource Systems, pp. 1245-1274.

Dames & Moore, (1961). Report of Soil Investigation, Proposed Foundry Equipment Installation, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1964). Report of Soils Investigation, Proposed Paint Shop Building, Renton Plan, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1970). Report of Soils Investigation, Proposed Structural Test Laboratory, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1972). Report of Soils Investigation, Proposed Warehouse, Houserway, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1974). Report of Soils Investigation, Proposed Two-Story Pipe Shop, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1978). Report of Soils Investigation, Proposed Steel Shop Building, No. 5 Expansion, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1980). Report of Soils Investigation, Paint Shop Building Expansion, Renton, Washington, for Pacific Car & Foundry Company.

Dames & Moore, (1984). Preliminary Soils Investigation, Proposed Plant Expansion, Renton, Washington, for Pacific Car & Foundry Company.

Deutsch-Wenzel, R., H. Brune, O., Grimmer, G. Dettbarn, and J. Misfeld, (1983). Experimental studies in rat lungs on the carcinogencity and dose-response relationships of eight frequently occurring environmental polycyclic aromatic hydrocarbons. J. Natl. Cancer Inst. 71:539-544.

Ecology and Environment, (1986). Report Prepared for EPA, Site Inspection Report of Pacific Car & Foundry Company, Renton, Washington. TDD R10-8510-11B.

EPA, (1980). Ambient Water Quality Criteria. Office of Water Regulations and Standards, Criteria and Standards Division. EPA/440/5-80.

EPA, (1985a). Summary of Available Information Related to the Occurrence of Vinyl Chloride and Groundwater Water as a Transformation Product of Other Volatile Organic Chemicals, U.S. Department of Commerce, Mclean, Virginia, 17 p.

EPA, (1985b). Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments. EPA/600/8-85/010.

EPA, (1986a). Superfund public health evaluation manual. EPA 540/1-86-060.

EPA, (1986b). Quality criteria for water - 1986. EPA 440/5-86-001.

EPA, (1986c). Air Quality Criteria for Lead. EPA/ORD Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. EPA 600/8-83/018f.

EPA, (1986d). Health Effects Assessment for PAHs. EPA/50/1-86-013.

EPA, (1988a). Integrated Risk Information System. Office of Research and Development, Environmental Criteria and Assessment Office.

EPA, (1988b). Personal Communication. Carcinogen Assessment Group, October 1988, Washington, D.C.

EPA, (1988c). Special Report on Ingested Inorganic Arsenic. Skin cancer: nutritional essentiality EPA Risk Assessment Forum. EPA 625/3-87/013.

EPA, (1988d). Proposed Drinking Water Standards. EPA Office of Drinking Water, Washington D.C.

EPA, (1988e). Superfund Exposure Assessment Manual. EPA Office of Remedial Response. EPA 540/1-88-001. Draft Report, 157 p.

EPA, (1988f). National Oil and Hazardous Substances Pollution Contingency Plan; Proposed Rule - 53 Fed Reg 51394, December 21, 1988.

EPA, (1989a). Exposure Factors Handbook, USEPA Research and Development, Office of Health and Environmental Assessment, EPA 600/8-89/043.

EPA, (1989b). Statement of Work for the RI/FS Human Health Risk Assessment - Regional 10 Draft Document.

EPA, (1989c). Health Effects Assessment Summary Tables. EPA Environmental Criteria and Assessment Office. OSWER OS-230.

EPA, (1989d). National primary and secondary drinking water regulations; proposed rule 40 CFR 141, 142, 143:22061-22160.

Farris et al., (1979). Urban Drainage Stormwater Monitoring Program, a report to supplement the Environmental Management for the Metropolitan Area, Part II, Urban Drainage - Stormwater Monitoring Program, October, 1974, Appendix C.

Feldman, R. J., H. I. Maibach, (1970). Absorption of some organic compounds through the skin in man. Journal of Investigative Dermatology. 54(5):399-404.

Finch, R., (1973). "Effects of Regulatory Guidelines on the Intake of Mercury from Fish - the MECCA PROJECT." Fishery Bulletin 71, p.615-626.

Freeze, R. A. and J. A. Cherry, (1979). Groundwater, Prentice-Hall, Inc., N.J. 604p.

Galvin, D. V. and R. K. Moore, (1982). Toxicants in Urban Runoff. Toxicant Program Rep. 2. Municipality of Metropolitan Seattle, Seattle, WA. 230 pp.

Gilchrist, C. A., A. Lynes, G. Steel, and B. T. Whitlam, (1972). The determination of polyaromatic hydrocarbons in the environment by glass gas chromatography. Anal. Chem. 50, 243.

Glass, G. (1984). A Review of the Available Data in the Vicinity of the Tacoma Smelter. Prepared for the Air Work Group, Commencement Bay Superfund Site. Tacoma: Tacoma-Pierce County Health Department.

Goyer, R. A., (1986). Toxic Effects of Metals. In Casarett and Doull's Toxicology; The Basic Science of Poisons. 3rd ed. eds. Klaassen, C. D., M. O. Amdur, and J. Doull. Chapter 19, 582-635. New York: Macmillan.

Hart Crowser, Inc., (1983). Summary Report, Hydrologic Analysis, Renton Well No. 9, Renton, Washington, prepared for the City of Renton and RH2 Engineering, November 11, 1983, J-1148.

Hart Crowser, Inc., (1986a). Site Assessment, Soil and Groundwater Quality, PACCAR Facility, Renton, Washington.

Hart Crowser, Inc., (1986b). Data Analysis, Oil Assessment, Tank 21 Excavation.

Hart Crowser, Inc., (1987a). Replacement Production Wells RW-1, RW-2, and RW-3, City of Renton, Washington, prepared for RH2 Engineering, July 14, 1987, J-1667.

Hart Crowser, Inc., (1987b). Additional Groundwater Flow Assessment Data, PACCAR Defense Systems Facility, Renton, Washington, October 5, 1987.

Hart Crowser, Inc., (1988a). Remedial Action Activities at LW-11, PACCAR Defense Systems, Renton, Washington, dated February 26, 1988.

Hart Crowser, Inc., (1988b). Work Plan, Remedial Investigation/Feasibility Study and Redevelopment, Proposed Kenworth Plant Site, Renton, Washington, dated May 27, 1988.

Hart Crowser, Inc., (1989a). Preliminary Geotechnical Assessment and unpublished chemical data, Kenworth Renton Truck Plant Project, Houser Way North Sewer Line, dated April 27, 1989.

Hart Crowser, Inc., (1989b). Geologic and Groundwater Assessment Report, MIS Building Tank Replacement, Renton, Washington, dated May 26, 1989.

Hawley, J. K., (1985). Assessment of health risk from exposure to contaminated soil. Risk Analysis. 5(4):289-302.

Heidelberger, C. and S. M. Weiss, (1951). The distribution of radioactivity in mice following administration of 3,4-benzpyrene-5-C^{14} and 1,2,5,6-dibenzanthracene-9,10-C^{14}. Cancer Research. 11: 885-891.

HNTB, (1984). Report Prepared by Applied Geotechnology, Inc. Field Investigation, Soil Contamination Study, Pacific Car & Foundry Company, Renton, Washington.

Javitz, (1980). Seafood Consumption Data Analysis. SRI International. Final Report prepared for EPA Office of Water Regulations and Standards. EPA Contract 68-01-3887.

Jewell, D. M., R. G. Ruberto, and B. E. Davis, (1972). Systematic approach to the study of aromatic hydrocarbons in heavy distillates and residues by elution adsorption chromatography. Anal. Chem. 44, 2318.

Kimbrough, R. D., H. Falk, and P. Stehr, (1984). Health implications of 2,3,7,8-tetrachloro-dibenzodioxin (TCDD) contamination of residual soil. Journal of Toxicology and Environmental Health. 14: 47-93.

Klaassen, C. D., M. O. Amdur, and J. Doull, eds., (1986). Casarett and Doull's Toxicology: The Basic Science of Poisons. 3rd ed. New York: Macmillan.

LaGoy, P. K., (1987). Estimating soil ingestion rates for use in risk assessment. Risk Analysis 7:355-359.

Landau, (1989). Property Assessments, E&H Properties (Renton, Kent, Auburn, Duwamish), King County, Washington for Boeing Environmental Affairs by Landau Associates, Inc., dated July 24, 1989.

Lepow, M. L., (1975). Investigations in sources of lead in the environment of Urban Children. Environ. Res. 10:415.

Luzier, J. E., (1969). Geology and Groundwater Resources of Southwestern King County, Washington. Washington Water Supply Bulletin No. 28.

METRO, (1982). Cedar River Resource Inventory, Technical Report WR-82-10, Water Quality Division.

METRO, (1985a). Background Water and Soil Quality at the Pilchuck Tree Farm Demonstration Site, 1982-1984. Report submitted to Municipality of Metropolitan Seattle, by Harper-Owes, Seattle, WA. 60 pp.

METRO, (1985b). Water Quality in Nearshore Lake Washington, King County, Washington. 1981 - 1984 Baseline Monitoring Report by Gregory J. Pelletier, Joanne Davis, Nancy Mesner, Peggy Burbank, W. Terra Prodan. Municipality of Metropolitan Seattle, Water Quality Divisions, 1984. Technical Report WR-85-1.

NBBJ, (1989). Draft Environmental Impact Statement Kenworth Truck Plant, Renton, Washington, dated August 1989.

PARBC, (1969). Climatological Handbook, Columbia Basin States, Precipitation Vol. 2. Meteorology Committee Pacific Northwest River Basins Commission.

Pierce, R.S., D.T. Noviello, and S.H. Rogers, (1981). Commencement Bay Seafood Consumption Report. Preliminary Report. Tacoma, Washington. Tacoma-Pierce County Health Department.

Poiger, H. and C. Schlatter, (1980). Influence of Solvents and absorbents on dermal and intestinal absorption of TCDD. Food and Cosmetic Toxicology 18:477-481.

PSAPCA, (1988). Puget Sound Air Pollution Control Agency, Personal communication, Steven Fry, July 27, 1988.

Puffer, H., (1981). Consumption Rates of Potentially Hazardous Marine Fish Caught in the Metropolitan Los Angeles Area. EPA Grant #R807 120010.

Que-Hee, S.S., B. Peace, C.S. Clark, J.R. Boyle, R.L. Bornschein, and P.B. Hammond, 1985. Evolution of Efficient Methods to Sample Lead Sources, such as House Dust and Hand Dust, in the Homes of Children. Environmental Research 38:77-95.

Roels, H. A., J. P. Buchet, R. R. Lauwerys, P. Bruaux, F. Claaeys-Thoreau, A. LaFontaine, G. Verduyn, (1980). Exposure to lead by the oral and pulmonary routes of children living in the vicinity of a primary lead smelter. Environ. Res. 22:81-94.

Romberg et al., (1984). Toxicant Pretreatment Planning Study Technical Report C1: Presence, Distribution, and Fate of Toxicants in Puget Sound and Lake Washington. Municipality of Metropolitan Seattle (Metro), Seattle, Washington.

Ryan, E. A., E. T. Hawkins, B. Magee, and S. L. Santos, (1987). Assessing Risk from Dermal Exposure at Hazardous Waste Sites. Superfund Proceedings of the 8th National Conference of Hazardous Materials Control Research Institute, pp. 166,168.

Schaum, John, (1984). Risk Analysis of TCDD Contaminated Soil. EPA-600/8-84-031. Exposure Assessment Group. Office of Health and Environmental Assessment. ORD. USEPA.

Shannon, R. E., (1975). Systems simulations: the art and science. Prentice-Hall, Inc., N.J. 387 pp.

Skidmore, E. L. and N. P. Woodruff, (1968). Wind erosion forces in the United States and their use in predicting soil loss. Agricultural Handbook No. 346, Agricultural Research Service. United States Department of Agriculture.

Thorslund, T.W., C.C. Brown, and G. Charnley, 1987. Biologically motivated cancer risk models. Risk Analysis 7: 109-119.

Thyssen, J., J. Althoff, G. Kimmerle, and U. Mohr, (1981). Inhalation studies with benzo(a)pyrene in Syrian golden hamsters. J. Natl. Cancer Inst. 66:575-577.

Travis, C. C. and H. A. Hattemer-Frey, (1988). Determining an acceptable level of risk. Env. Sci. Tech. 22(8):873-876.

Tseng, W.P., 1977. Effects and dose-response relationships of skin cancer and Blackfoot disease with arsenic. Environmental Health Perspectives 19:109-119.

Tsentas, C., and D.J. Supkow, Ph.D., (1985). Migration and Apparent Subsurface Biodegradation of Organic Compounds in a Fractured Bedrock Aquifer, Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Ground Water, Houston, Texas, 77-89.

Versar, Inc., (1989). Personal communication with Dr. Jeff Driver July 5 regarding "soil adherence to human skin" in preparation for Bulletin of Environmental Contamination and Toxicology.

Verschuersen, K., (1983). Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York.

Wester, R. C. et al., (1983). Pharmacokinetics and bio-avialability of intravenous and topical nitroglycerine in the Rhesus monkey: Estimate of percutaneous first-pass metabolism. Journal of Pharmaceutical Science. 72(7): 745-748.

Wilson, B.H, G.B. Smith, and J.F. Rees, (1986). Biotransformations of Selected Alkylbenzenes and Halogenated Aliphatic Hydrocarbons in Methanogenic Aquifer Material: A Microcosm Study, Environ. Sci. Technol., 20, 997-1002.

WSU (Washington State University), (1968). Washington Climate for King, Kitsap, Mason, and Pierce Counties, E.M. 2734, January.

Wynder, E.L., and D. Hoffman, (1959). A study of tobacco carcinogenesis. VII. The role of higher polycyclic hydrocarbons. Cancer 12:1079-1086.

Zedeck, M.S., (1980). Polycyclic Aromatic Hydrocarbons: A Review, Journal of Env. Pathology and Toxicology, 3:537-567.

HARTCROWSER

Earth and Environmental Technologies

Remedial Investigation Report
PACCAR Site
Renton, Washington

Appendices A through D

Prepared for
PACCAR, Inc.

September 1, 1989
J-1639-09

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This volume contains supporting Appendices A through D for the Remedial Investigation Report prepared for the PACCAR Site located in Renton, Washington. These appendices include:

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APPENDIX A
FIELD DATA COLLECTION PROCEDURES

CONTENTS

APPENDIX A
FIELD DATA COLLECTION PROCEDURES

The field work for this project was completed between June and December 1988 by Hart Crowser, Inc., and our subcontractors. The field representatives for the project were Brian Christianson, Project Engineering Geologist; Timothy Walker, Senior Technician; Galen Tritt, Environmental Specialist; and Steve Siebert, Staff Engineer. The project manager was Matthew Dalton, Principal Hydrogeologist. Hydrogeological and geochemical inputs were provided by Elizabeth Hill, Senior Staff Hydrogeologist, and Mark Herrenkohl, Staff Geochemist, respectively.

Geoboring, Inc., of Puyallup, Washington under subcontract to Hart Crowser completed the drilling, soil sampling, and well installation activities. Associated Geotechnical Services, (Fred Tuttle, owner) of Seattle, Washington completed the test pits using a backhoe. Services by Concrete Coring Company, of Seattle, Washington were required in areas covered with concrete. Dodds Engineers, Inc., also under subcontract to Hart Crowser, Inc., completed the surveying activities. Soil, groundwater, and surface water samples collected for chemical analysis were delivered to Laucks Testing Laboratories, Inc., for chemical testing.

The current program of subsurface exploration and sampling included the completion of 85 test pits and 151 hollow-stem auger borings, eighteen of which were installed with groundwater monitoring wells. Additional piezometers were also installed in December 1988. Surface investigations included the selection of three soil/gravel ballast samples and three surface water/ditch samples. This sampling was completed to supplement previously collected data.

Sampling Locations and Numbering System

The subsurface and surface sampling locations are presented on Figures 1.3, 1.4, and 1.5 in the main body of the report. The current sampling locations were selected in the field by hand taping or pacing from existing physical features (e.g., building foundations, fences, etc.). The letters and numbers which identify a particular soil boring or test pit are those previously used (see Section 1.5 of report) or are referenced to the 100/200-foot grid system presented on Figures 1.3 and 1.4 (for these current sampling locations). The letters and numbers correspond to the east-west and north-south running grid lines, respectively.

The letters and numbers which identify a particular groundwater monitoring well are a function of the company which installed the well. A well with "HC", "OSP", or "OW" followed by a number and a letter (S-shallow, I-intermediate, D-Deep, and R-replacement) indicates it was installed by Hart Crowser, Inc. All wells designated by "LW" were installed by Landau Associates and those by "DM" by Dames and Moore. Wells identified by "MW" followed by a number and letter (e.g., 3S) and located on-site were installed by HNTB. CH2M-Hill and RH2 Engineering were responsible for the installation of City of Renton wells located off the PACCAR site. City monitoring wells (off-site PACCAR) are indicated by "MW" followed by a number. Pumping wells are designated by "PW" or RW (replacement well) and a number.

The ground surface and top of well casing elevations as presented on the boring logs, were provided by Dodds Engineering, Inc. Elevations of wells are considered accurate to within 0.01 foot. Elevations were measured using the U.S.C. and G.S. Brass Cap Bench Mark (L384 Reset 1962) at N.E. corner of Park Avenue and N. 8th Street in Renton, Washington.

Test Pit and Boring Soil Sampling Procedures

Soil sampling in areas covered with asphalt or fill surfaces was conducted with a hollow-stem auger drilling rig (borings) and/or backhoe (test pits) based on accessibility. Areas covered with concrete were initially cored by Concrete Coring followed by drilling and sampling with a hollow-stem auger drilling rig (Geoboring, Inc.). The depth of test pits and borings was approximately ten (10) feet.

Soil samples were collected from each of the explorations. The vertical sample interval of the test pits and borings was approximately 2-1/2 to 3 feet and 1-1/2 to 2 feet, respectively. Generally, three samples were taken from each exploration and one sample was analyzed by the laboratory. A detailed soils log was prepared for each exploration location based on visual observation using the soils classification system (ASTM D 2488) presented on Figure A-1. Soils were also described and documented as either fill or natural in deposition. Samples containing other materials such as scrap metal, slag, wood, etc. were visually described in similar terms but without field particle size assessment. Any visual contamination (e.g., product) was also indicated on the field logs. Exploration logs are presented in Appendices C and D. The exploration logs represent our interpretation of the drilling/excavation, sampling, and field testing information. The depth where the soils or characteristics of the soils changed is shown, however, the actual changes may be gradual.

Soil samples were obtained from the test pit walls or backhoe bucket with a stainless-steel spoon. The spoon was cleaned in an alconox-water solution and rinsed in successive baths of tap and deionized water. The sample from each depth interval was placed in two clean, teflon-lined, quart glass jars and one 4-ounce volatile jar. One quart jar was placed in a chilled cooler. The volatile jar was completely filled (i.e., no head space) and also placed in the cooler. The second quart jar was filled approximately half-full and the jar mouth was covered with aluminum foil and capped. After sitting (out of the sun) for 30 to 60 minutes, the vapor concentration of the sample jar headspace was measured using a photoionization detector (H-Nu Model PI-101 w/10.2 eV Lamp). The H-Nu readings were recorded on the field logs. In addition, one set of field duplicates was collected per 20 test pit or boring explorations to evaluate variation, if any, attributable to the sampling, sub-sampling, handling, and storage aspects of a chemical analysis (discussed later).

Samples were obtained from the borings using a 24-inch-long, 3-inch-diameter split-spoon sampler (oversize sampler). The larger sampler increased the soil recovery per depth interval. The split-spoon was cleaned between sampling intervals using an alconox/water solution and rinsed in successive baths of tap and deionized water. The relative density of the soil was assessed by determining the number of blow counts (no. 140 or no. 300 hammers) to penetrate the soil per 12 inches. The oversized sampler blow count can be converted to the ASTM D 1586 standard penetration test (SPT) blow count (N) using the graph presented on Figure A-2. Sample handling was the same as that presented for test pit samples.

After samples were collected, the excavated soil was backfilled into the test pit unless grossly contaminated. Loose soil on the backhoe bucket was also brushed into the excavation. Grossly contaminated soils from the test pits and excess soil cuttings from the borings were barreled and stored on-site until they were disposed of in an appropriate way. The backhoe bucket and drilling equipment (e.g., augers) were steam cleaned between sampling locations at designated decontamination areas. The cleaning water was also barreled and stored on-site.

Soil/Gravel Ballast Sediments

A total of three soil/gravel ballast samples, designated GB-1, X-2, and X-3, were collected at the PACCAR site on September 1, 1988, and September 14, 1988. The locations of these samples are presented on Figure 1.4. The three samples were collected in and around existing railroad ties and tracks that had visual signs of oil-staining. The soil was collected with a stainless steel spoon and placed in clean teflon-lined, quart glass jars provided by the laboratory. Between each sampling event, the spoon was cleaned in an alconox-water solution and rinsed in successive baths of tap and deionized water. Soil samples were sent to the laboratory for chemical analysis.

Well Installation

The wells we installed are of 2-inch-diameter Schedule 40 PVC single well construction and have either 5- or 10-foot screened sections (0.020-inch slot size). Wells were installed at selected depths by lowering the casing down the hollow-stem auger to the desired depth. Colorado 10/20 silica sand was poured slowly down the auger/PVC casing forming a sand pack material around the screen to a level 1 to 2 feet above the top of the well screen. VOLCLAY grout (American Colloid Company) was placed above the screened sections to within approximately two feet of the surface. The weight of grout to water equaled or exceeded 9.4

lbs/gallon. All wells have a concrete surface seal and are protected by a steel flush-mount or 2/3-foot steel monument. Well construction information and field test results are presented on the well logs presented in Appendix D.

Well Development

The new wells (work plan Task 1.4) completed in the course of this study were developed on August 31 through September 22, 1988. Wells were developed by the use of one of the following: 1.7-inch Brainard Kilman (B-K) pump; air driven motor with 3/4-inch PVC check-ball (Instrumentation Northwest, Inc.); or bailer. The selection of development equipment was dependent on water volume.

Wells were developed by purging at least three to five casing volumes of water in order to remove the fine-grained and suspended material from the well bottom. Many wells, however, remained turbid or cloudy after the initial development sequence and required additional development sequences.

Water Level Measurements

Water level measurements were made to a measured accuracy of about 0.05 foot with an Olympic Model 150 Electric Well Probe and a decimally graduated tape measure. The probe was lowered down the well casing until water was encountered. The tip of the well probe was routinely rinsed with deionized water between wells in order to prevent chemical cross-contamination.

Hydraulic Conductivity (K) Testing

Falling and rising head hydraulic conductivity tests (slug tests) were conducted at 20 monitoring wells. Both on-site and off-site wells were tested. The tests were initiated by causing a rapid change in the water level in the well by introducing (falling head) or removing (rising head) a solid cylindrical rod of known volume. The recovery of the water level with time was monitored using a 7 psi pressure transducer coupled to a Terra unit and lap-top computer. During the test each water level measurement was transmitted from the transducer through a Terra unit and was displayed on the screen of a lap-top computer.

The falling head test was conducted first. For this test, the slug rod was lowered down the well, causing the water level to rise. With time, the water level dropped to the static level.

Next we did the rising test. The slug rod was removed and the water level fell. With time the well recovered to the static water level.

The data obtained from the falling and rising head tests were plotted, analyzed by a modified Hvorslev method, interpreted, and are presented in this report in Section 5.

Summary of the Hvorslev Method

The Hvorslev (1951) method was used to obtain an estimate of the saturated horizontal conductivity of a formation in the vicinity of a monitoring well screen.

The equation is given below:

$$K_h = d_e^2 \ln(2L/D)\ln(H_1/H_2)/8L(t_2-t_1)$$

where:

K_h = hydraulic conductivity
L = length of sand pack
D = diameter of sand pack
d_e = effective diameter of the standpipe
H_1 = hydraulic head at time t_1
H_2 = hydraulic head at time t_2
ln = natural log

This equation is based upon the assumptions that: 1) the hydraulic conductivity of the sand pack is much greater than that of the formation; 2) the ratio of the sand pack length to width is greater than 4; and 3) the aquifer material is uniform, isotopic, and saturated.

In some of the monitoring wells, the static water level was below the elevation of the top of the sand pack and therefore the square of the effective diameter of the standpipe (d_e^2) was estimated as:

$$d_e^2 = D^2 n + d^2(1-n)$$

where:

d = diameter of the well casing
n = porosity of the sand pack

Water Sampling

Water samples were taken for chemical analysis from existing wells (Task 1.2), new wells (Task 1.4), surface water (ditches), rinseate distilled water, and tap water used to fill drill rig tanks. Sampling was performed from July 5 to 12, 1988 (Task 1.2), and from October 3 to 11, 1988 (Task 1.4). Surface water was sampled from the west (SW-1, SW-1R) and east (SE-1) ditches (on-site) on October 17 and November 11, 1988, respectively. Water samples were collected in storm ditches at the most northerly location on-site to assess surface water transport off-site. Groundwater monitoring well and surface water locations are presented on Figure 1.5. In conjunction with sampling, other water measurements were taken including temperature, pH, and electrical conductance. These data are presented in Table A-1.

The sample collection procedure for groundwater was as follows. The depth to water in each well was measured and the volume of water in the well was calculated. A 3-foot-long, 1-3/4-inch-diameter stainless-steel bailer was employed to remove a minimum of three casing volumes. If the well became dry before three casing volumes was successfully removed, then, sampling was performed after the well had sufficiently recovered. Purged water was collected in five-gallon buckets and transferred to a 55-gallon drum for storage on-site.

Surface water was collected by a peristaltic sampling pump. Water was collected over the entire water column (6 inches to 2 feet depth) to obtain a representative sample. Rinse water was collected from deionized water sprayed through a split-spoon sampler (borings) over a sampling spoon (test pits) and through a bailer. Tap water contained in the drill rig tank was simply poured in sample jars.

Table A-1: Temperature, pH and Electrical Conductance

WELL NO.	DATE	TEMP. (C)	pH	ELECTRICAL CONDUCTANCE (micromhos)
LW-12D	05-Jul-88	13	6.72	342
LW-12S	05-Jul-88	14	6.57	285
LW-5D	05-Jul-88	14	6.43	350
LW-15S	05-Jul-88	14	6.56	370
LW-3S	06-Jul-88	15	6.58	480
LW-2D	06-Jul-88	13.3	6.47	318
LW-2S	06-Jul-88	14.7	6.66	460
LW-3D	06-Jul-88	13.5	6.68	250
LW-9D	06-Jul-88	13.2	6.48	420
LW-9S	06-Jul-88	13.8	6.51	400
DM-3D	07-Jul-88	14.2	6.38	465
LW-10D	07-Jul-88	15.1	6.58	315
LW-5S	07-Jul-88	17.4	6.82	410
LW-6D	07-Jul-88	13.2	6.44	400
LW-6S	07-Jul-88	15.2	6.82	325
MW-2I	07-Jul-88	13.8	6.5	370
LW-13D	08-Jul-88	14.2	6.61	303
LW-13S	08-Jul-88	19.2	6.35	420
LW-14S	08-Jul-88	16.8	6.3	300
LW-1D	08-Jul-88	15	6.4	700
LW-1S	08-Jul-88	21.7	6.95	380
MW-3I	08-Jul-88	15.7	6.6	280
LW-8D	11-Jul-88	13.9	6.43	130
MW-1	11-Jul-88	11.5	6.34	100
LW-10S	12-Jul-88	16.9	6.49	149
MW-2DR	03-Oct-88	13.4	6.47	290
OW-4S	03-Oct-88	15.8	6.09	360
OW-5S	03-Oct-88	17.5	5.79	550
OW-4D	03-Oct-88	15.3	5.92	280
DM-2D	04-Oct-88	13.2	6.4	730
OSP-1D	04-Oct-88	14.1	6.4	390
OSP-1S	04-Oct-88	14.9	6.1	360
OSP-2D	04-Oct-88	13.3	6.7	540
OW-5D	04-Oct-88	16.4	6.4	440
MW-10	06-Oct-88	13.2	6.72	330
OSP-2S	06-Oct-88	15.9	6.37	210
OSP-3D	06-Oct-88	12.7	6.78	270
OSP-4D	07-Oct-88	13.1	7.04	580
OSP-4S	07-Oct-88	16	6.34	330
OSP-5D	10-Oct-88	13	6.67	490
OSP-5S	10-Oct-88	14.3	6.4	280
OSP-6D	10-Oct-88	15.5	6.5	570
OSP-6S	10-Oct-88	18.2	6.31	740
OSP-7D	11-Oct-88	14.8	6.45	780
OSP-7S	11-Oct-88	16.4	6.38	970
SW-1	17-Oct-88	11.1	6.3	195

Table A-1 - (Continued)

Well No.	Date	Temperature in Degrees C	pH	Electrical Conductance in micromhos
OSP-4D	6 FEB 89	10.5	6.7	460
OW-5S	6 FEB 89	14.4	6.6	510
OW-5D	6 FEB 89	12.7	6.4	380
MW-3I	7 FEB 89	11.3	6.4	280
LW-3S	7 FEB 89	8.7	6.5	480
OW-4S	7 FEB 89	11.3	6.5	290
OW-4D	7 FEB 89	13.1	6.4	270
LW-12S	7 FEB 89	13.3	6.6	360
LW-12D	7 FEB 89	12.3	6.5	410
LW-3D	8 FEB 89	10.1	6.5	270
LW-6S	8 FEB 89	9.1	6.6	290
LW-6D	8 FEB 89	12.4	6.3	500
LW-9S	8 FEB 89	10.7	6.4	440
LW-9D	8 FEB 89	10.8	6.4	460
LW-13D	8 FEB 89	10.7	6.4	330
OSP-2D	9 FEB 89	12.7	6.6	340
OSP-5D	9 FEB 89	12.8	6.5	430
OSP-7S	9 FEB 89	11.6	6.4	790
OSP-7D	9 FEB 89	10.7	6.3	620
MW-10	9 FEB 89	12.6	6.6	320

Temperature, pH, and conductivity of the water samples were measured (Cole-Parmer Instrumentation Company). Water was transferred from a full bailer (monitoring wells) or peristaltic sampling pump (surface water) to sample bottles containing appropriate preservatives (Table A-2). Each bottle was labeled according to the chemical analysis to be performed. Samples collected for dissolved metal analysis were filtered through a 0.45 micron Sample Pro disposable filter (QED Environmental Systems, Model FF-8200) via a peristaltic sampling pump (Cole-Parmer Instrumentation Company, Model 7570-10).

After each sampling event (e.g., monitoring well, ditch) was completed, bailers and other sampling equipment (e.g., stainless-steel funnels) were cleaned in an alconox-water solution and rinsed in successive baths of tap and deionized water. Testing equipment which was routinely decontaminated included the pH and conductance meters. Decontamination after each use consisted of rinsing of equipment probes in deionized water. Polypropylene rope, silicon and tygon tubing used for sampling was discarded.

Sample jars were wrapped with a plastic shell, then placed in coolers with the completed and signed chain of custody forms for delivery. Each cooler received several bags of frozen Blue Ice to keep samples cool. Samples were delivered either by taxi cab or Hart Crowser personnel to Laucks Testing Laboratory for chemical analysis.

Table A-2 - Containers and Preservatives Used in Sampling

Quantity	Container	Analyses	Preservative Added/Container
2	1,000 ml polypropylene	total metals	2.0 mlHNO3(conc.) + 2.0 ml D.I.
2	1,000 ml polypropylene	dissolved metals	2.0 mlHNO3(conc.) + 2.0 ml D.I.
4	40 ml clear glass	volatile organics	none
4	1,000 ml amber glass	extractable organics	none
1	1,000 ml polypropylene	water hardness	none

Chain of Custody

A chain of custody form was originated with every soil or water sample collected in this study and propagated with each release and receipt of sample materials. Chain of custody forms were filled out, signed, and counter-signed for transfer of samples from the possession of the field representative to that of the Hart Crowser geochemist. Receipt of sample shipments from Hart Crowser to Laucks Testing Laboratory were acknowledged by signature on the chain of custody document. Original chain of custody documents and copies are maintained in the Quality Assurance and Quality Control records of Hart Crowser.

Chain of custody seals were used routinely to assure the security of the sampling and shipment process. Seals were signed, dated and placed over the interfaces of shipping coolers and their lids.

Health and Safety

The health and safety program provided guidance to Hart Crowser and subcontractor personnel working at the PACCAR site in Renton. This program included the on-site maintenance of protective equipment, routine monitoring decontamination procedures, and documentation.

Protective equipment available for field operations included fitted respirators with CMC-H cartridges. Cotton-polyester blend coveralls, hard hat, protective eye-glass wear, rubber gloves, and rubber steel-toed boots were worn at all times during drilling, sampling, and well development operations to prevent contamination of clothing and skin by potentially harmful materials. Coveralls were changed at least once per day and boots and gloves were washed frequently.

Explorations in the vicinity of plant operations and locations off-site were delineated into an exclusion zone by the use of barricades and caution tape. All equipment used inside the exclusion zone, were left inside this area.

Monitoring was performed on a frequent, regular basis during drilling and digging. During each exploration an MSA 361 meter was used to detect levels of H2S, oxygen, and flammable gases; and an H-Nu PI-101 photoionization meter was used to monitor levels of organic vapors. A daily record was kept on names of personnel on-site, of site activities, potential hazards, protective equipment used, and monitoring equipment measurements.

Key to Exploration Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 - 4	Very soft	0 - 2	<0.125
Loose	4 - 10	Soft	2 - 4	0.125 - 0.25
Medium dense	10 - 30	Medium stiff	4 - 8	0.25 - 0.5
Dense	30 - 50	Stiff	8 - 15	0.5 - 1.0
Very dense	>50	Very stiff	15 - 30	1.0 - 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Minor Constituents

Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling

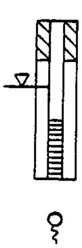
BORING SAMPLES

- ⊠ Split Spoon
- Shelby Tube
- Cuttings
- Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

- ⊠ Grab (Jar)
- Bag
- Shelby Tube

Ground Water Observations



Surface Seal

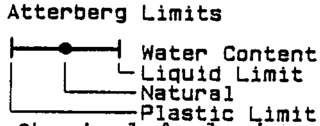
Ground Water Level on Date (ATD) At Time of Drilling

Observation Well Tip or Slotted Section

Ground Water Seepage (Test Pits)

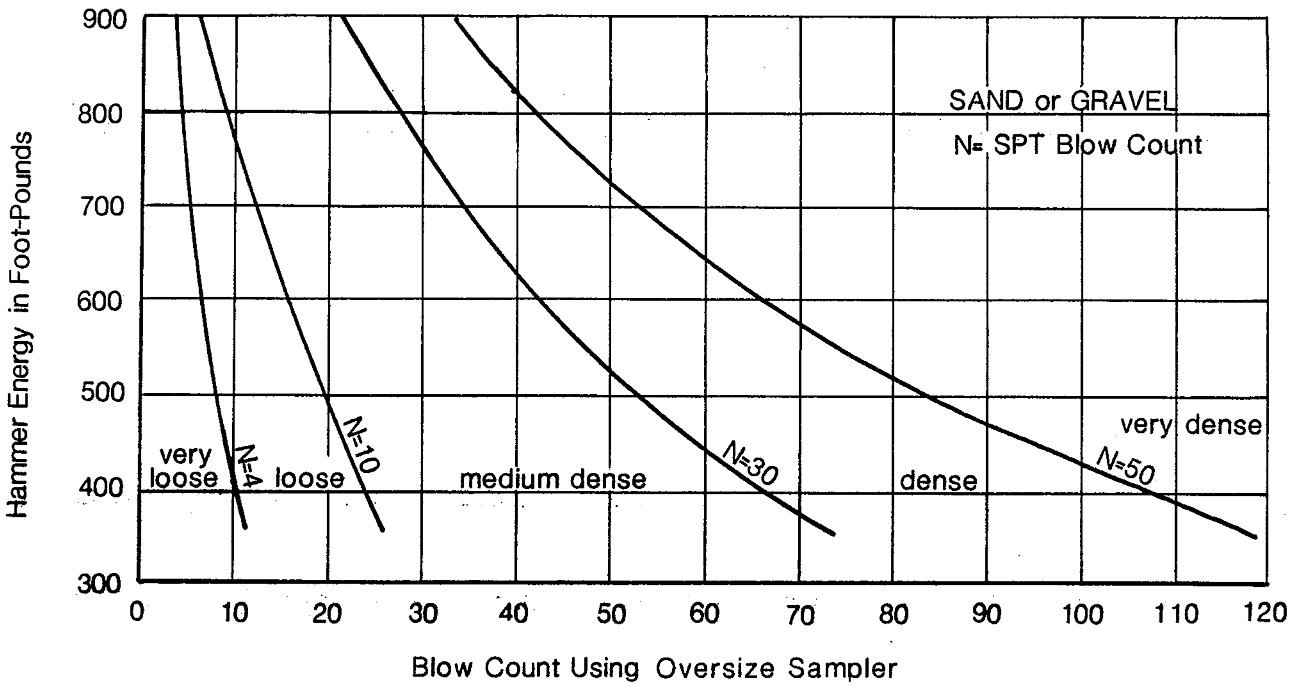
Test Symbols

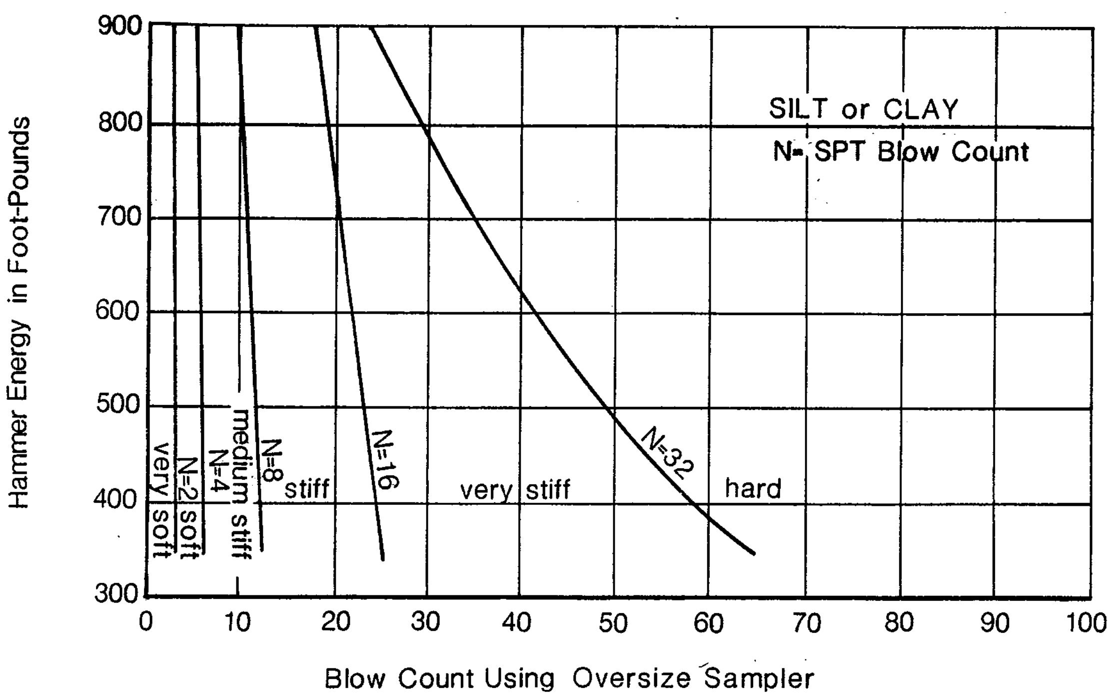
GS	Grain Size Classification
CN	Consolidation
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
CA	Chemical Analysis



J-1639-10 January 1989
HART-CROWSER & associates, inc.
Figure A-1

Oversize Sampler to SPT Blow Count Conversion





Example: Hammer = 325 Pounds Drop = 30 Inches
Hammer Energy = 325x30/12 = 813 Foot-Pounds
Blow Count = 30 Using Oversize Sampler
For SAND Interpolate from Upper Figure to N = 37

Reference: Dames and Moore Data Sheet
"Presumptive Soil Properties"

HARTCROWSER
J-1639-10 10/88
Figure A-2

APPENDIX B
LABORATORY PROCEDURES

CONTENTS

APPENDIX B
LABORATORY PROCEDURES

Soils and water samples were analyzed for both physical and chemical properties in the laboratory. Grain size analyses were completed on selected samples while soil/water samples were analyzed for a variety of constituents as summarized in Section 6.

Soil Classification

Soil samples recovered in the explorations were visually classified in the field. Visual-manual field and laboratory observations include density/consistency, moisture condition, grain size and plasticity estimates based on methods of ASTM D 2488.

The classifications of selected samples were checked by performing laboratory grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Grain Size Analysis (GS)

Grain size analyses were performed on representative samples in general accordance with ASTM D 422. The wet sieve analysis method was used for most samples and determines the size distribution greater than the U.S. No. 200 mesh sieve. The size distribution for particles smaller than the No. 200 mesh sieve was determined by the hydrometer method for a selected number of samples. The results of the tests are presented as curves in Appendix E on Figure E-19 plotting percent finer by weight versus grain size.

Soil/Water Analyses

The analytical methods and modifications are listed in Table B-1 and supporting text.

Table B-1 - Specification of Analytical Methods

Soil Analyses	Preparation Method	Analytical Method
Total Petroleum Hydrocarbons	SW 3540	EP 418.1
Total Solids	NA	SM 209F
Total Metals*	LX SM1	SW 6010
Total Arsenic	LX SM3	SW 7061
EP Toxicity Metals**	SW 1310/LX EP3	SW 6010
GC/FID Screen	SW 3550	LX GC/FID
GC/MS Extractables	SW 3550	SW 8270
PCBs	SW 3550	SW 8080
GC/MS Volatiles	NA	SW 8240
Groundwater Analysis		
Volatiles	NA	SW 8240
Semivolatiles	SW 3510	SW 8270
Dissolved and Total Metals:		
Arsenic	LX WM3-A	SW 7061
Nickel, lead, chromium, zinc, copper, iron, and manganese	LX WM1	SW 6010
Hardness	NA	EP 130.2

* Metals to be analyzed are lead, chromium, nickel, zinc, copper, and cadmium.

** The same six metals as analyzed on a total basis, plus arsenic.

References

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S. EPA, November 1986.

EP = Methods for Chemical Analysis of Water and Wastes, U.S. EPA, March 1983.

SM = Standard Methods for the Examination of Waste and Wastewater, APHA, AWWA, AND WPCF, 16th edition, 1985.

LX = An in-house Testing Laboratory method or modification of a previously published method.

Table B-1 - Continued

Testing Laboratory Method

LX SM1: A modification of SW 3550. Sample which has been dried at 105°C is used, rather than as received sample; some of the volumes of reagents vary; and digestion times vary.

LX SM3: A modification of SW 7061. The dried sample is digested directly, rather than digesting an aliquot of a previous digestion.

LX EP3: A modification of SW 1310. The procedure reduces the volume once, rather than twice, and by a less amount. If NOx fumes are generated, additional HNO_3 will be added. Both are HNO_3 and HCl digestions.

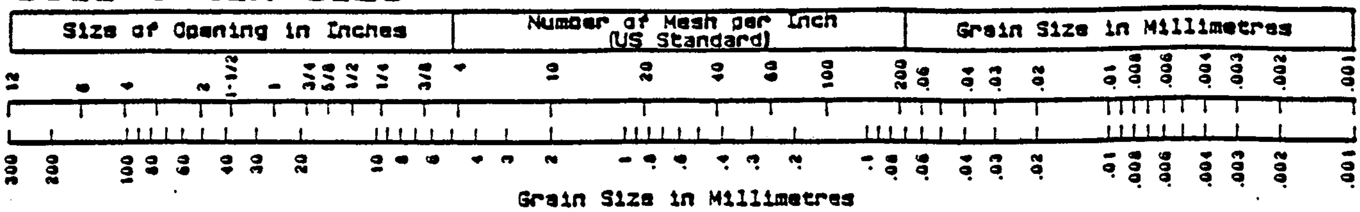
LX GC/FID: The sample is extracted in the same manner as a sample which would ultimately be submitted for GC/MS ABN analysis. All GC/MS surrogates are added and the final solvent and extract volumes are the same. The extract is analyzed by gas chromatography (GC) fitted with a flame ionization detector (FID), using a DB5 fused silica capillary column for the chromatographic separation. All peaks within the retention time window of 8 to 48 minutes are summed and calculated as phenanthrene. Deliverables include all sample, standard, and blank chromatograms.

WM1: A modification of Method SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM3-A: A modification of SM 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI, and uses preserved, not digested, sample.

Unified Soil Classification (USC) System

Soil Grain Size



COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines		* GRAVEL with >12% fines		Clean SAND <5% fines		* SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W, >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A Line with PI <4

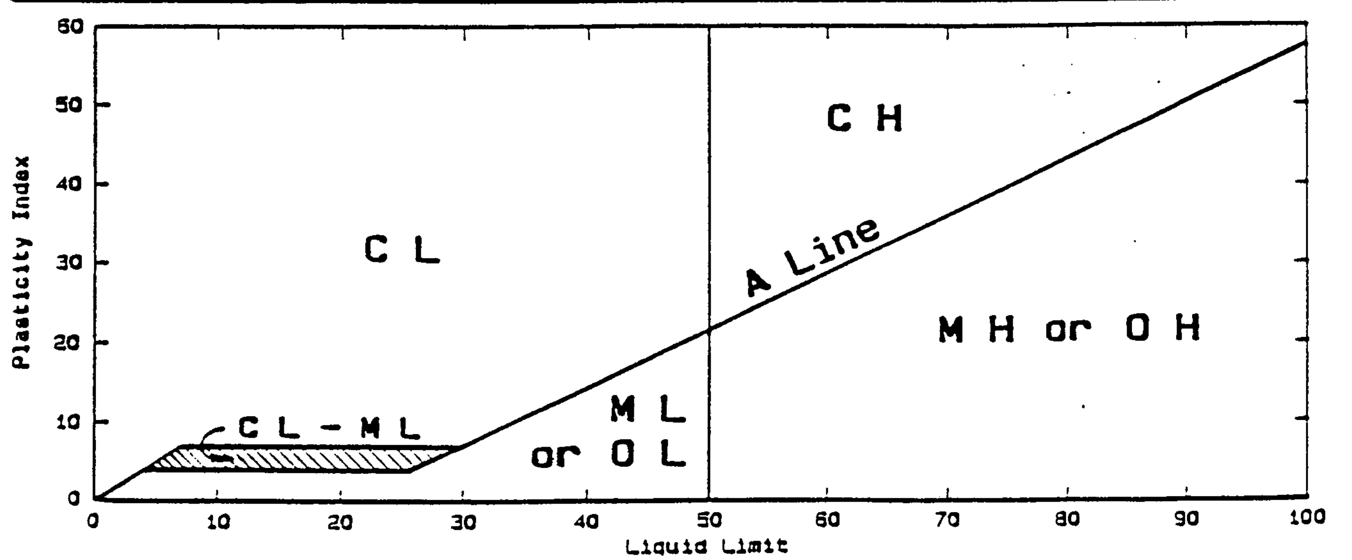
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases requiring use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particle diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



J-1639-09 December 1988
HART-CROWSER & associates, inc.
Figure B-1

APPENDIX C
BORING AND TEST PIT DATA

CONTENTS

Hart Crowser
J-1639-09

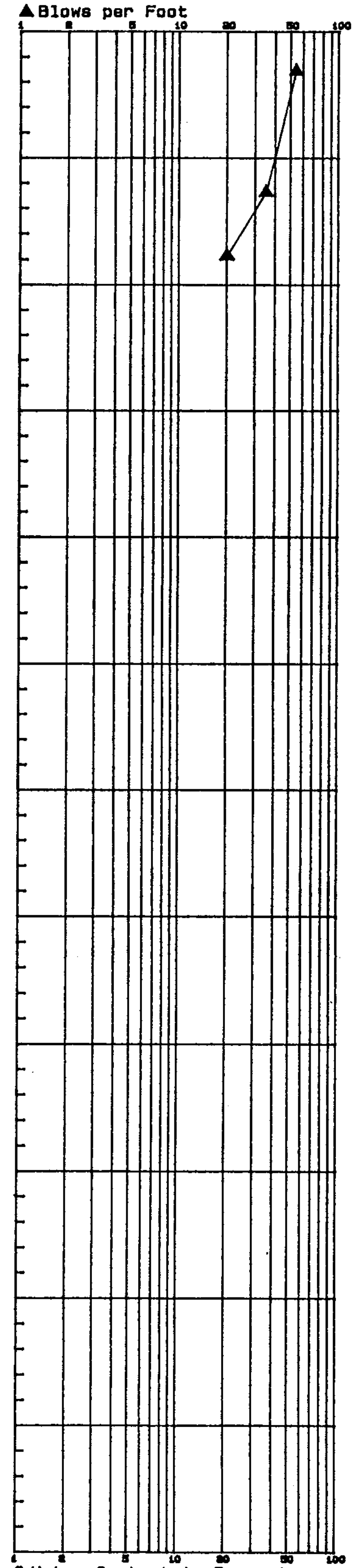
SOIL BORING LOGS -
HART CROWSER (1988)
FIGURES C-1 THROUGH C-134

Boring Log A12/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
3 inches ASPHALT over dense, dry, brown, sandy GRAVEL. (FILL)	0	S-0.2	CA	0
Hard, dry, brown, sandy SILT. (Natural)				
Dense, dry, brown, silty SAND. (Natural)				
Medium dense, wet, brown, slightly silty SAND. (Natural)	5 (water level ATD)	S-5.0		0
		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/11/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-1

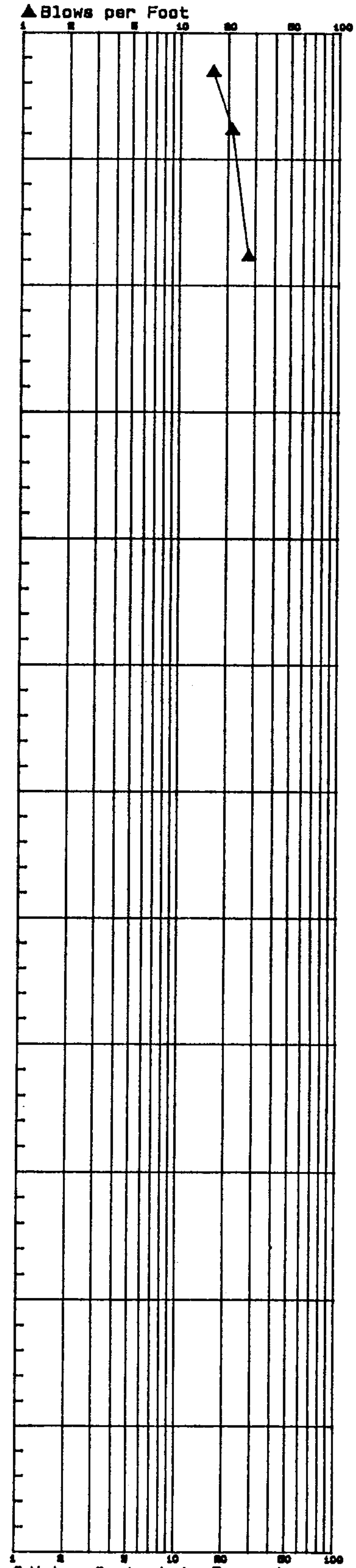
Boring Log A13/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
3 inches ASPHALT over loose, damp, brown, sandy GRAVEL.(FILL)	0	S-0.2		0
Medium stiff, damp, brown, slightly sandy SILT.(Natural)		S-2.5		0
Loose, damp, brown, silty SAND.(Natural)				
Medium dense, wet, brown, sandy GRAVEL.(Natural)	5 (ATD)			
Interbedded medium dense, wet, brown SAND and very stiff, dry, brown SILT (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/11/88.	10			

STANDARD PENETRATION RESISTANCE
▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988
HART-CROWSER & associates, inc.
Figure C-2

Boring Log B1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

3 inches ASPHALT over medium dense, dry, brown-gray, sandy GRAVEL. (FILL)

Medium dense, dry, black, ashy SAND to SAND. (FILL)

6 inch PEAT layer. (Natural)

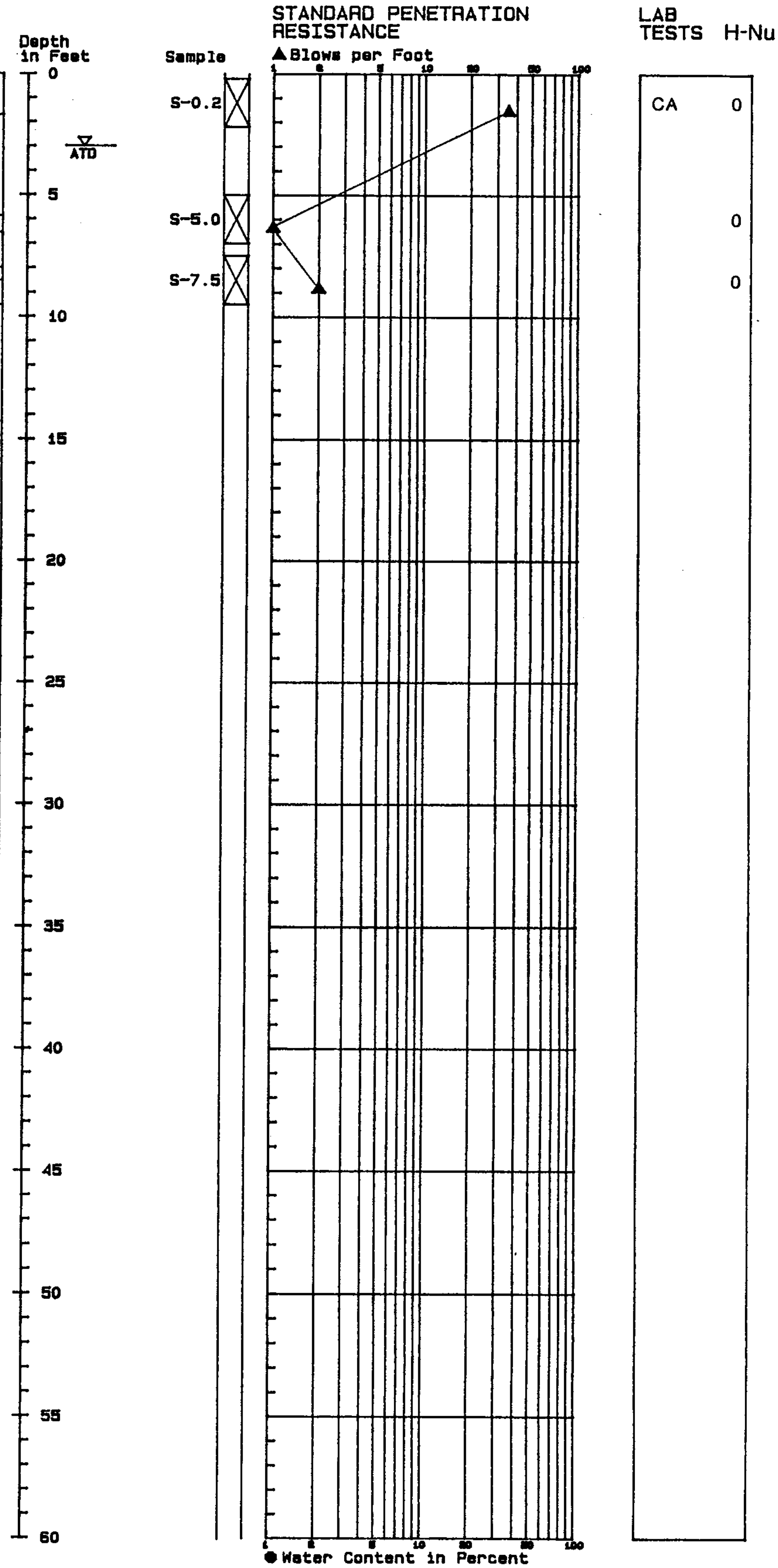
Very soft, wet, gray, slightly sandy SILT.

Wet, gray PEAT. (Natural)

Very loose, wet, gray, slightly silty SAND. (Natural)

Very soft, wet, gray, clayey SILT (Natural)

Bottom of Boring at 9.5 Feet.
Completed 8/11/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

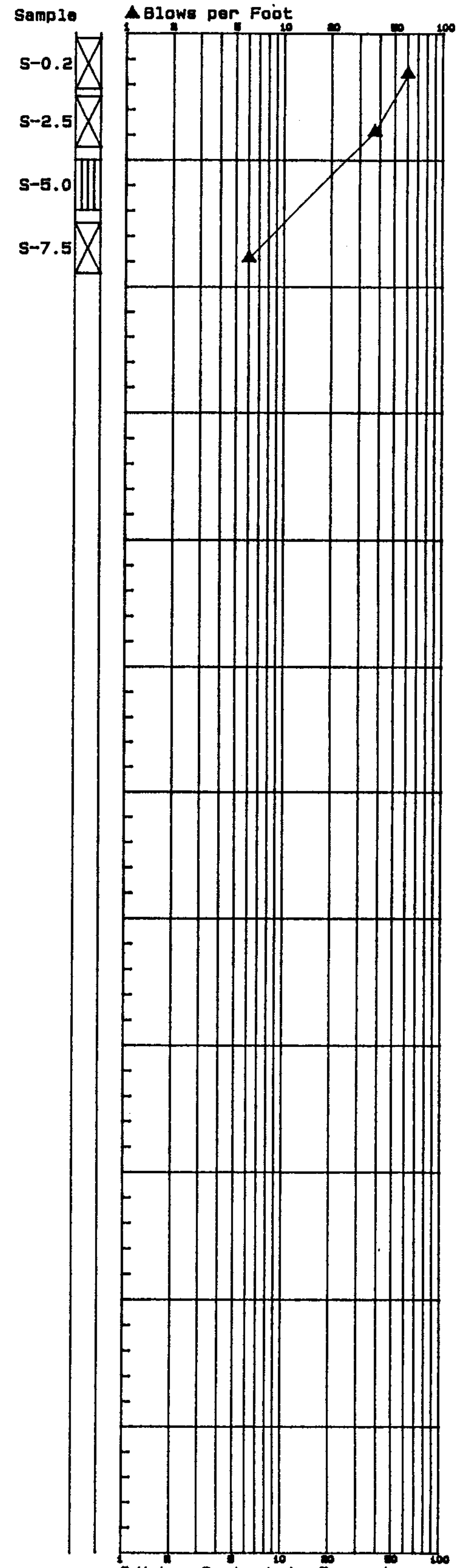
Figure C-3

Boring Log B3/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet
3 inches ASPHALT over dense to medium dense, damp to wet, brown-gray to gray, sandy GRAVEL. (FILL)	0
Very loose, wet, gray, gravelly, silty SAND with oily substance in cuttings. (Natural)	5 (ATD)
Bottom of Boring at 9.5 Feet. Completed 8/11/88.	9.5



LAB TESTS H-Nu

CA

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-4

Boring Log B13/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

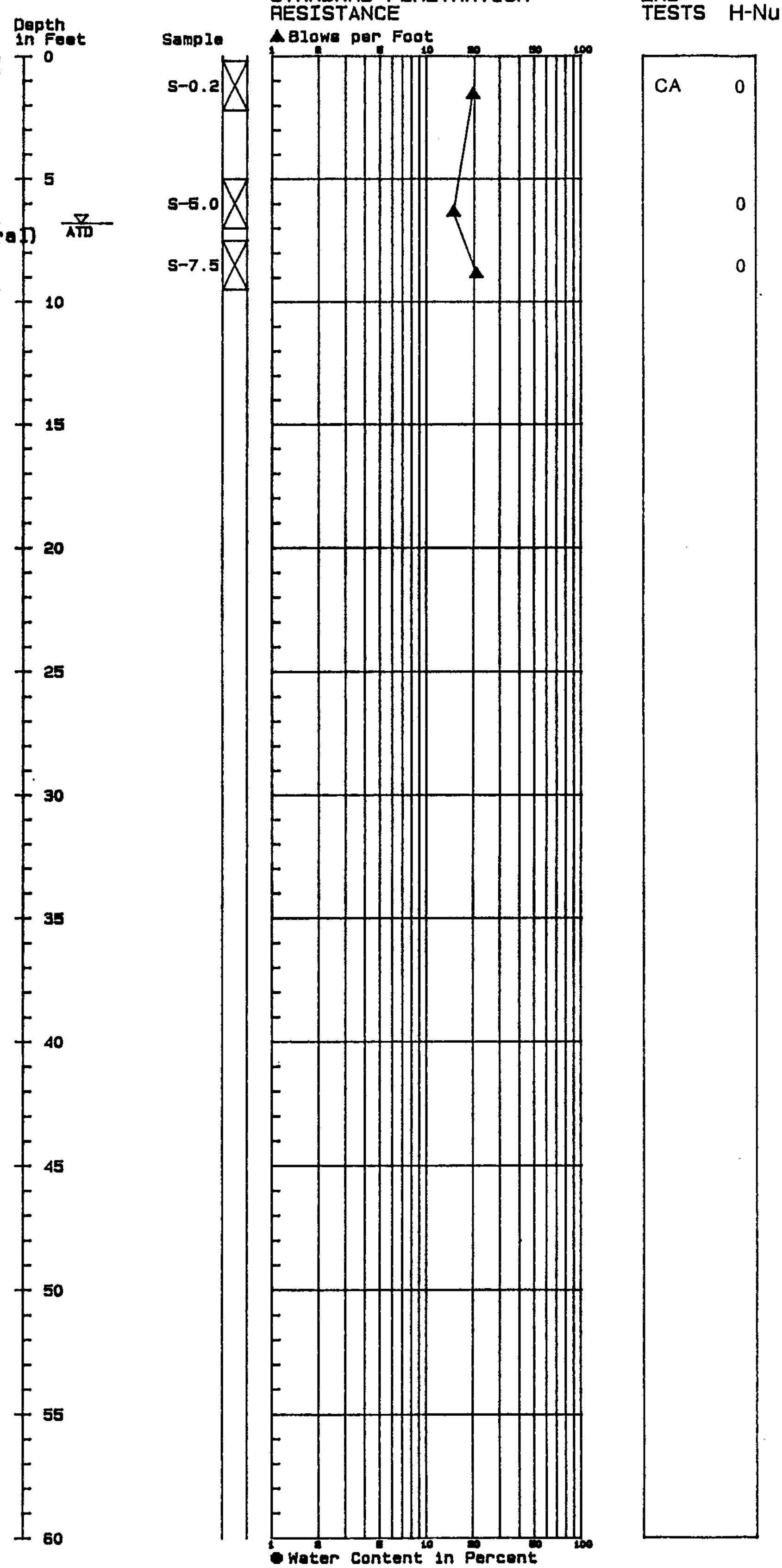
3 inches ASPHALT over medium dense damp, brown, sandy GRAVEL.(FILL)

Stiff, damp, brown, slightly sandy SILT with GRAVEL/SAND lenses.(Natural)

Loose, wet, brown, sandy GRAVEL.(Natural)

Medium dense, wet, brown, gravelly SAND.(Natural)

Bottom of Boring at 9.5 Feet. Completed 8/11/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-5

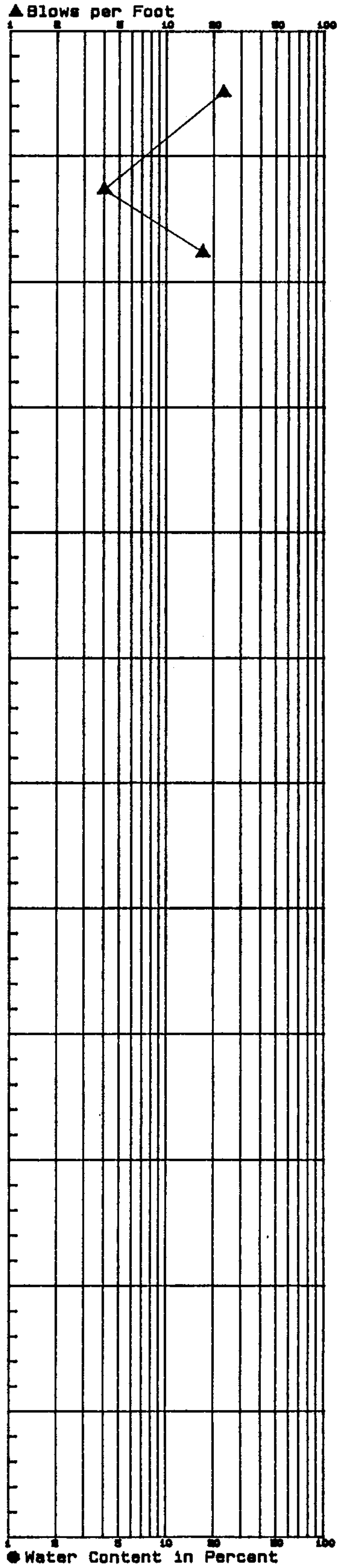
Boring Log E9/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
CONCRETE.	0			
Loose, moist, brown, slightly silty, very sandy GRAVEL. (FILL)		S-1.1	CA	0.2
Very loose, damp to moist, gray, slightly silty, fine SAND grading to loose, wet, gray, silty, fine SAND, with chunk of wood at 6.7-foot-depth (Natural)	5	S-6.0		0.7
		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/12/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-6

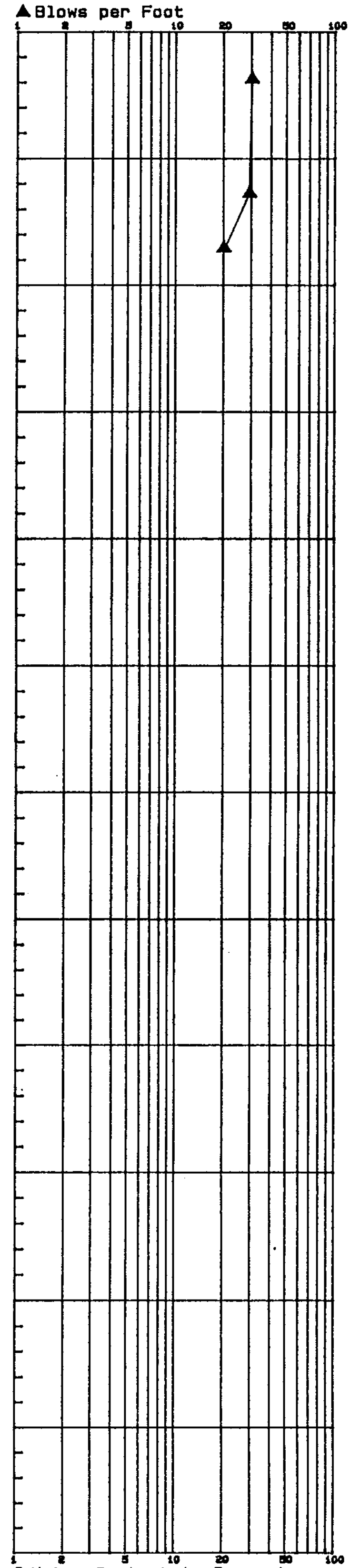
Boring Log F6/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
6 inches CONCRETE over loose, moist to wet, black, slightly silty, sandy GRAVEL with strong solvent-like odor orange and white mottling. (FILL)	0	S-0.5		100
Medium dense, wet, gray, slightly silty, fine SAND. (Natural)	5 (ATD)	S-5.0	CA	58
Loose, wet, gray, fine SAND. (Natural) 1/2 foot PEAT layer.		S-7.5		65
Bottom of Boring at 9.0 Feet. Completed 7/27/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-7

Boring Log F7/HB01

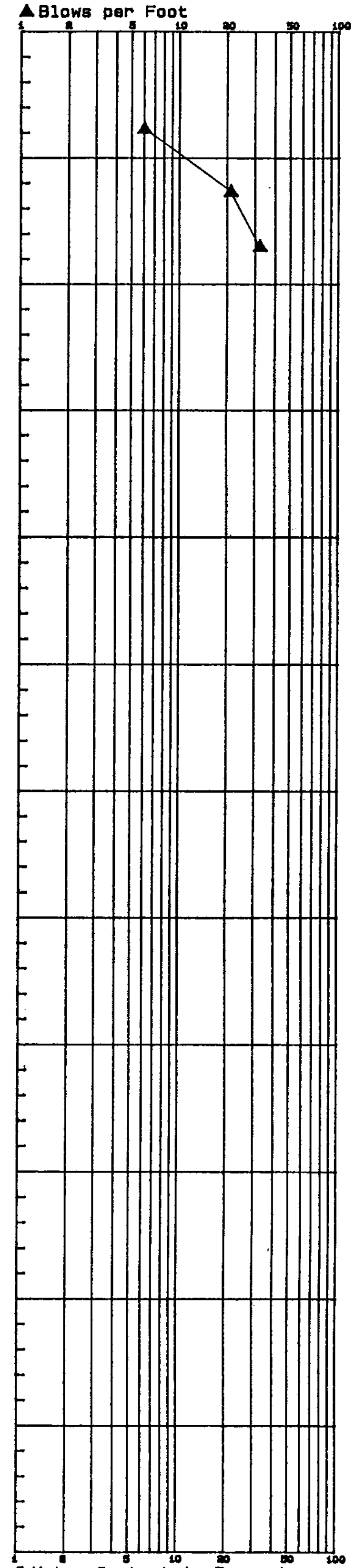
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Near surface cuttings are dark brown -gray with yellow particles.(FILL)	0			
Very loose to medium dense, wet, gray, slightly silty SAND.(Natural)		S-2.5		0
	5	S-5.0		0
		S-7.5	CA	0
Bottom of Boring at 9.0 Feet. Completed 7/22/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

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Figure C-8

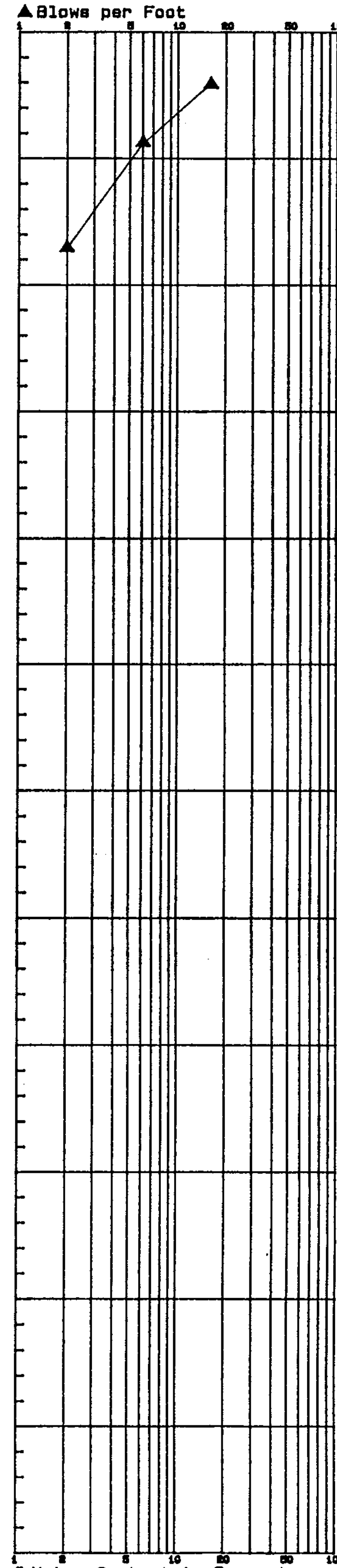
Boring Log F10/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Loose, wet, black, silty, very gravelly SAND with metal & building rubble, and glass fragments. (FILL)	0	S-0.7	CA	150
Very loose, wet, gray, very silty, medium to fine SAND. (Natural)		S-3.0		0.8
Very soft, wet, gray SILT.	5	S-7.5		0.5
Bottom of Boring at 9.0 Feet. Completed 7/25/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-9

Boring Log G4/HB01

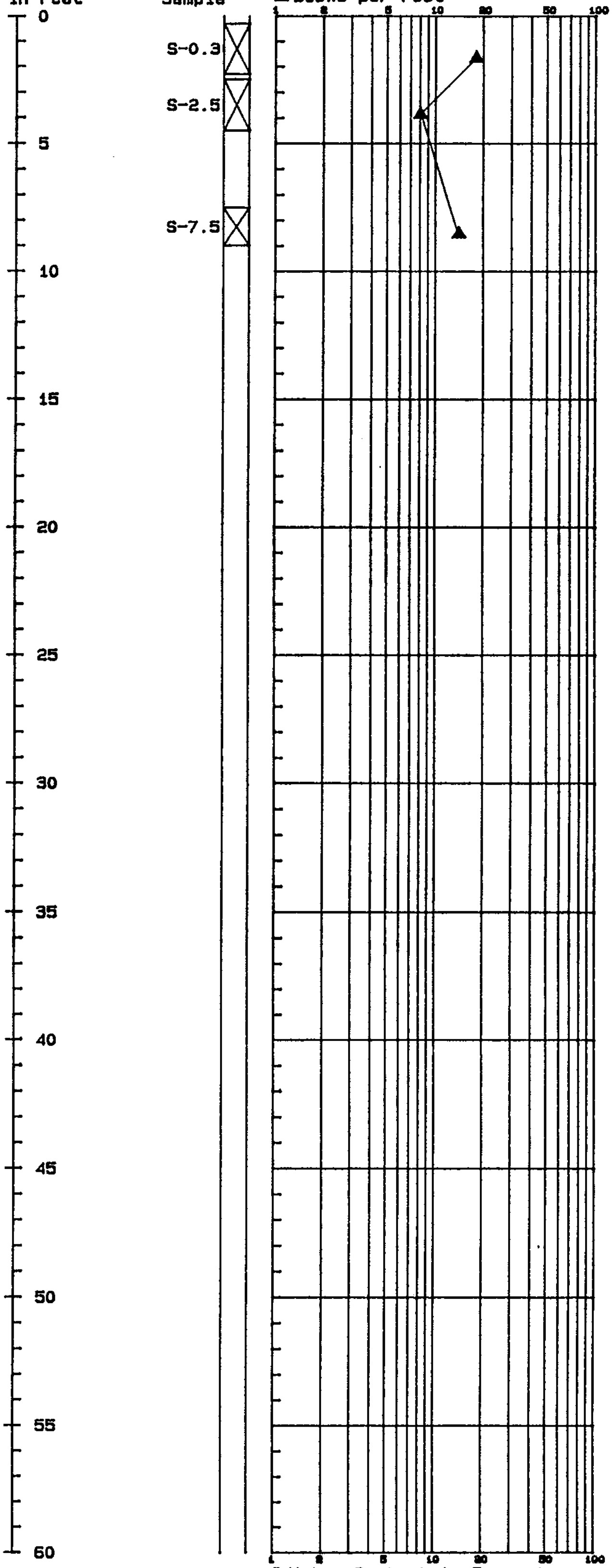
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
4 inches ASPHALT over loose, moist, brown, slightly silty, sandy GRAVEL. (FILL)	0	S-0.3	CA	0
Loose, wet, gray, silty, fine SAND. (Natural)		S-2.5		12
Medium dense, wet, gray, slightly silty, sandy GRAVEL. (Natural)		S-7.5		2
Bottom of Boring at 9.0 Feet. Completed 7/28/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-10

Boring Log G5/HB01

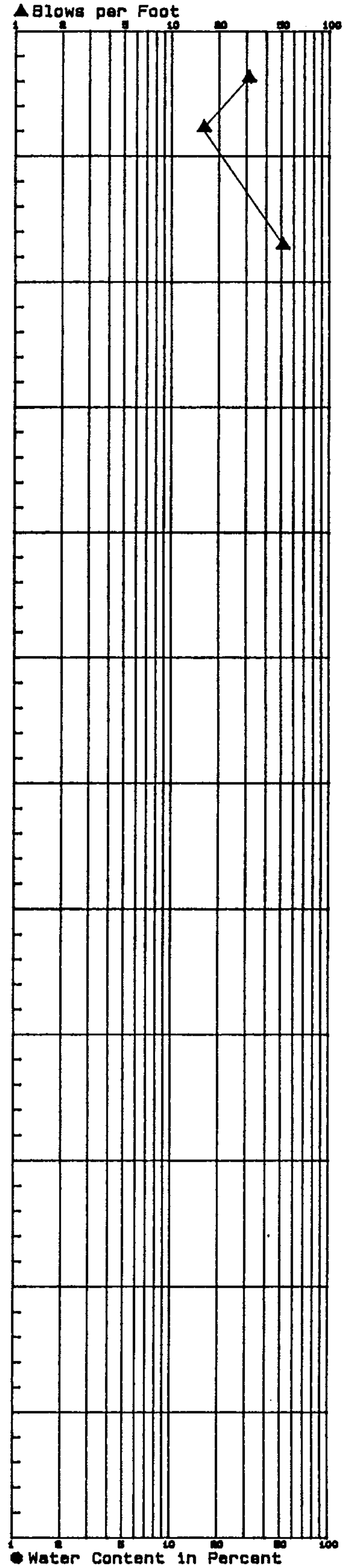
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	Medium dense, black, wet, silty, gravelly SAND with brown and white mottling. (FILL)
3	Loose to medium dense, wet, gray, very silty, fine SAND. (Natural)
9	Bottom of Boring at 9.0 Feet. Completed 7/27/88.

Sample	LAB TESTS	H-Nu
S-0.5		150
S-2.5		145
S-7.5	CA	180

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-11

Boring Log G6/HB01

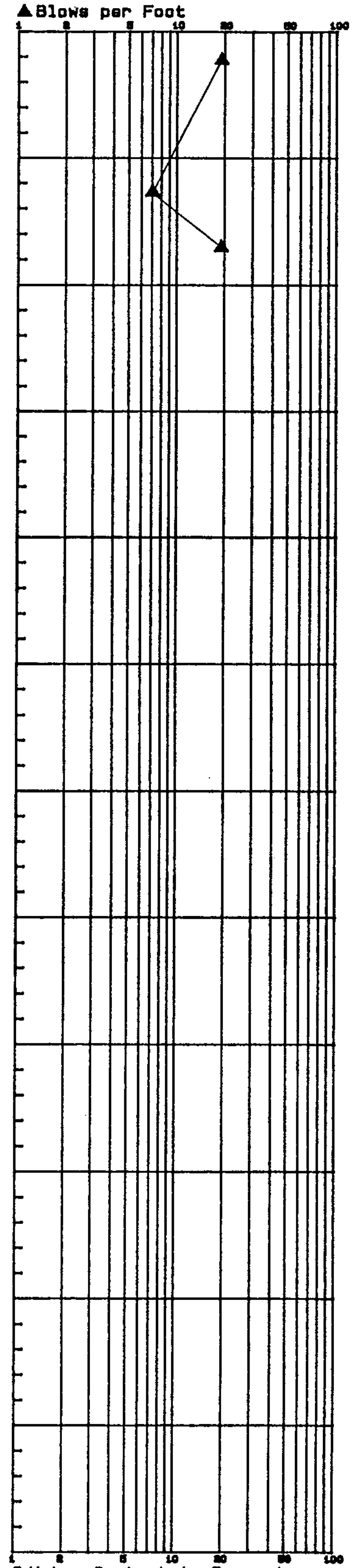
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	LAB TESTS	H-Nu
Loose, moist to wet, gray and black, silty, very gravelly SAND. (FILL)	0	S-0.1	CA	0.2
Loose, wet, black, silty, medium to fine SAND with black cuttings. (FILL)				
Medium stiff, wet, gray and black, slightly sandy to clean SILT. (Natural)	5	S-5.0		
		S-7.5		0
Loose, wet, gray, silty, fine to medium SAND. (Natural)				
Bottom of Boring at 9.0 Feet. Completed 7/22/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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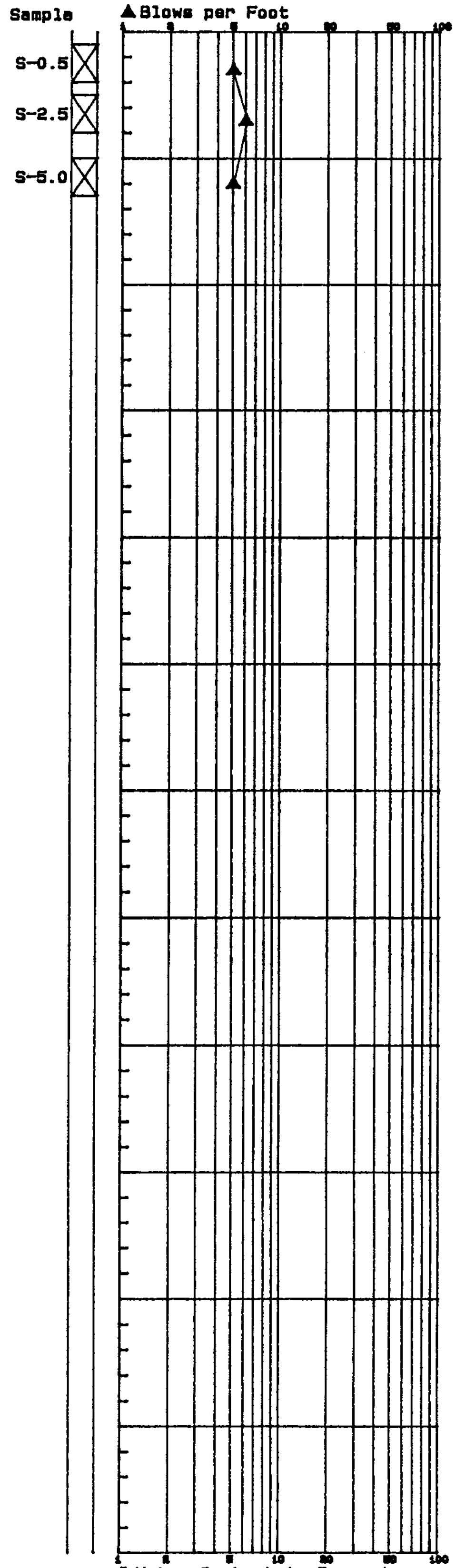
Figure C-12

Boring Log G8/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet
Very loose, moist to wet, black, silty, gravelly, medium to coarse SAND. (FILL)	0
Very loose, wet, gray, silty, medium to fine SAND. (Natural)	5
Bottom of Boring at 6.5 Feet. Completed 7/21/88.	



LAB TESTS / H-Nu

Sample	LAB TESTS	H-Nu
S-0.5		4.5
S-2.5		32
S-5.0	CA	0

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-13

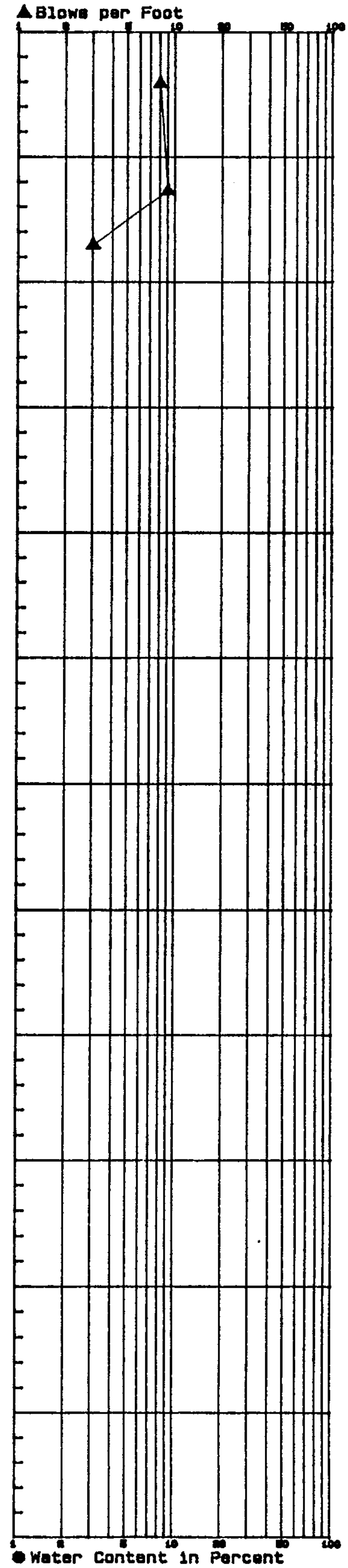
Boring Log G9/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Very loose, moist, brown, slightly silty, sandy GRAVEL. (FILL)	0	S-0.7	CA	0
Wet, black PEAT with sand cuttings. (Natural)	5			
Loose to very loose, wet, gray, silty to very silty, medium to fine SAND with interbedded very soft, sandy SILT. (Natural)		S-5.0		0
	ATD	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/22/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-14

Boring Log H3/HB01

SOIL DESCRIPTIONS

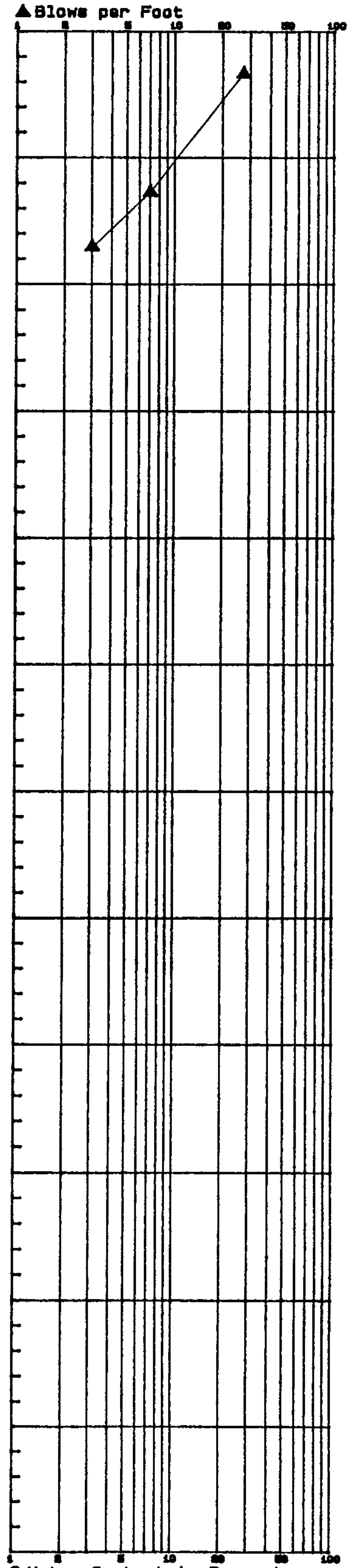
Ground Surface Elevation in Feet

Depth in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over medium dense, moist, brown, slightly silty, sandy GRAVEL with metallic particles. (FILL)	0	S-0.3		3
PEAT or organic SILT. (Natural)	5			
Very loose, wet, gray, slightly silty, medium to fine SAND and very soft, wet, gray, sandy SILT. (Natural)		S-5.0	CA	0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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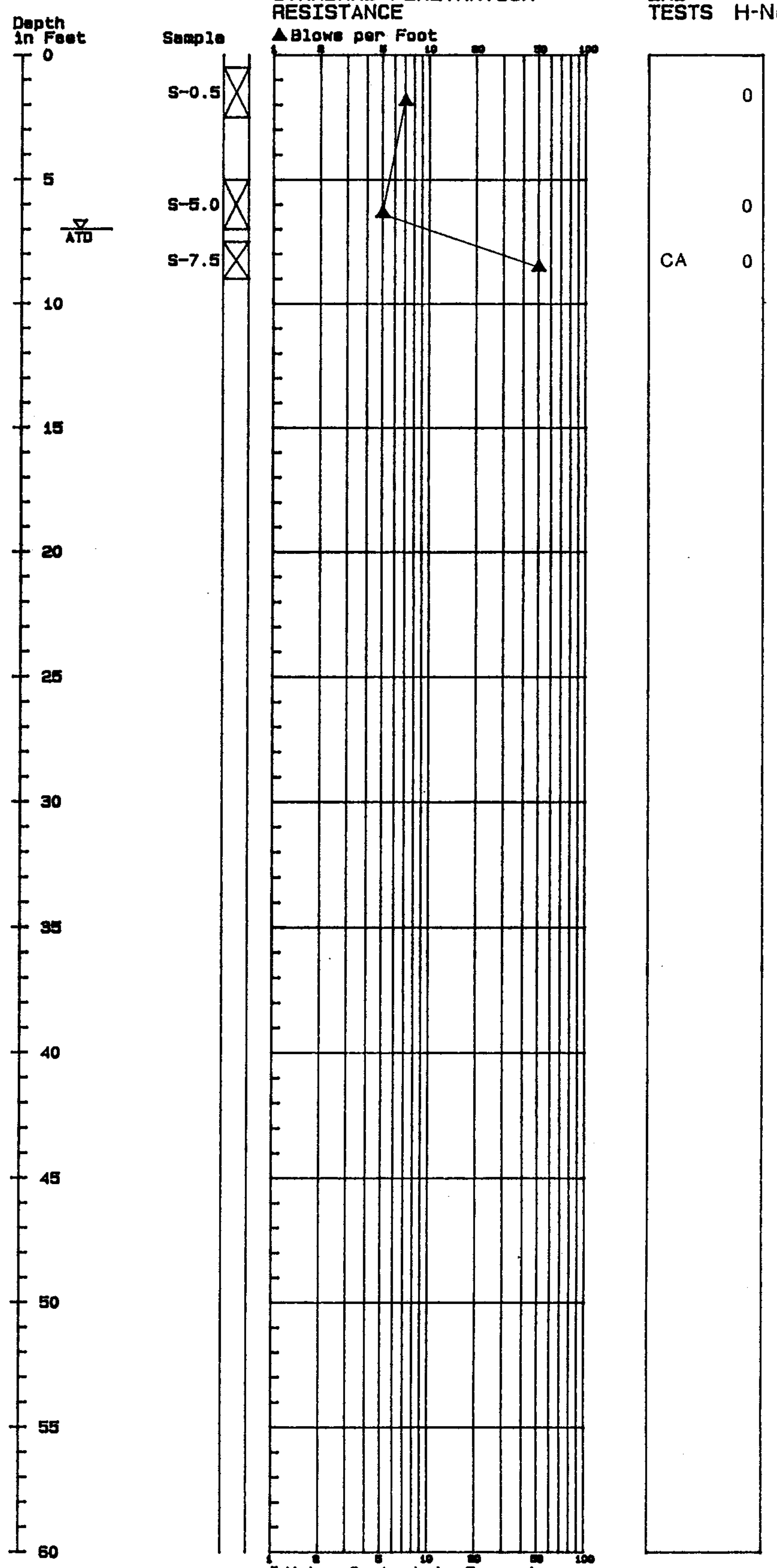
Figure C-15

Boring Log H4/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist, black-orange, slightly silty, very sandy GRAVEL with building materials, brick, sandstone. (FILL)	0.5	S-0.5		0
Very loose, wet, gray, very silty SAND. (Natural)	5.0	S-5.0		0
Medium dense, wet, gray, slightly silty, gravelly, fine to medium SAND (Natural)	7.5	S-7.5	CA	0
Bottom of Boring at 9.0 Feet. Completed 7/27/88.				



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-16

Boring Log H5/HB01

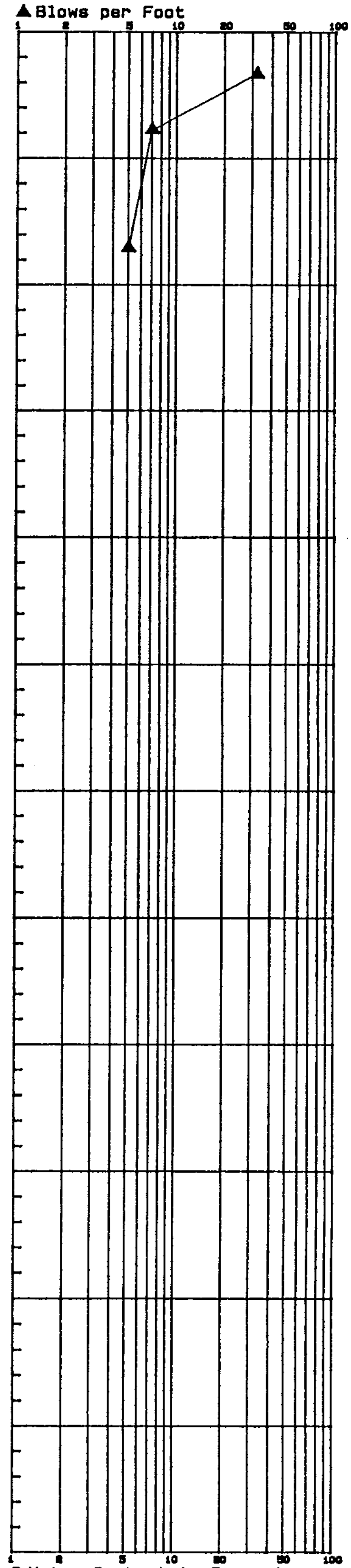
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet ASPHALT over medium dense, damp to moist, gray-brown, slightly silty, sandy GRAVEL. (FILL)	0	S-0.3	CA	5
Wet, gray PEAT. (Natural)		S-2.5		0
Medium stiff to soft, wet, gray, very sandy SILT. (Natural)	5 (ATD)	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/27/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-17

Boring Log H8/HB01

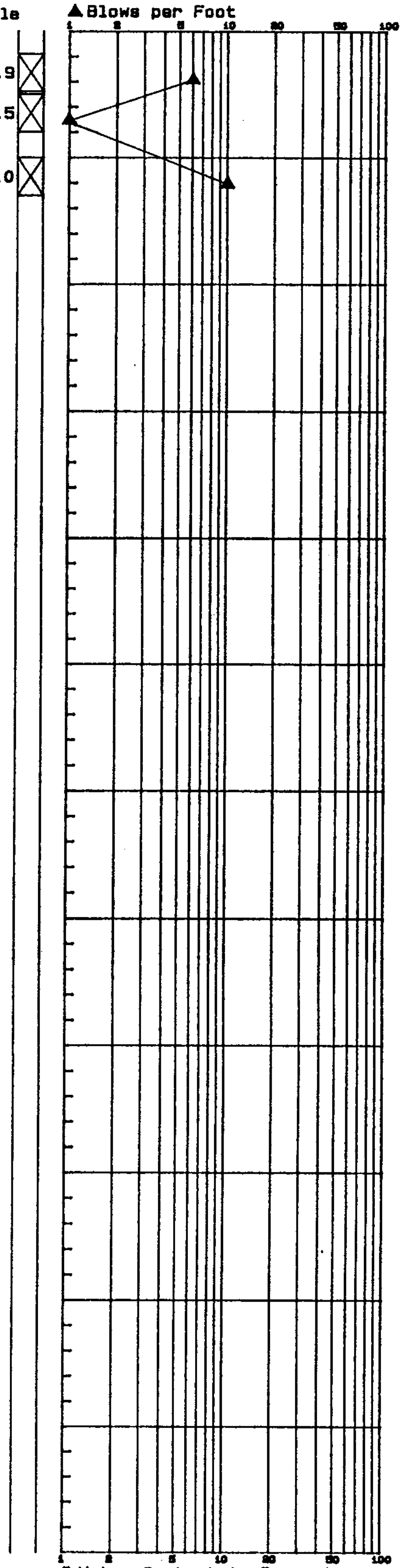
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	Medium stiff, moist to wet, dark brown, gravelly, very sandy SILT. (FILL)
	Very soft, wet, gray, slightly sandy SILT with fine to medium SAND lenses (Natural)
5	Loose, wet, gray, silty, medium to fine SAND. (Natural)
	Bottom of Boring at 6.5 Feet. Completed 7/21/88.

STANDARD PENETRATION RESISTANCE

Sample	LAB TESTS	H-Nu
S-0.9	CA	3.5
S-2.5		0
S-5.0		0



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-18

Boring Log H9/HB01

SOIL DESCRIPTIONS

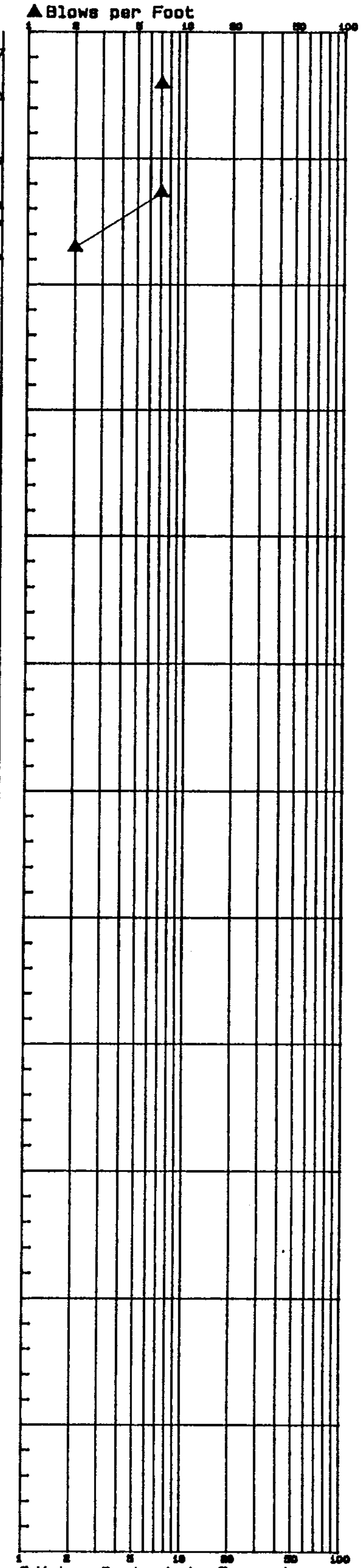
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Very loose, wet, black, silty, very gravelly SAND with some orange mottling, cinders, and other man-made particles. (FILL)	0	S-0.7		0
Very loose, wet, gray, silty, fine SAND with some peat. (Natural)	5	S-5.0	CA	0
Very soft, wet, gray, sandy SILT. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/25/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-19

Boring Log I3/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

0.5 feet CONCRETE over medium dense, moist, black-orange-red-white, slightly silty, very sandy GRAVEL with building rubble. (FILL)

Very stiff, wet, gray, clayey SILT. (Natural)

Very stiff, wet, gray, sandy SILT. (Natural)

PEAT.

Stiff, wet, gray, sandy SILT. (Natural)

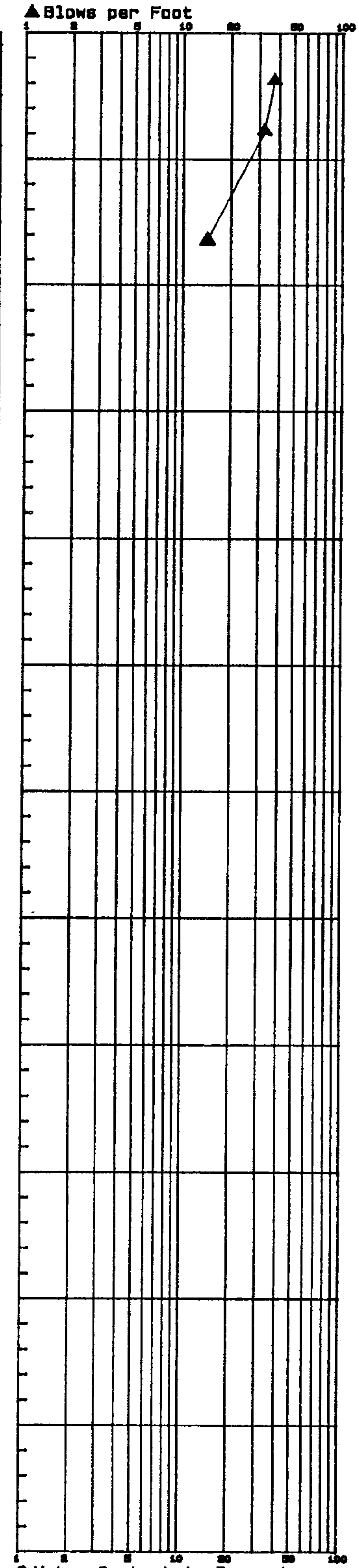
Loose, wet, gray, silty, fine SAND. (Natural)

Bottom of Boring at 9.0 Feet.
Completed 7/27/88.

Sample	LAB TESTS	H-Nu
S-0.5	CA	12.5
S-2.5		0
S-7.5		0

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-20

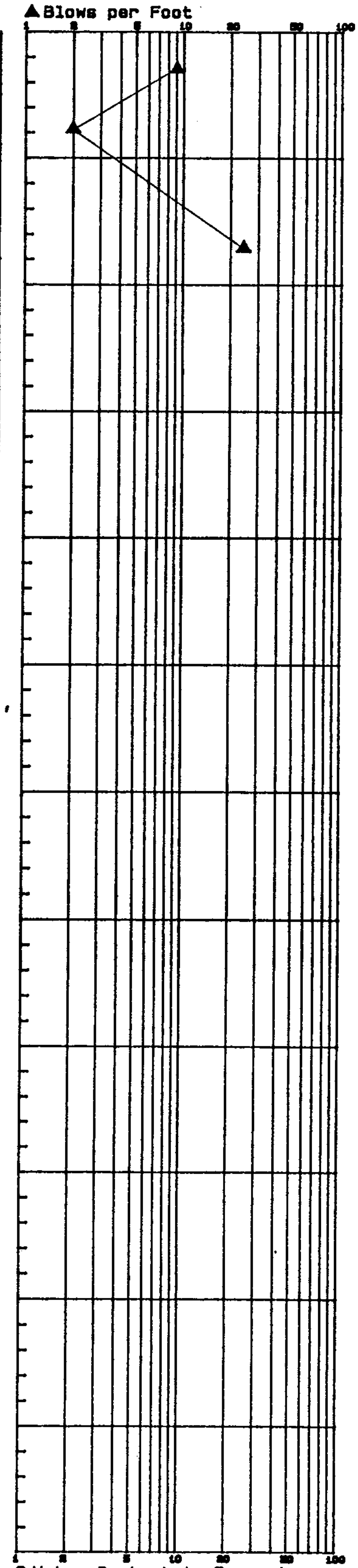
Boring Log I4/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	Very loose, wet, gray-black, slightly silty, sandy GRAVEL. (FILL)	S-0.1		2.7
	Very loose, wet, gray and brown, silty SAND. (Natural)	S-2.5	CA	0
5	Very loose to medium dense, wet, gray, sandy GRAVEL. (Natural)	S-7.5		0.2
9	Bottom of Boring at 9.0 Feet. Completed 7/22/88.			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-21

Boring Log I6/HB01

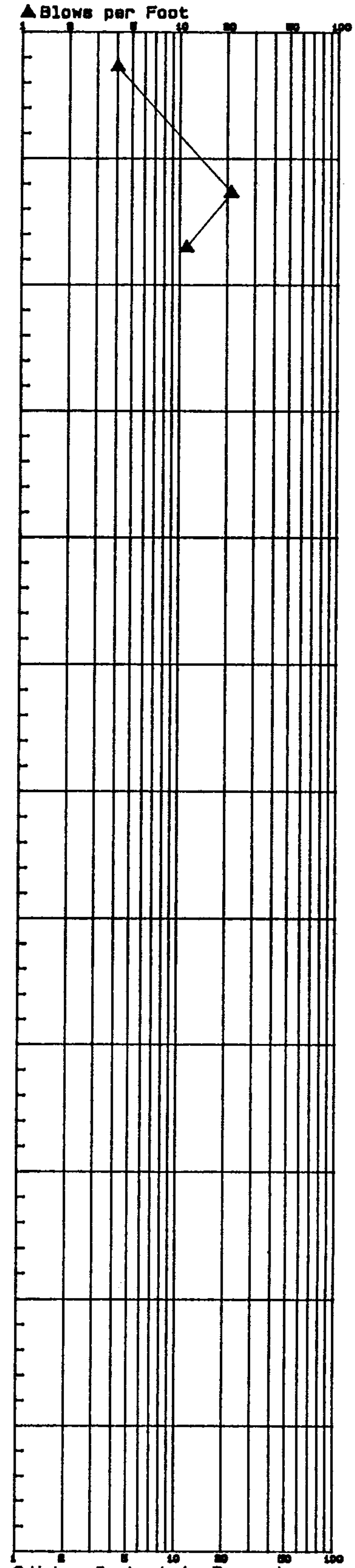
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	Very loose, dry, brown, slightly sandy GRAVEL. (FILL)	S-0.0		0
	Stiff, wet, gray, slightly sandy SILT. (Natural)	S-5.0	CA	0
	Loose, wet, gray, sandy GRAVEL. (Natural)	S-7.5		0.2
	Bottom of Boring at 9.0 Feet. Completed 7/22/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-22

Boring Log I7/HB01

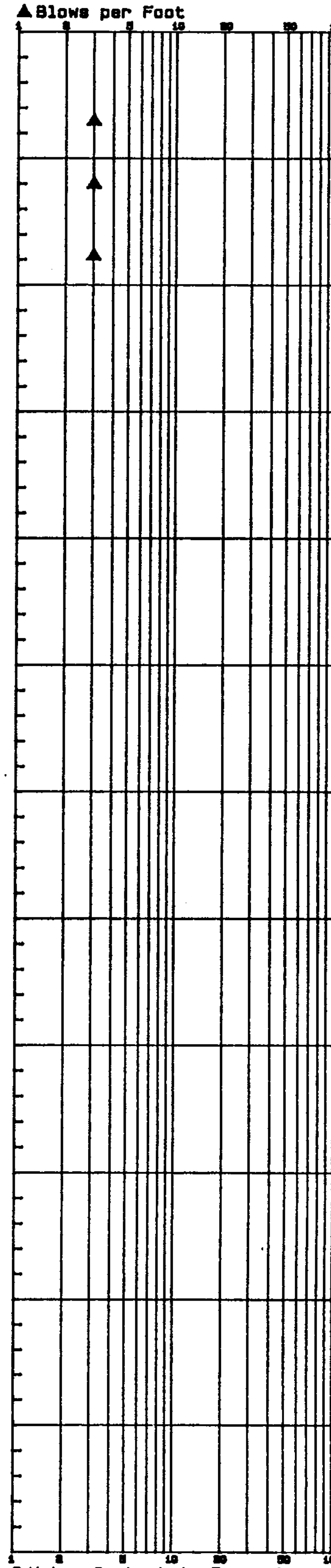
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	Very loose, wet, gray, sandy SILT with wood fragments. (Natural)
~2.5	Sandy GRAVEL (FILL?)
9.5	Bottom of Boring at 9.5 Feet. Completed 7/22/88.

Sample	LAB TESTS	H-Nu
S-2.5	CA	4
S-5.0		2.5
S-7.5		0

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-23

Boring Log I8/HB01

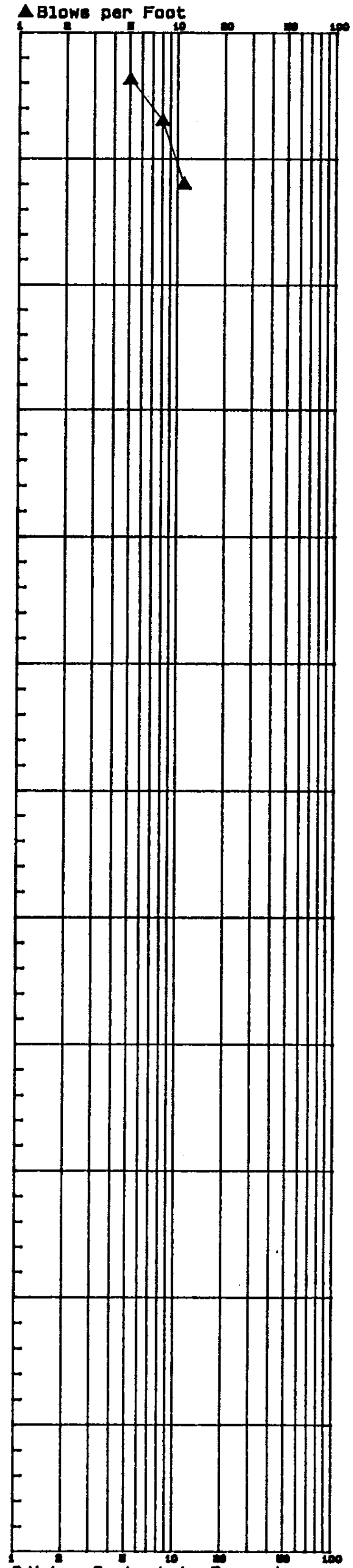
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Very loose, moist, black, silty, very gravelly SAND with light brown mottling and brick fragments. (FILL)	0	S-0.8		10
Loose, wet, gray, silty, medium to fine SAND with root fragments. (Natural)		S-2.5		25
	5	S-5.0	CA	12
Bottom of Boring at 6.5 Feet. Completed 7/21/88.				

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-24

Boring Log I9/HB01

SOIL DESCRIPTIONS

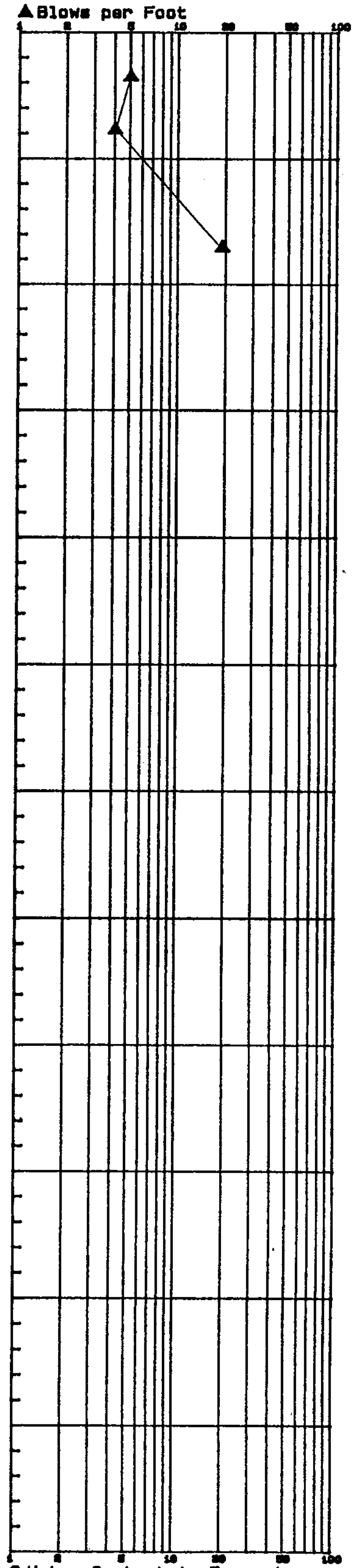
Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.4 feet CONCRETE over very loose, moist to wet, brown-black, slightly gravelly, silty SAND. (FILL)	S-0.4	CA	0
	Soft, wet, gray, very sandy SILT. (Natural)	S-2.5		0
	Loose, wet, dark gray, clean SAND. (Natural)	S-7.5		0.5
	Bottom of Boring at 9.0 Feet. Completed 7/29/88.			

Groundwater level: ATD (approx. 7.5 ft)

STANDARD PENETRATION RESISTANCE

▲Blows per Foot



Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-25

Boring Log I10/HB01

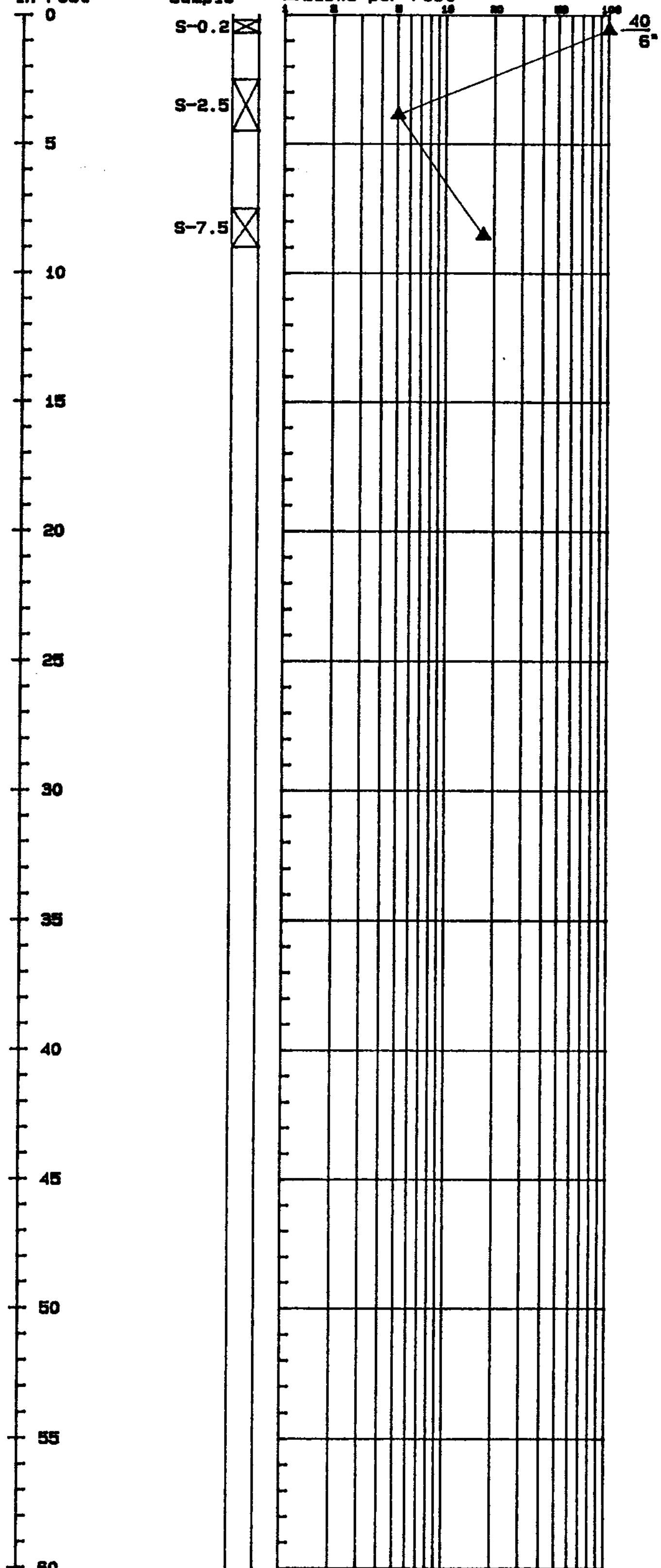
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet WOOD over moist, brown SOIL and WOOD FRAGMENTS. (FILL)	0	S-0.2		0
Loose, moist, brown, slightly silty, sandy GRAVEL. (FILL) chunks of slag.		S-2.5	CA	0
Soft to stiff, wet, gray, slightly sandy to sandy SILT. (Natural)	5	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/1/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-26

Boring Log J1/HB01

SOIL DESCRIPTIONS

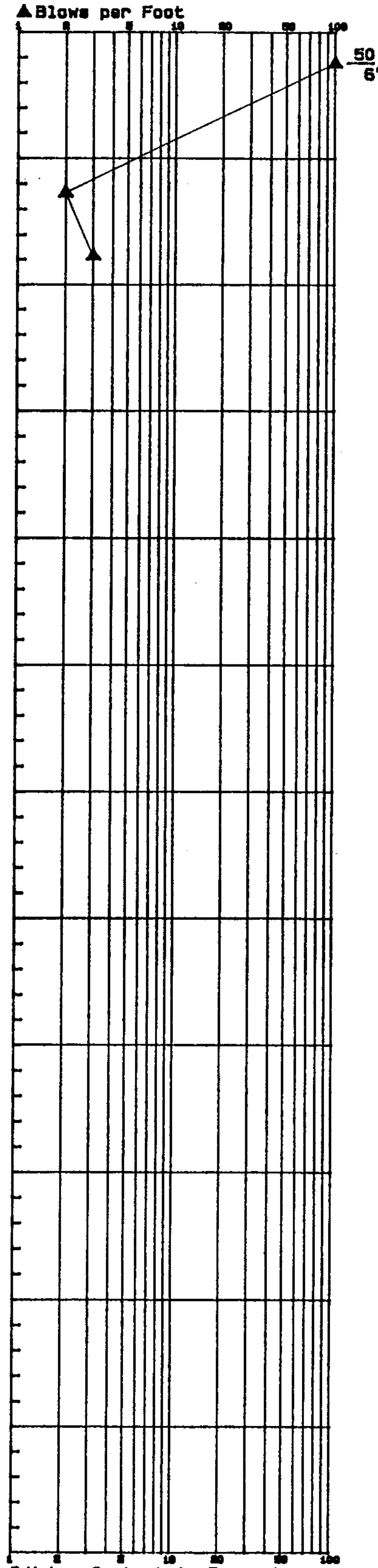
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over (dense), moist brown, sandy GRAVEL. (FILL)	0	S-0.8		1
Very loose, moist to wet, black, silty, gravelly SAND. (Natural)	5 (ATD)	S-6.0		1.8
Soft, wet, gray, very sandy SILT. (Natural)		S-7.5	CA	2.8
Bottom of Boring at 9.5 Feet. Completed 7/26/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-27

Boring Log J3/HB01

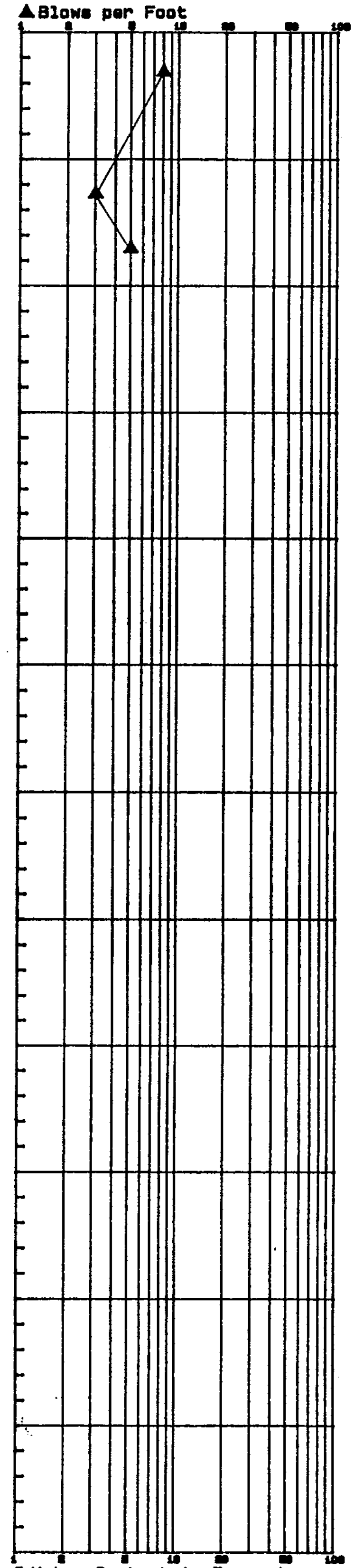
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.3 feet ASPHALT over very loose, moist, brown-black, slightly silty, sandy GRAVEL. (FILL)	S-0.2		90
5	PEAT.	S-5.0	CA	2
	Soft, wet, gray, sandy SILT with some tan mottling and moderately weathered organics. (Natural)	S-7.5		6
	Very loose, wet, gray-brown, slightly silty SAND. (Natural)			
	Bottom of Boring at 9.0 Feet. Completed 7/27/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-28

Boring Log J5/HB01

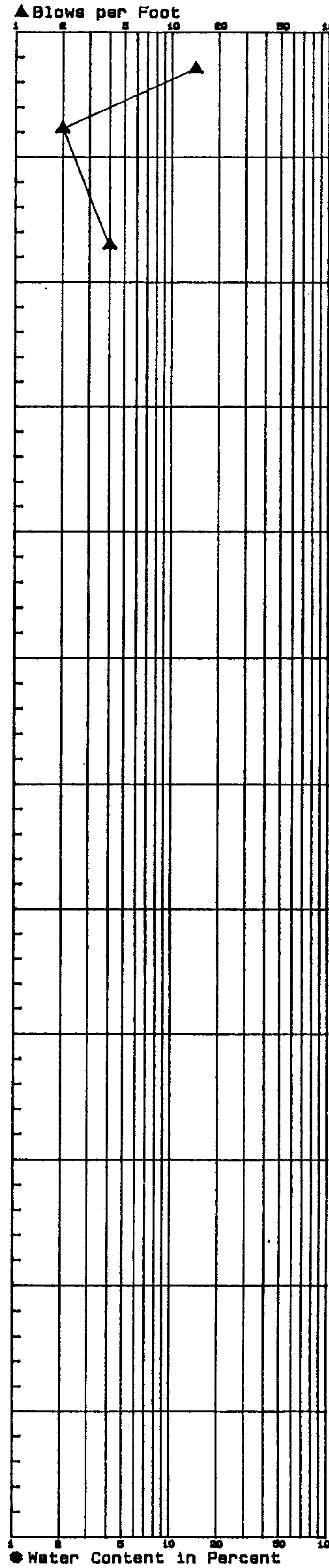
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Medium dense to very loose, damp to moist to wet, black-gray-brown, slightly silty, gravelly SAND with rubble and diesel-like odor. (FILL)	0–6.5	S-0.1		0
		S-2.5	CA	28
Very loose, wet, gray, silty SAND with small roots and product sheen. (Natural)	6.5–9.0	S-7.5		17
Bottom of Boring at 9.0 Feet. Completed 7/22/88.	9.0			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-29

Boring Log J6/HB01

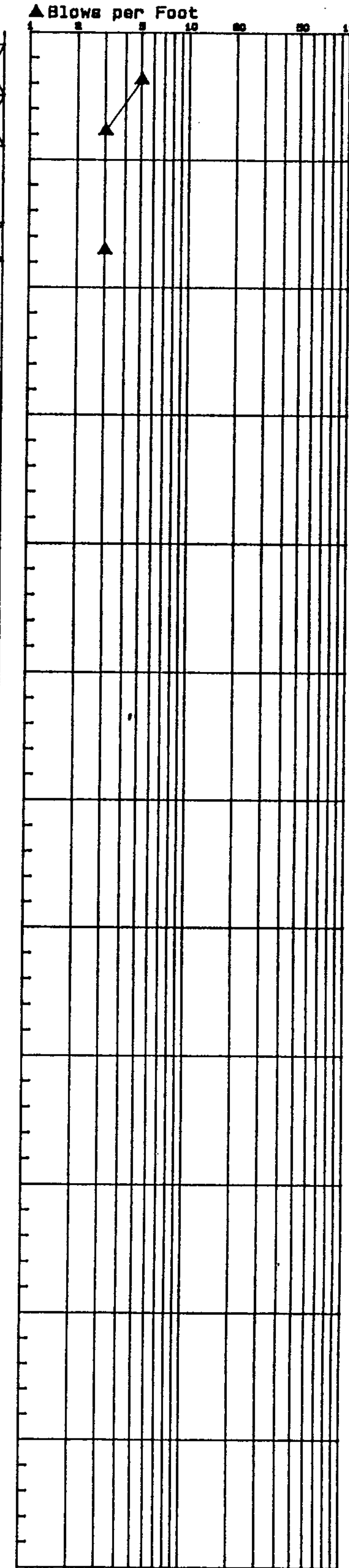
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	Very loose, moist, black, slightly gravelly, silty SAND with orange mottling. (FILL)	S-0.5	CA	0
	PEAT with some black mottling.	S-2.5		0
	Soft, wet, gray, sandy SILT. (Natural)			
5 (ATD ground water level, about 6 ft)	Very loose, wet, gray, very silty SAND. (Natural)	S-7.5		0.2
9.0	Bottom of Boring at 9.0 Feet. Completed 7/25/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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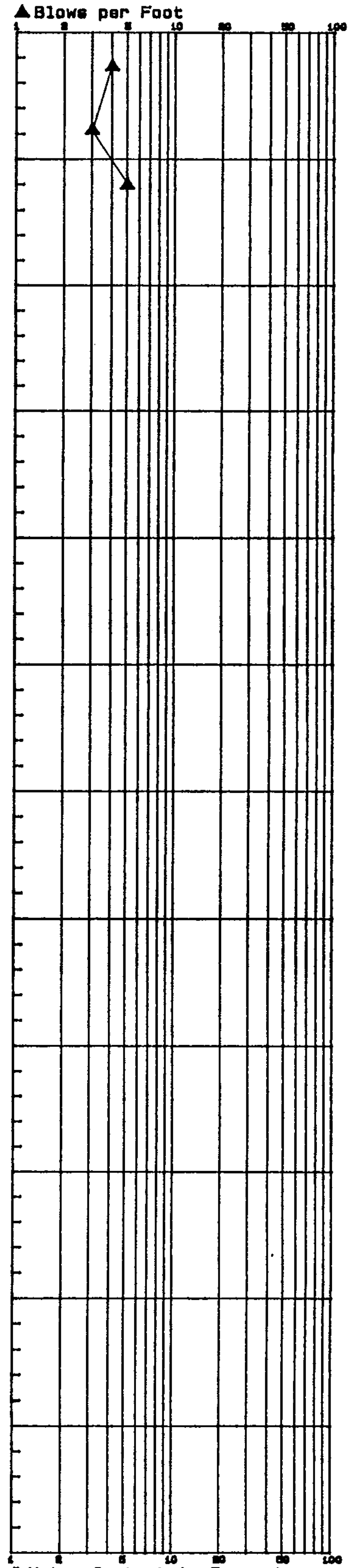
Figure C-30

Boring Log J7/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
Very loose, dry, light brown, slightly silty, sandy GRAVEL. (FILL)	0	S-0.0		0
Very loose, wet, gray, silty SAND. (Natural)		S-2.5		0
	5	S-5.0	CA	0
Bottom of Boring at 6.5 Feet. Completed 7/22/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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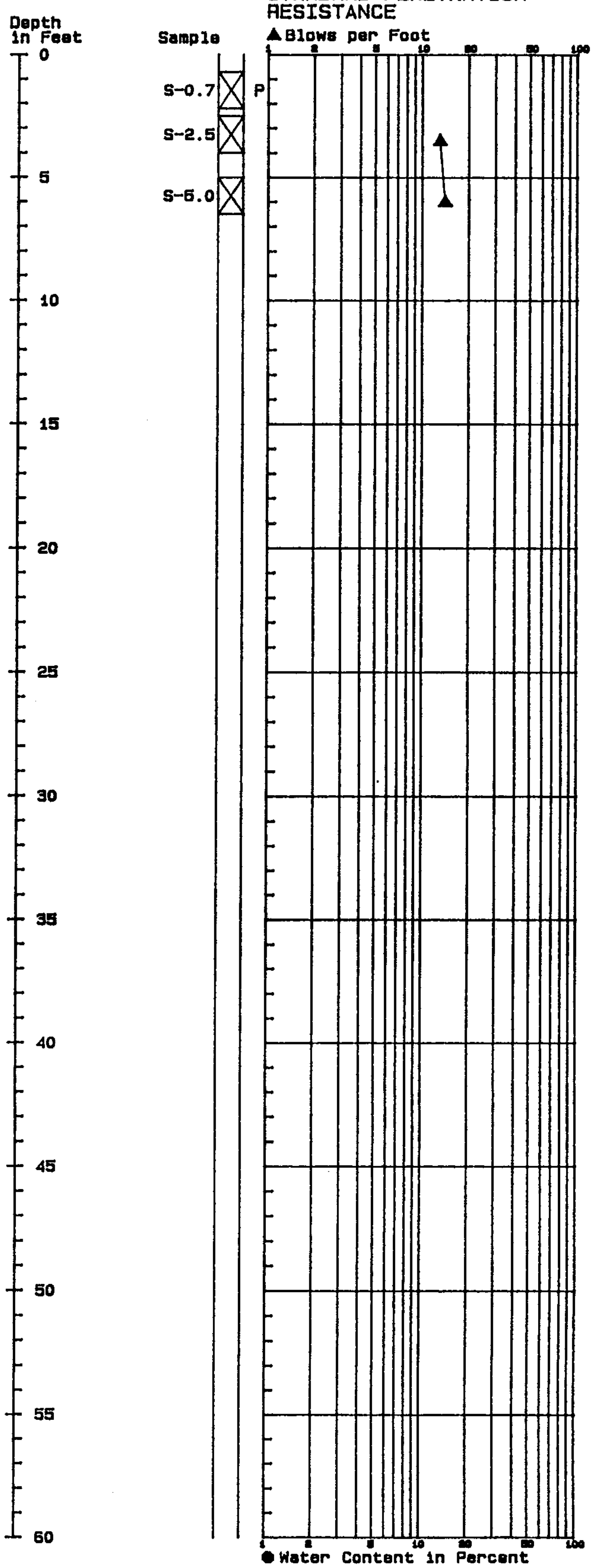
Figure C-31

Boring Log J8/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet
Very loose, moist to wet, black, slightly gravelly SAND with ashes and charcoal. (FILL)	0
Loose, wet, green-gray, slightly silty, medium to fine SAND with few small wood fragments. (Natural)	5
Bottom of Boring at 6.5 Feet. Completed 7/21/88.	



LAB TESTS	H-Nu
CA	1
	30
	10

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-32

Boring Log J9/HB01

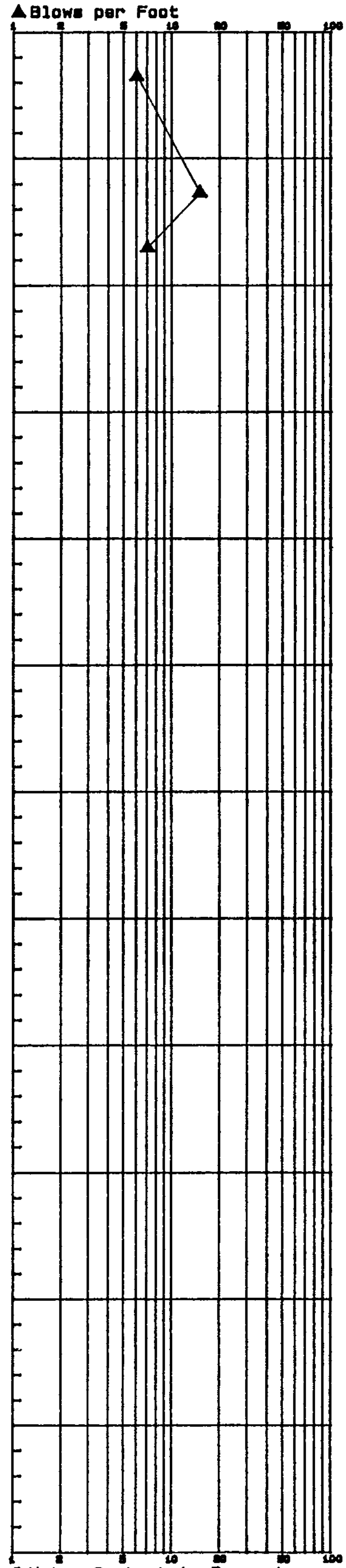
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE very loose, moist to wet, brown-black, silty very gravelly, medium to fine SAND. (FILL)	0–5	S-0.4		0
Stiff, wet, black-gray, very sandy SILT. (FILL)	5	S-5.0	CA	0.5
Interbedded very loose, wet, gray, silty SAND and medium stiff, wet, gray, sandy SILT with brown peat and large chunk of old wood. (Natural)	10	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/29/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-33

Boring Log K5/HB01

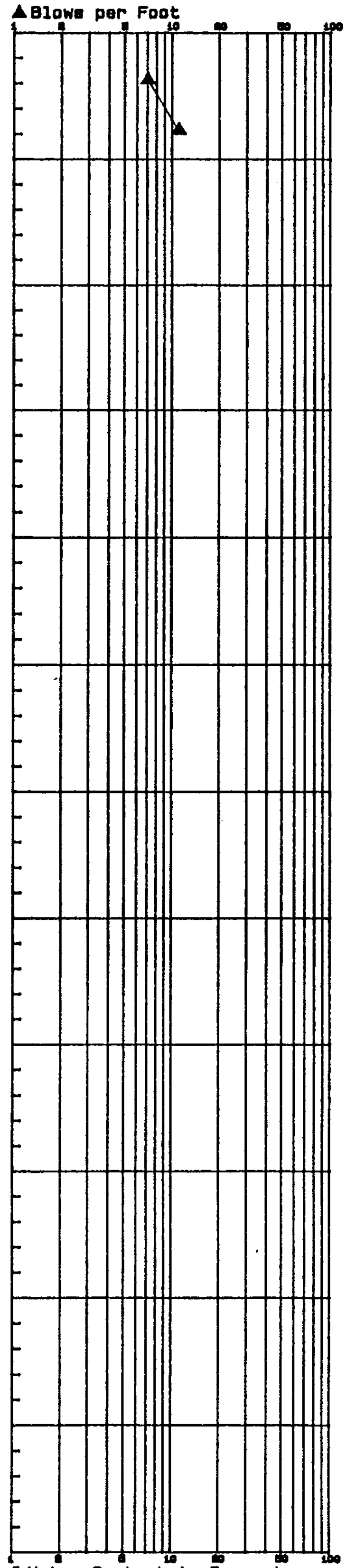
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist to wet, black, slightly silty, gravelly, fine to medium SAND. (FILL)	0	S-0.5	CA	0
		S-2.5		0
Very loose, wet, gray, very silty, fine SAND to medium stiff, slightly sandy SILT. (Natural)	5	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/26/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-34

Boring Log K6/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Very loose, damp, light brown, very gravelly SAND. (FILL)

Very loose, moist, black, silty, gravelly SAND. (FILL)

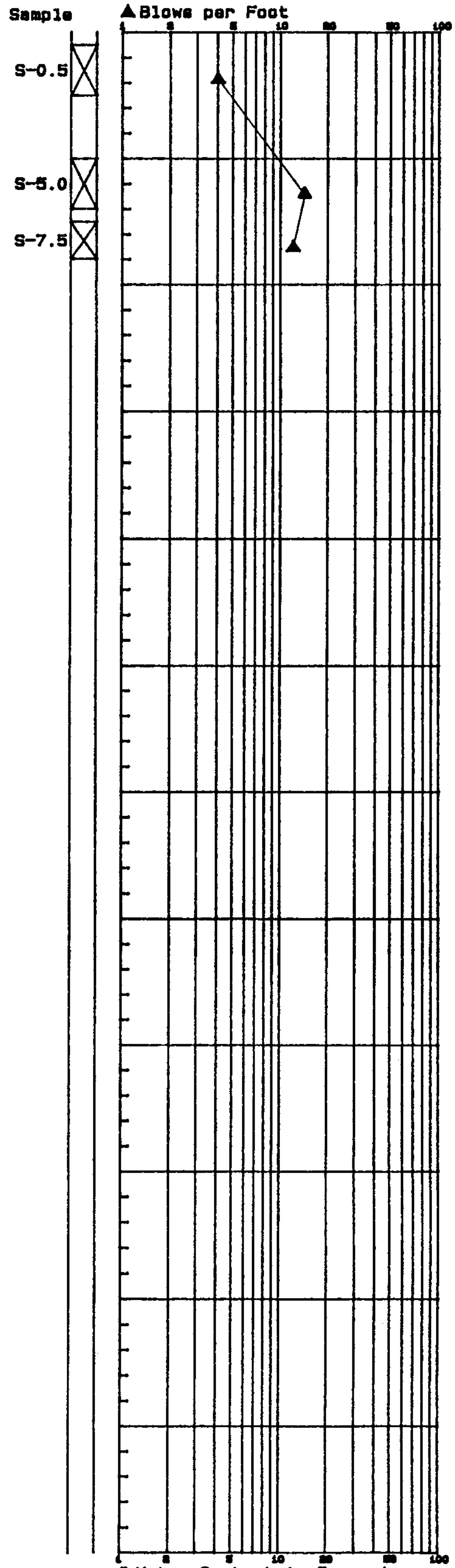
PEAT. (Natural)

Loose, wet, gray, gravelly, silty, medium to fine SAND. (Natural)

Loose, wet, gray, slightly silty, very gravelly SAND. (Natural)

Bottom of Boring at 9.0 Feet.
Completed 7/25/88.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60



Sample	LAB TESTS	H-Nu
S-0.5		0
S-5.0		0
S-7.5	CA	0

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-35

Boring Log K7/HB01

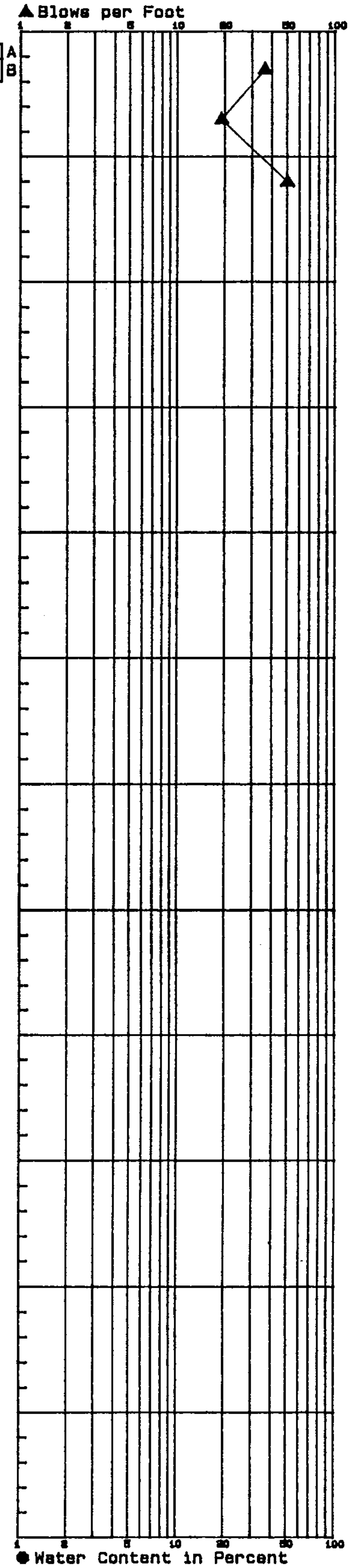
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Medium dense, wet, black, gravelly, silty SAND. (FILL)	0	S-0.5 (A, B)		0
Medium dense, moist, tan, slightly gravelly, silty, fine to medium SAND (FILL)		S-3.5	CA	0
Medium dense, wet, black, gravelly, silty SAND. (FILL)	5	S-5.0		0.8
Medium dense to dense, wet, green-gray, silty, medium to fine SAND. (Natural)				
Bottom of Boring at 6.5 Feet. Completed 7/21/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-36

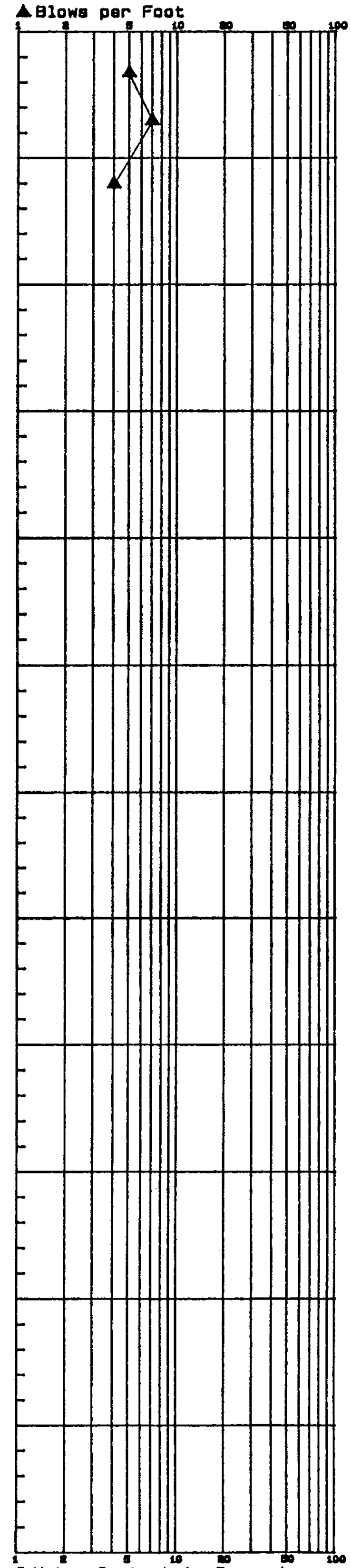
Boring Log K8/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Very loose, wet, black, silty, gravelly SAND. (FILL)	0	S-0.6		0.5
Loose, wet, gray, silty, medium to fine SAND. (Natural)		S-2.5		0
Very loose, wet, gray SAND and soft, wet, gray SILT. (Natural)	5	S-5.0	CA	0
Very loose, wet, gray, medium to fine SAND with some small root fragments. (Natural)				
Bottom of Boring at 6.5 Feet. Completed 7/21/88.				

STANDARD PENETRATION RESISTANCE



Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-37

Boring Log K9/HB01

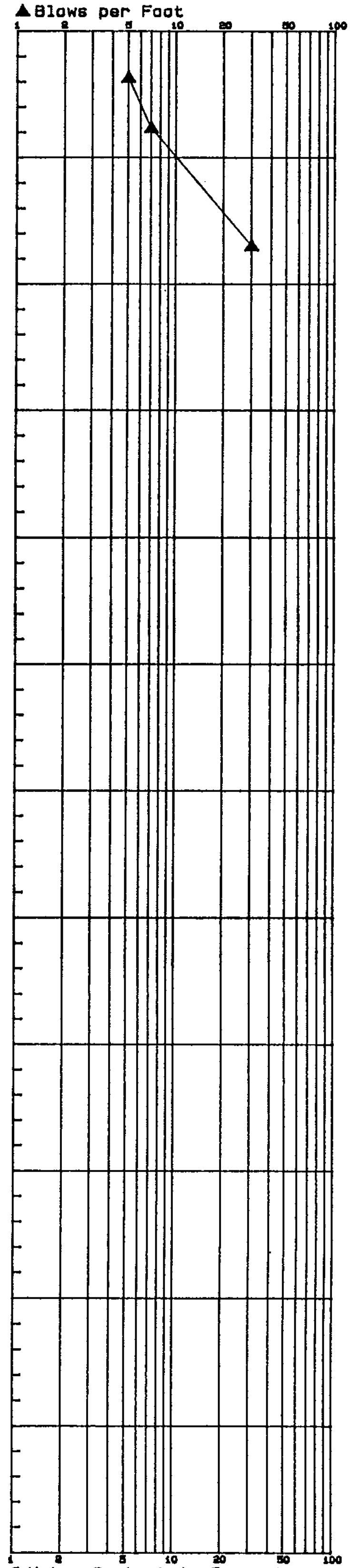
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.5 feet CONCRETE over very loose, moist to wet, black, slightly gravelly, silty SAND with white particles and small cinders. (FILL)	S-0.5		0.5
	Medium stiff, wet, gray, very sandy SILT. (Natural)	S-2.5		0.5
5	Medium dense, wet, gray, silty, fine SAND. (Natural)	S-7.5	CA	0
9	Bottom of Boring at 9.0 Feet. Completed 7/29/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

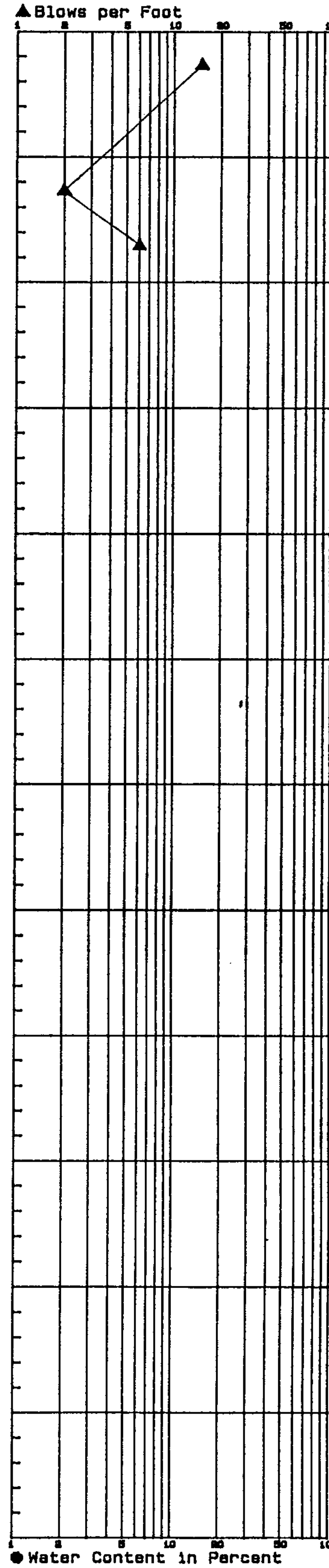
Figure C-38

Boring Log L1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
Medium dense, moist, brown, slightly silty, gravelly, medium to fine SAND with rust stains, pieces of metal and wood. (FILL)	0	S-0.0		0
Wet, gray PEAT. (Natural)	5	S-5.0	CA	0
Very soft, wet, gray, sandy SILT grading to very loose, wet, gray, silty SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/26/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-39

Boring Log L5/HB01

SOIL DESCRIPTIONS

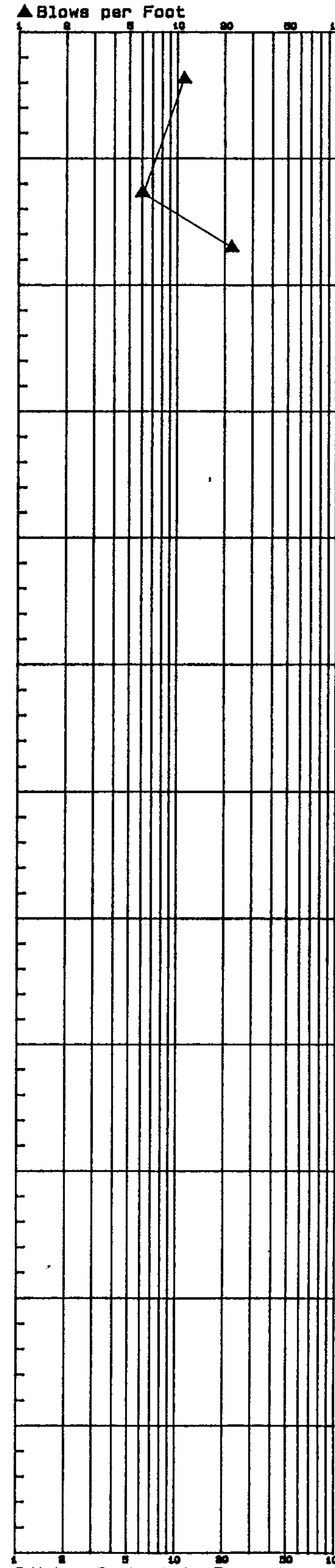
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over loose, moist, black, slightly silty, gravelly SAND with some light brown silt and orange mottling. (FILL)	0	S-0.5		0
PEAT. (Natural)	5	S-5.0	CA	0
Very loose, wet, gray, silty, medium to fine SAND. (Natural)				
Soft, wet, gray, very sandy SILT. (Natural)		S-7.5		0.8
Loose, wet, gray, slightly silty, slightly gravelly SAND with fine gravels at bottom. (Natural)				
Bottom of Boring at 9.0 Feet. Completed 7/26/88.				

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-40

Boring Log L6/HB01

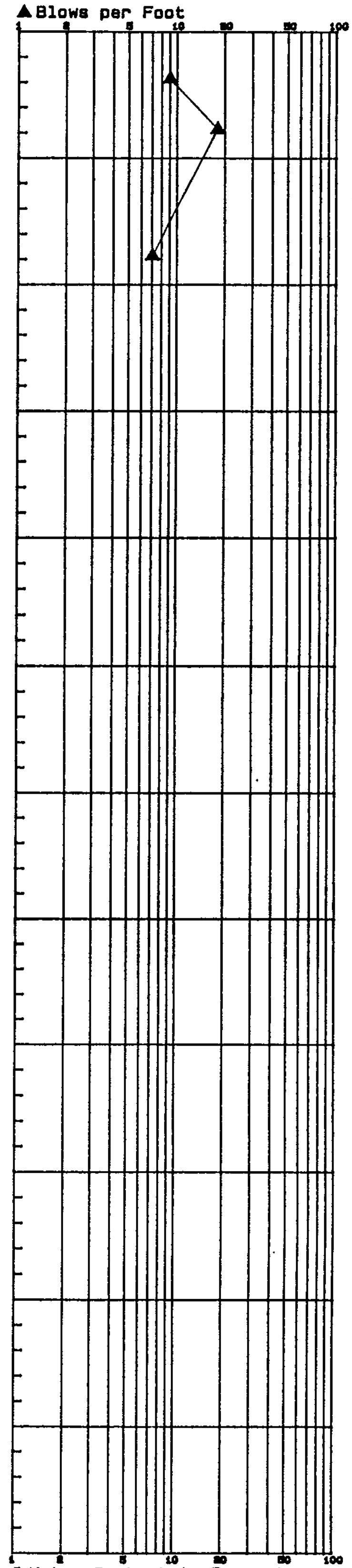
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over loose, moist to wet, black, slightly silty, very gravelly SAND. (FILL)	0	S-0.5		0
Medium dense to loose, moist to wet, light brown and gray, slightly silty fine SAND with some rust staining. (Natural)		S-2.5	CA	0
	5			
	ATD (water level)	S-7.5		0.3
Bottom of Boring at 9.5 Feet. Completed 8/12/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-41

Boring Log L7/HB01

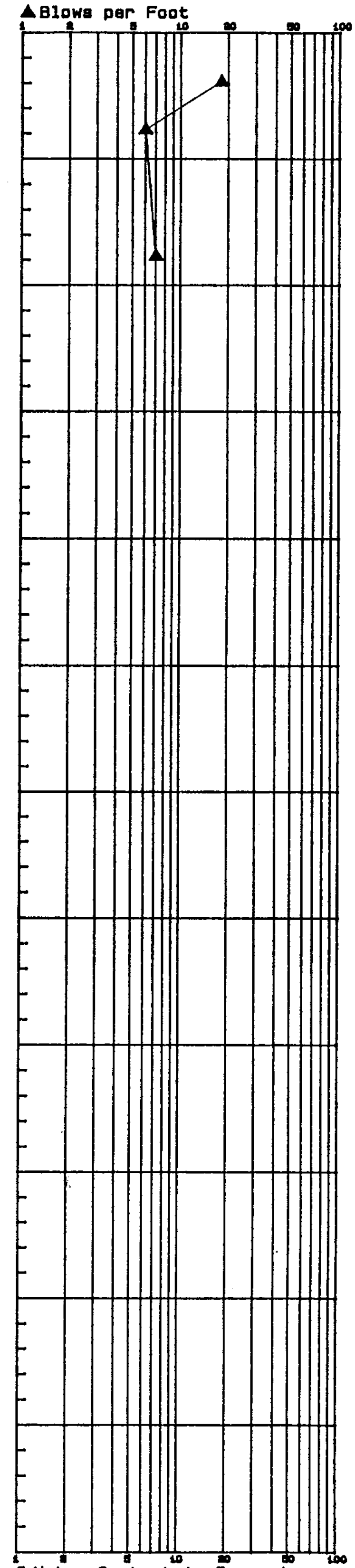
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over loose, moist to wet, brown-black, silty, very gravelly SAND. (FILL)	0	S-0.6	CA	0.3
Very loose, moist, tan SAND grading to very loose, wet, gray, very silty SAND. (Natural)		S-2.5		0.2
	ATD	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-42

Boring Log L8/HB01

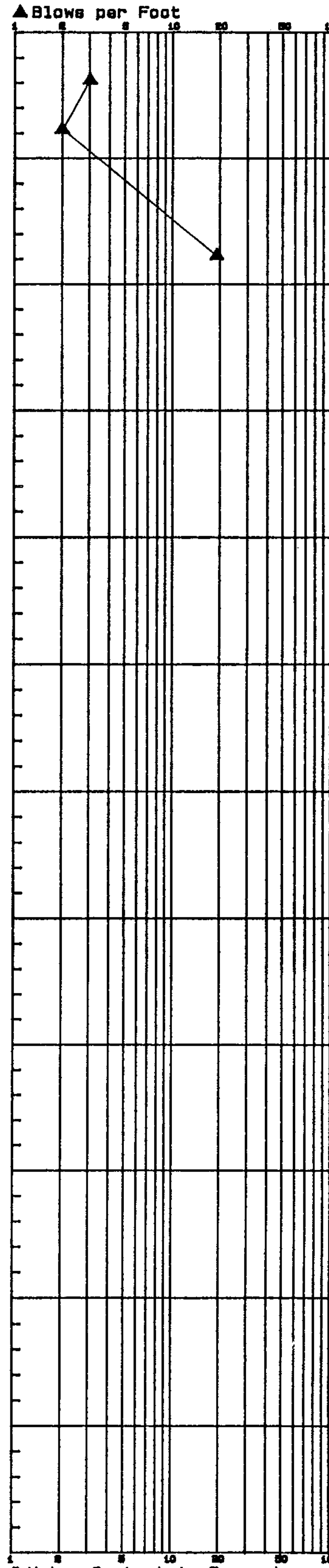
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over very loose, moist to wet, brown, silty, very gravelly SAND. (FILL)	0	S-0.6		0
Very Loose, wet, light brown to gray silty, fine SAND. (Natural)		S-2.5		0
Medium dense, wet, gray, slightly gravelly SAND. (Natural)	5 (ATD)	S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/12/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-43

Boring Log L9/HB01

SOIL DESCRIPTIONS

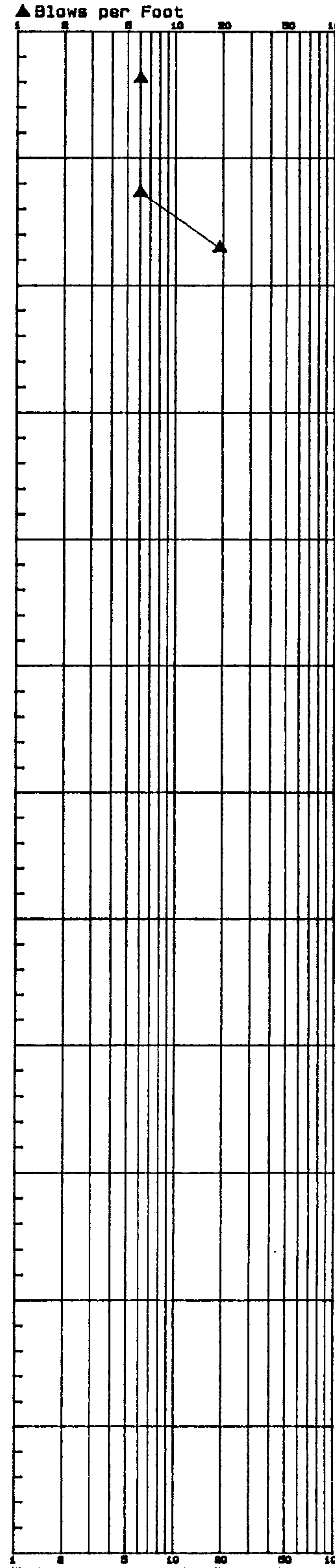
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist, black and gray, slightly silty, gravelly SAND. (FILL)	0–5.0	S-0.5	CA	0
Soft, wet, black and gray, very sandy SILT with root fragments. (FILL/Natural)	5.0–8.0	S-5.0		0
Loose, wet, gray, fine to medium SAND. (Natural)	8.0–9.0	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/29/88.				

ATD

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

LAB TESTS H-Nu

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-44

Boring Log L10/HB01

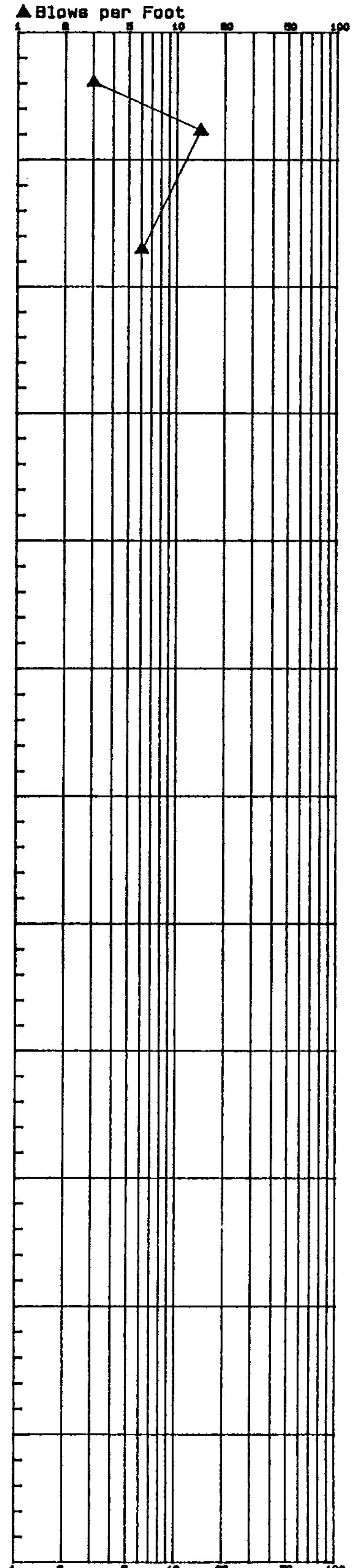
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over very loose, moist to wet, dark brown-black-gray, slightly gravelly, silty, fine SAND. (FILL)	0	S-0.6		0
Loose to very loose, wet, gray, very silty, fine SAND with interbedded soft, wet, gray very sandy SILT and very silty, fine SAND. (Natural)		S-2.5	CA	0
	ATD	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/29/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-45

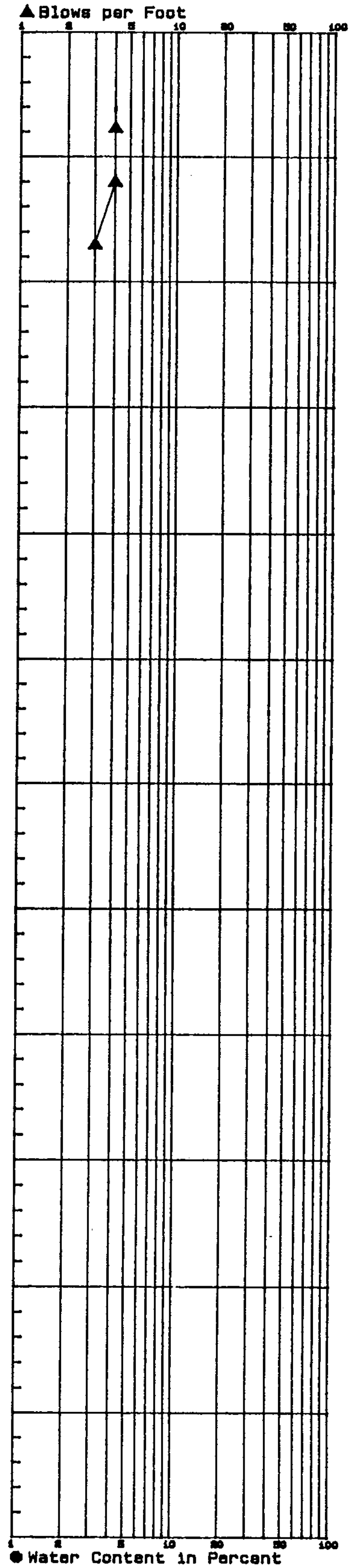
Boring Log L11/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet ASPHALT over damp, gray, sandy GRAVEL. (FILL)	0			
Very loose, damp, black-gray, sandy GRAVEL with mixed organics, charcoal slag. (FILL)		S-2.5	CA	30
Moist, brown PEAT. (Natural)	5	S-5.0		3
Very loose, moist to wet, gray, silty SAND. (Natural)		S-7.5		2
Soft, wet, gray, sandy SILT. (Natural)				
Bottom of Boring at 9.0 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-46

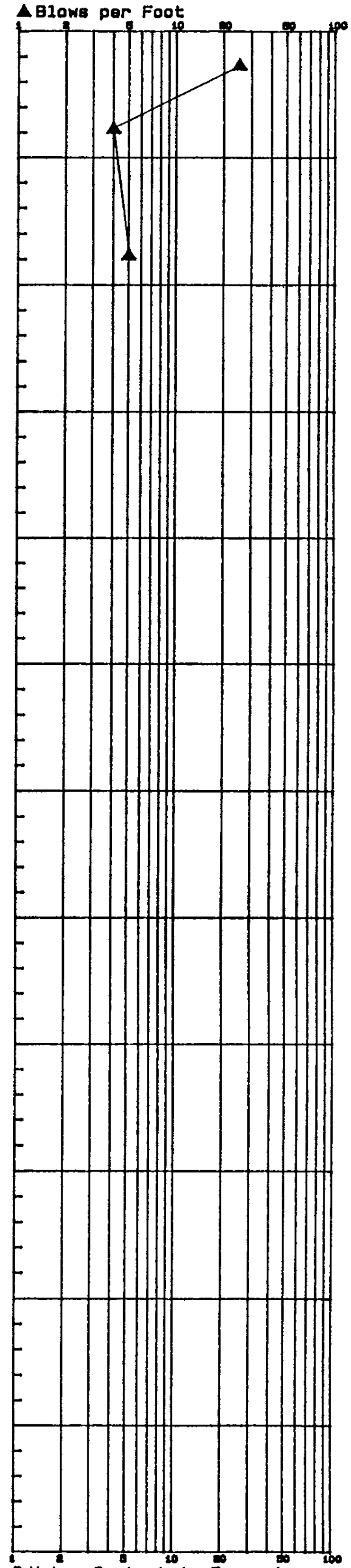
Boring Log M1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0–4.5	Medium dense, moist, dark brown and light brown, slightly silty, sandy GRAVEL with large gravels and cobbles. (FILL)	S-0.0		0.2
		S-2.5	CA	0
4.5–7	Soft, wet, gray-brown, slightly gravelly, very sandy SILT. (Natural)			
7–9.5	Very loose, wet, gray, silty SAND. (Natural)	S-7.5		0
9.5	Bottom of Boring at 9.5 Feet. Completed 8/17/88.			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-47

Boring Log M5/HB01

SOIL DESCRIPTIONS

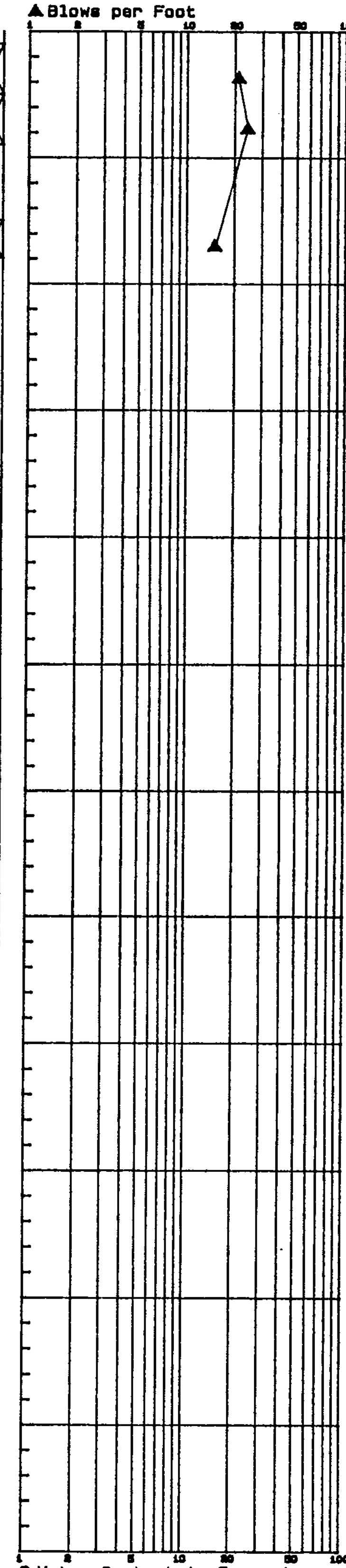
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over moist, black, slightly silty, gravelly SAND. (FILL)	0	S-0.5		0
Loose, moist, gray, very silty, medium to fine SAND. (FILL)		S-2.5		
Loose, wet, gray, silty, very gravelly, medium to fine SAND with fine gravels at bottom. (Natural)	ATD	S-7.5	CA	14
Bottom of Boring at 9.0 Feet. Completed 7/26/88.				

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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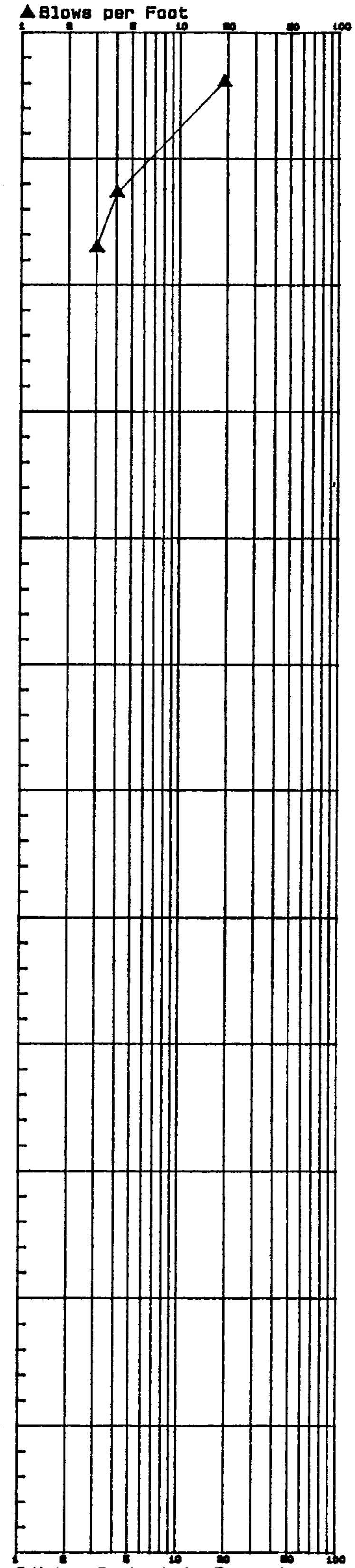
Figure C-48

Boring Log M6/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
Medium dense, dry to damp, light brown, slightly silty, sandy GRAVEL. (FILL)	0	S-0.6	CA	0.5
Soft, wet, gray, sandy SILT. (Natural)	5	S-5.0		0
Very loose, wet, gray, silty SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/25/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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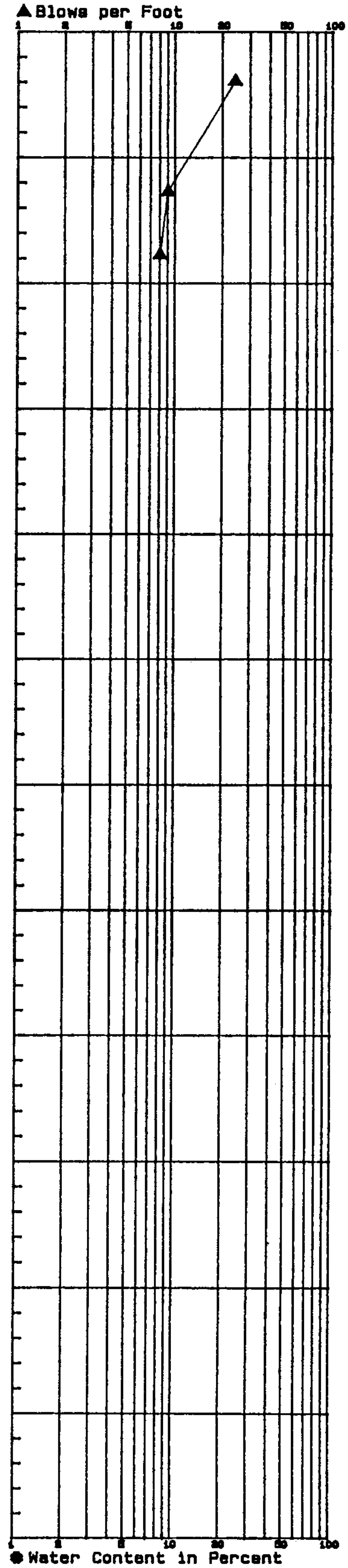
Figure C-49

Boring Log M7/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over loose, wet, dark brown, silty, very sandy GRAVEL with brick fragments. (FILL)	0–2.5	S-0.6		0.3
Very loose, wet, gray, silty, fine SAND. (Natural)	2.5–7.5	S-5.0	CA	0.2
Medium stiff, wet, gray, sandy SILT. (Natural)	7.5–9.5	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	9.5			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-50

Boring Log M8/HB01

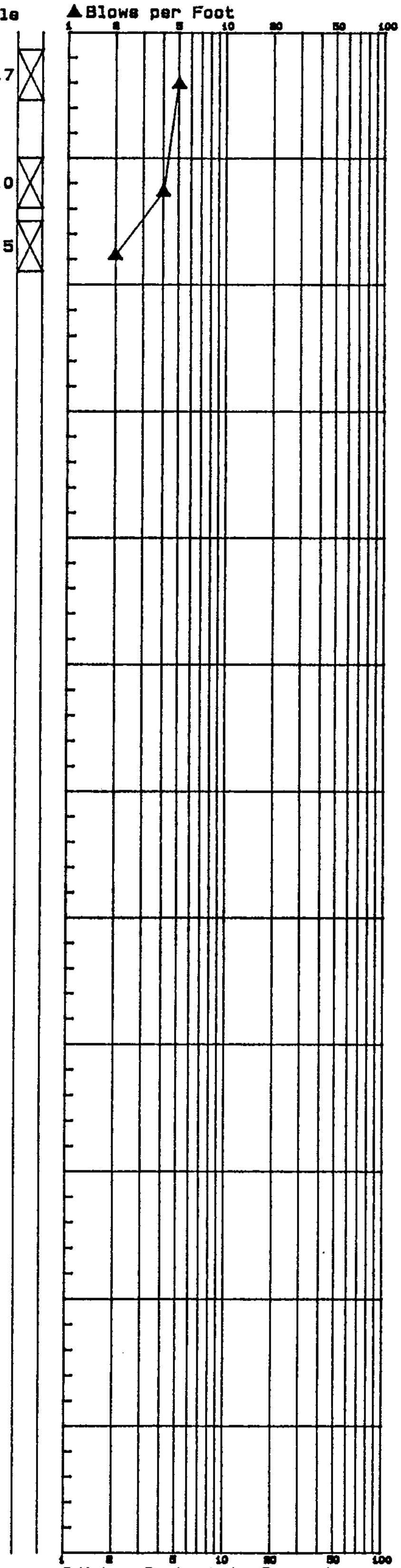
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	LAB TESTS	H-Nu
0.7 feet CONCRETE over moist, brown-black-rust and black, slightly silty very gravelly SAND. (FILL)	0	S-0.7	CA	7
Very loose, wet, black-gray, slightly silty, fine SAND. (Natural)	5	S-5.0		0.3
Very soft, wet, gray, slightly sandy SILT. (Natural)		S-7.5		0.3
Bottom of Boring at 9.5 Feet. Completed 8/12/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-51

Boring Log M9/HB01

SOIL DESCRIPTIONS

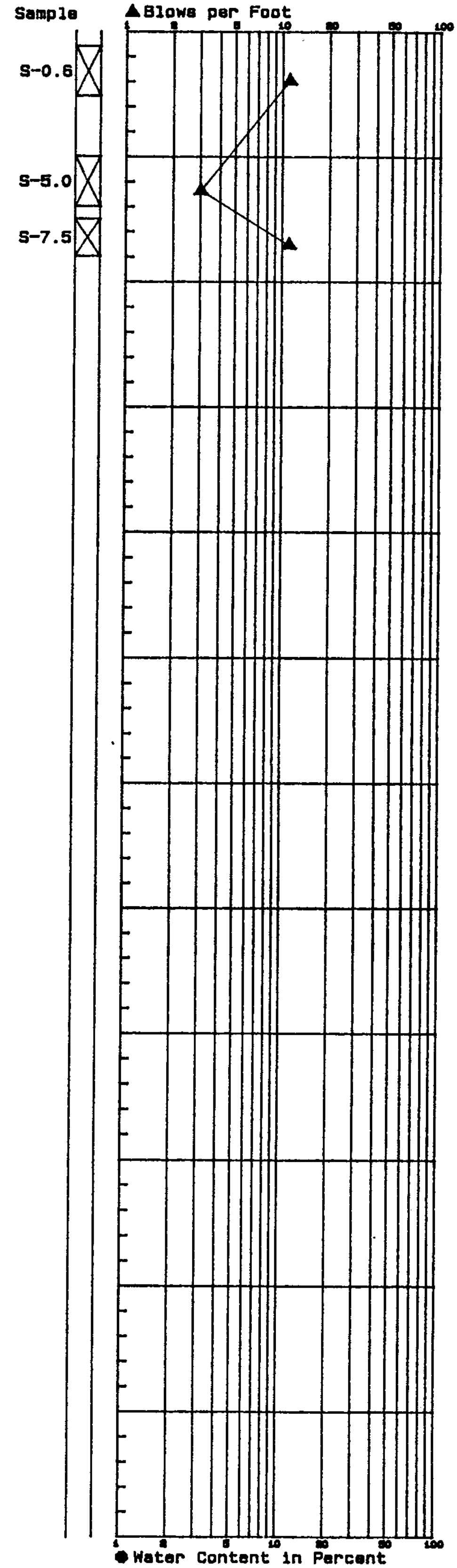
Ground Surface Elevation in Feet

Soil Description	Depth in Feet
0.6 feet CONCRETE over very loose, moist, black and gray, slightly silty, gravelly SAND. (FILL)	0
Very soft, wet, gray, slightly sandy SILT. (Natural)	5
Very loose, wet, gray, very silty, fine SAND. (Natural)	ATD
Bottom of Boring at 9.0 Feet. Completed 7/29/88.	10

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲Blows per Foot



Sample	LAB TESTS	H-Nu
S-0.6		0
S-5.0	CA	0
S-7.5		0

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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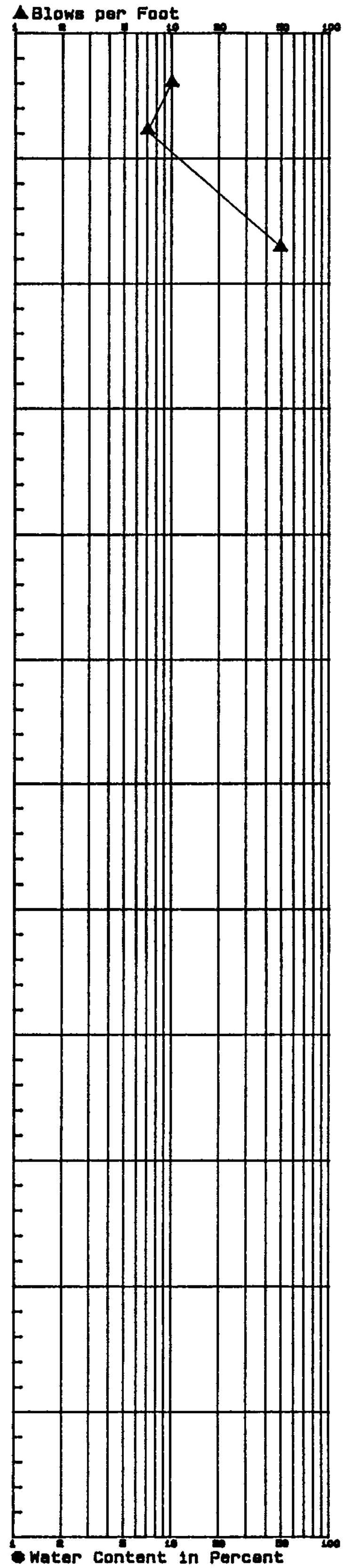
Figure C-52

Boring Log M10/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Sample	Depth in Feet	Lab Tests	H-Nu
0.6 feet CONCRETE over very loose, moist, gray-brown, slightly silty, very sandy GRAVEL. (FILL)	S-0.6	0	CA	0
Very loose, wet, gray, very silty, fine SAND. (Natural)	S-2.5			46
Very stiff, wet, gray, clayey SILT. Medium dense, wet, gray, fine SAND. (Natural)	S-7.5			1.8
Bottom of Boring at 9.0 Feet. Completed 8/1/88.				



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-53

Boring Log N1/HB01

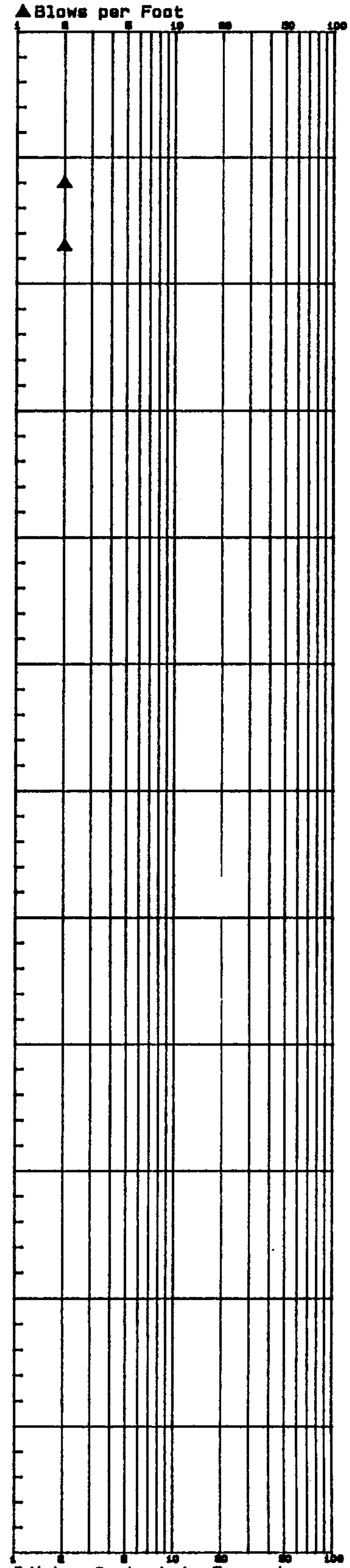
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over (loose), dry, brown, slightly silty, sandy GRAVEL with some slag, scrap metal. (FILL)	0–5.5	S-0.6	CA	0
Very soft, wet, gray, very sandy SILT. (Natural)	5.5–9.0	S-5.0		0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Comp_eted 8/3/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-54

Boring Log N2/HB01

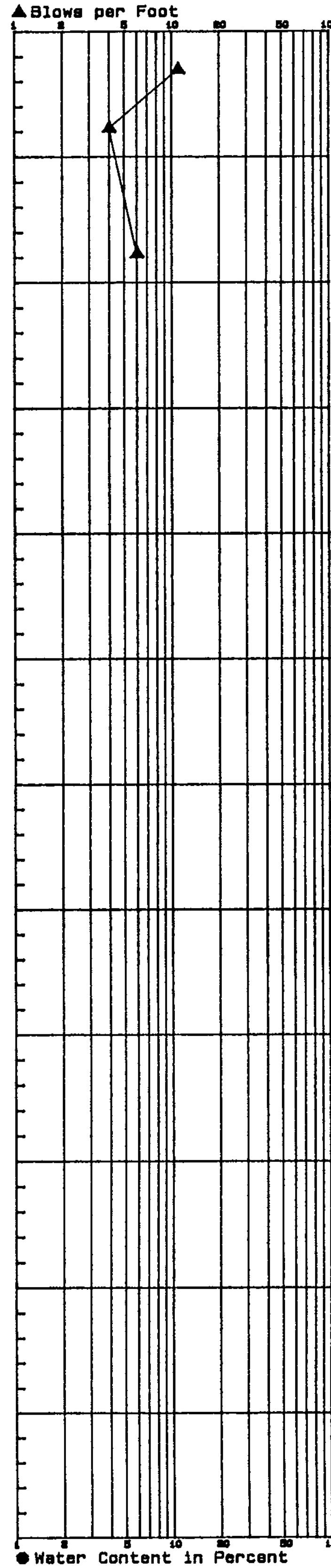
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over loose, moist, brown, slightly silty, very sandy GRAVEL to very loose, wet, black, slighlty silty, gravelly SAND. (FILL	0–8	S-0.5		0.5
		S-2.5	CA	0.3
Medium stiff, wet, gray, slightly sandy SILT. (Natural)	8–9.5	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/4/88.	9.5 (ATD water level at ~9)			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-55

Boring Log N3/HB01

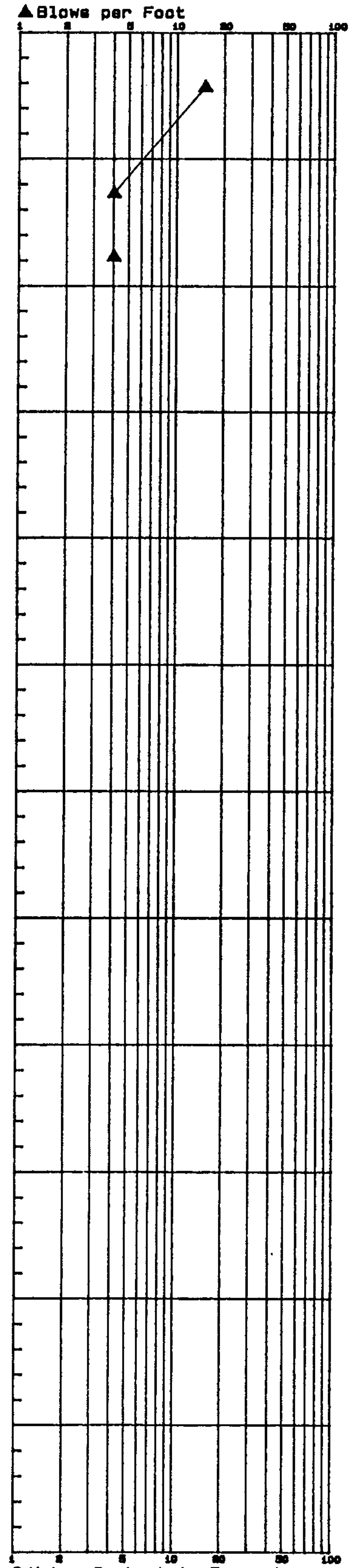
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over loose, moist, brown, sandy GRAVEL. (FILL)	0	S-0.8		0
Very loose, wet, gray, very silty, fine SAND. (Natural)	5	S-5.0		0
Soft, wet, gray, very sandy SILT. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/4/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

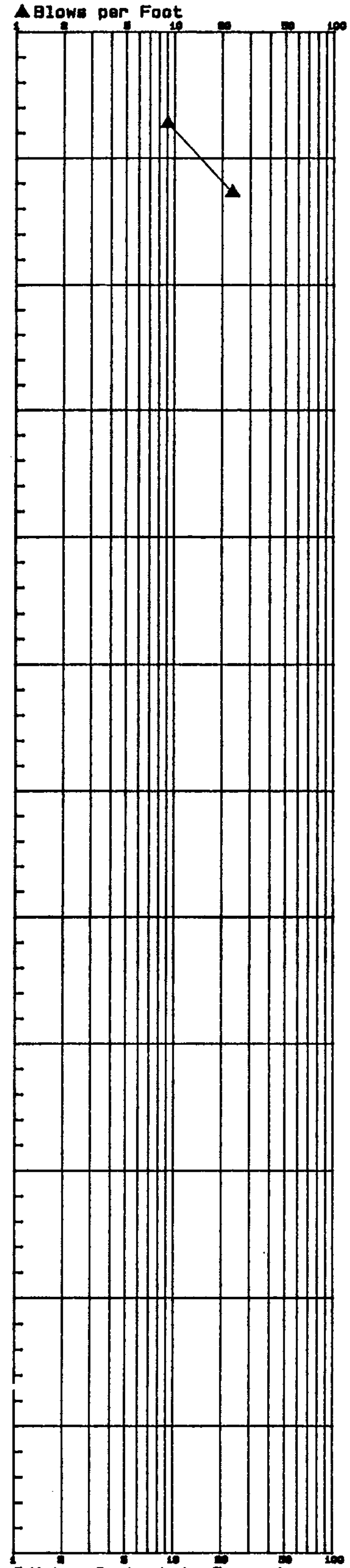
HART-CROWSER & associates, inc.

Figure C-56

Boring Log N5/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
0.7 feet CONCRETE over medium dense, damp, black, slightly sandy, silty GRAVEL with slight petroleum-like odor.	0–5	S-0.8		4
Medium dense, damp, gray, CONCRETE RUBBLE.	5	S-5.0	CA	14
Medium dense, moist, black, gravelly fine sandy SILT with strong petroleum-like odor. Obstruction at 7.5 feet.				
Bottom of Boring at 7.5 Feet. Completed 8/24/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

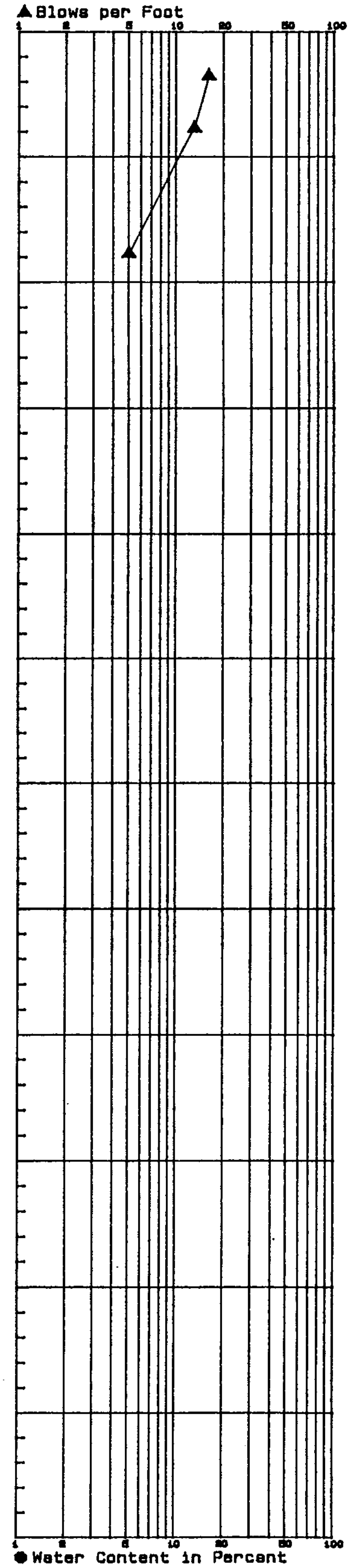
Figure C-57

Boring Log N6/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.4 inches CONCRETE over medium dense, moist, dark brown, slightly silty, very gravelly SAND with black mottling, white particles. (FILL)	S-0.4		0
ATD (water level)		S-2.5		0
		S-7.5	CA	0
	Very loose, wet, gray, very silty, fine SAND. (Nautral)			
9.5	Bottom of Boring at 9.5 Feet. Completed 8/12/88.			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-58

Boring Log N7/HB01

SOIL DESCRIPTIONS

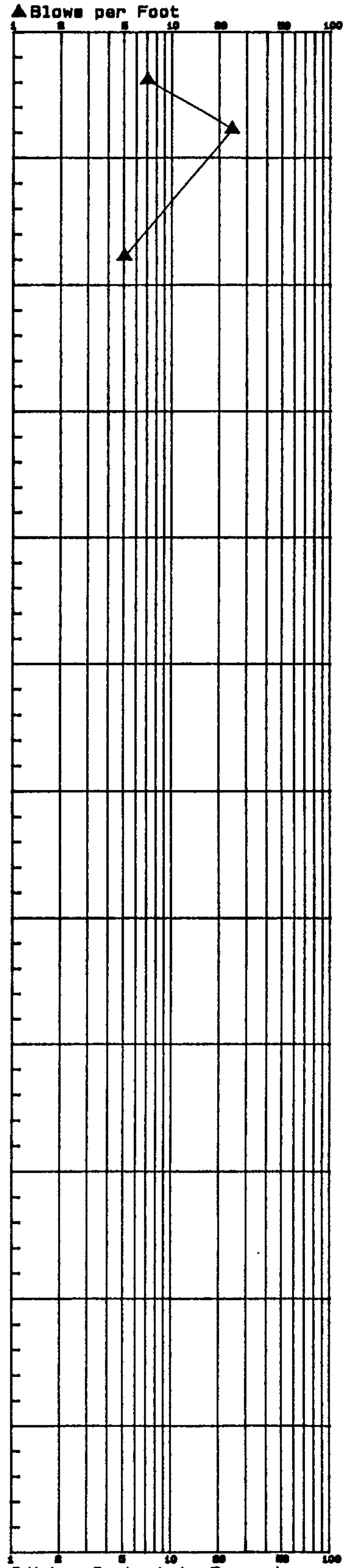
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over very loose, moist, black, very silty, very sandy GRAVEL with wood fragments. (FILL)	0	S-0.6		0
Loose, wet, gray slightly silty, fine SAND grading to soft, wet, gray sandy SILT. (Natural)		S-2.5	CA	0
	5	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	10			

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-59

Boring Log N8/HB01

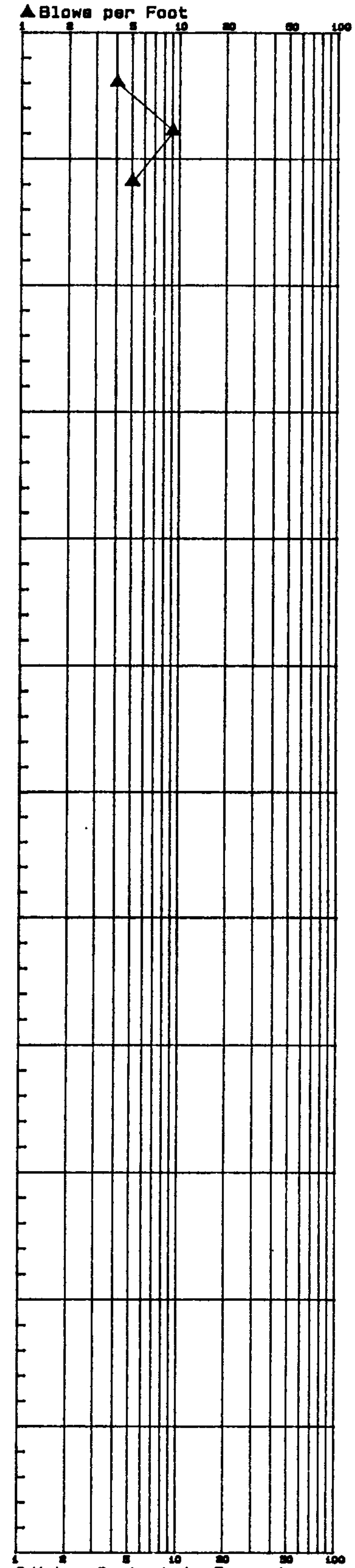
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over very loose, moist, black, slightly silty, very sandy GRAVEL with white particles, some light orange mottling. (FILL)	0	S-0.6	CA	0
Loose to very loose, wet, gray, silty, fine SAND. (Natural)		S-2.5		0
	5	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/2/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-60

Boring Log N9/HB01

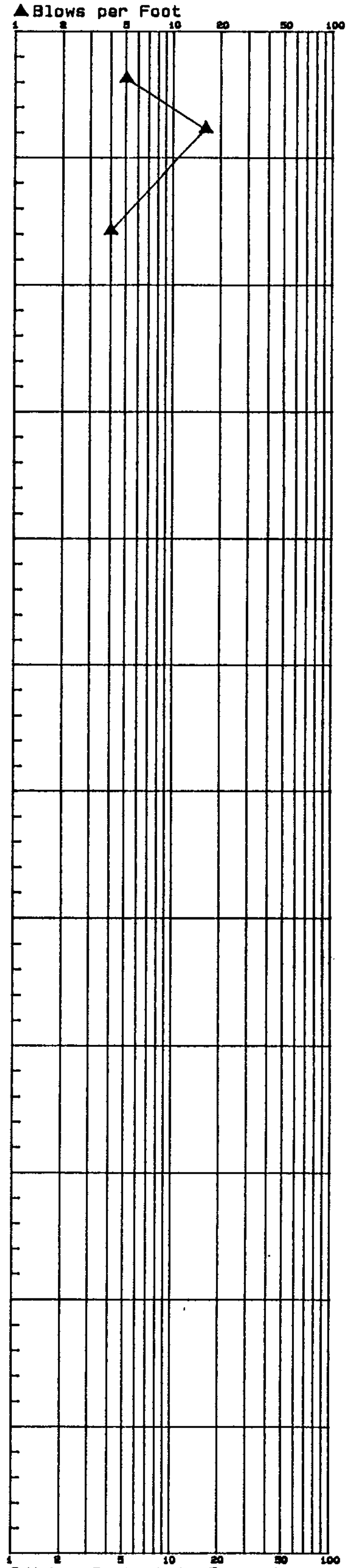
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist, brown-black, silty, very gravelly SAND with cinders and wood chips. (FILL)	0	S-0.5		0.3
Loose to very loose, moist to wet, gray, very silty, fine SAND with scattered organics. (Natural)		S-2.5	CA	0.3
	5	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/29/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-61

Boring Log N10/HB01

SOIL DESCRIPTIONS

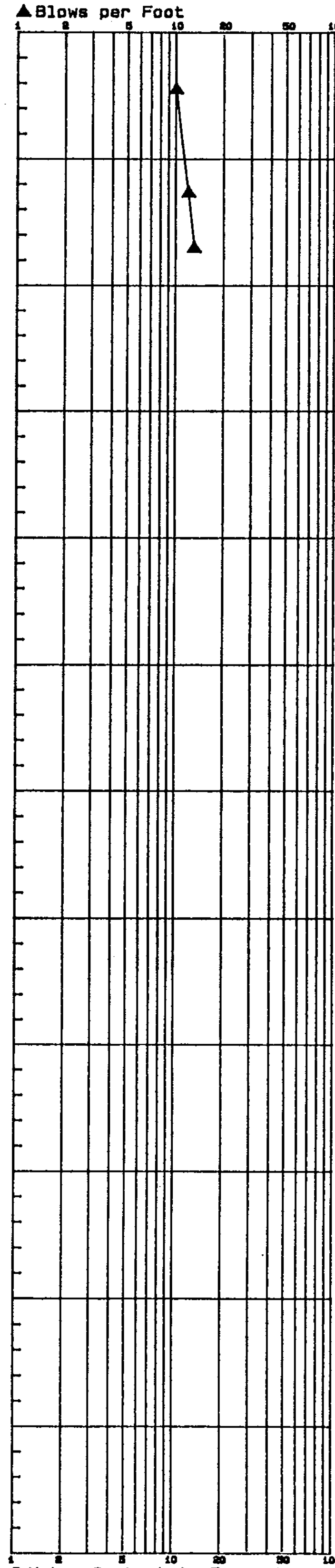
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	0.9 feet CONCRETE over very loose, moist, light brown, gravelly, silty SAND with rust stains and white particles. (FILL)
	Interbedded very loose to loose, wet gray, silty, fine SAND and medium stiff to stiff, wet, gray, sandy
5 (ATD)	
9.0	Bottom of Boring at 9.0 Feet. Completed 8/1/88.

Sample	LAB TESTS	H-Nu
S-0.9		0
S-5.0		0
S-7.5	CA	0

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-62

Boring Log N11/HB01

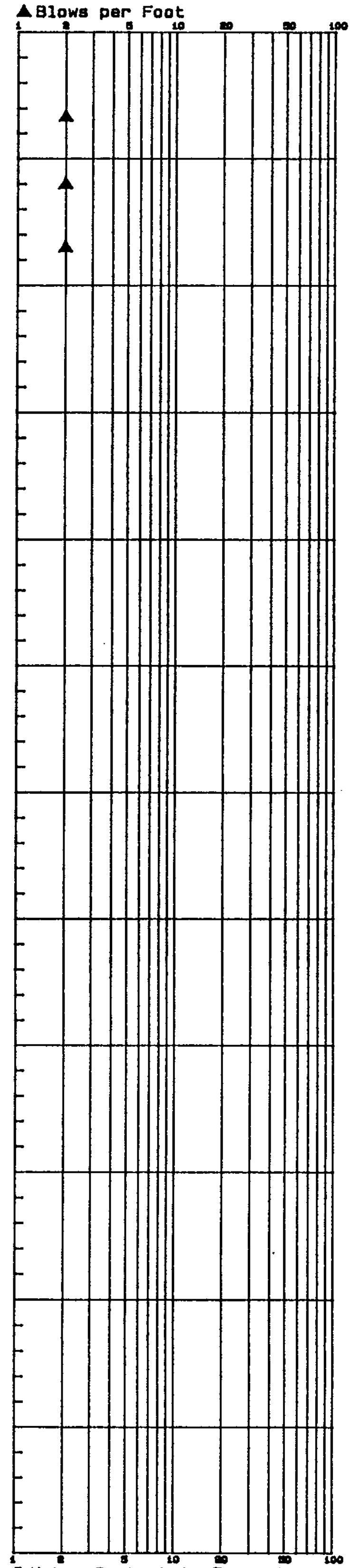
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
CONCRETE.	0			
Loose, wet, gray, sandy GRAVEL. (FILL)		S-2.0		0
Wet, brown PEAT. (Natural)	5	S-6.0	CA	0
Very loose, wet, gray, slightly silty SAND with SILT lenses. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-63

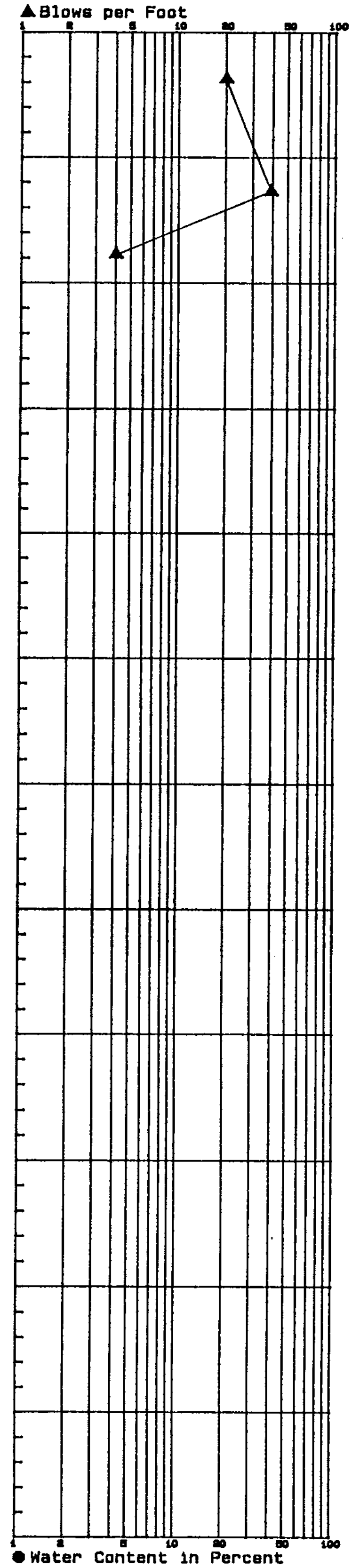
Boring Log 02/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over stiff, moist to wet, gray, sandy SILT. (Natural)	0	S-0.5		0
Medium dense, wet, gray, slightly silty SAND grading to medium stiff, wet, gray, slightly sandy SILT. (Natural)	5	S-5.0	CA	0
		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/15/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

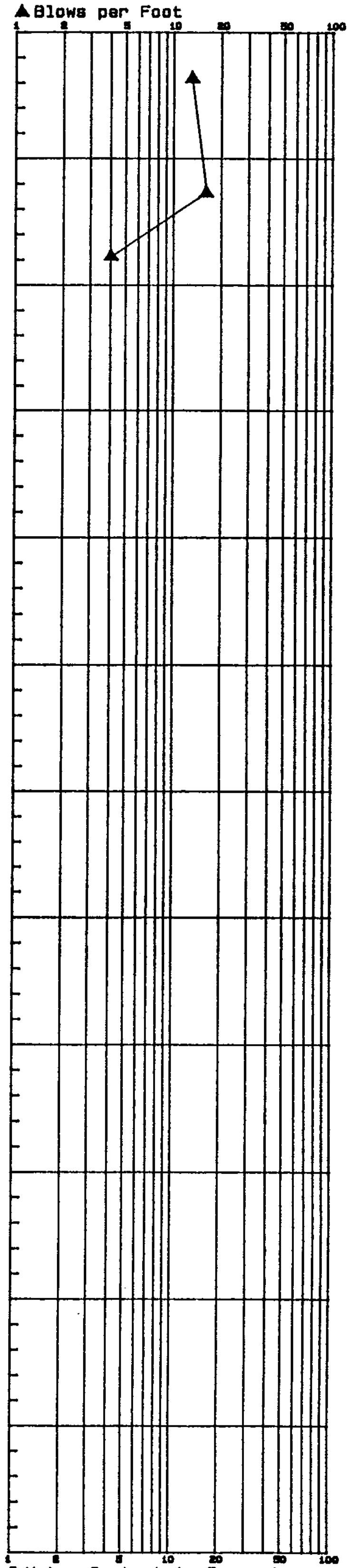
Figure C-64

Boring Log 03/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.8 feet CONCRETE over loose, moist, brown, slightly silty, very sandy GRAVEL. (FILL)	0–5	S-0.8		0
Loose, wet, gray, very silty, fine SAND. (Natural)		S-5.0		0
Soft, wet, gray, very sandy SILT. (Natural)		S-7.5	CA	0
Bottom of Test Pit at 9.5 Feet. Completed 8/3/88.	10			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-65

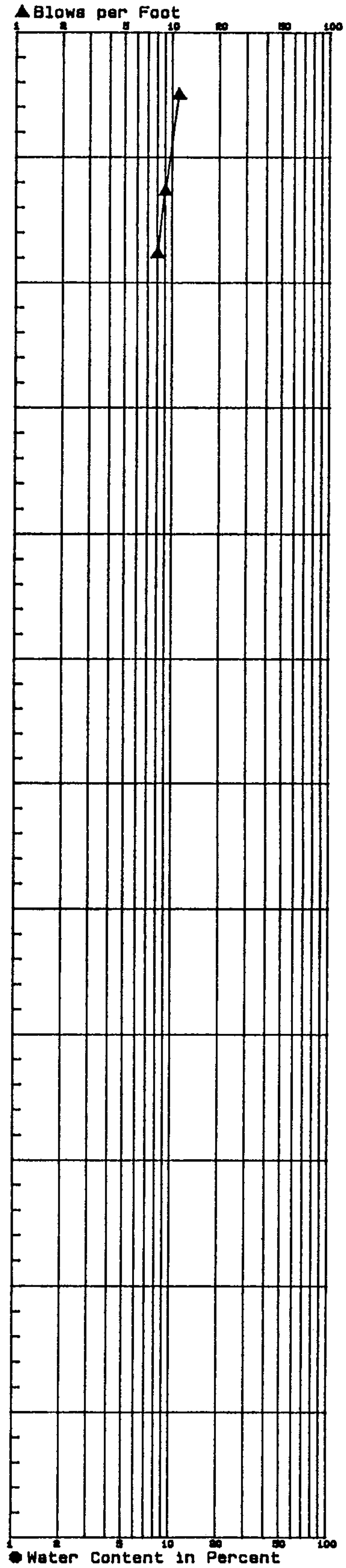
Boring Log 04/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	ASPHALT. FILL. Railroad Tie.			
	Loose, moist, black, slightly silty, very sandy GRAVEL with creosote-like odor. (FILL)	S-1.5	CA	2.5
5	Loose, wet, gray, slightly silty, fine SAND grading to medium stiff, wet, gray, sandy SILT. (Natural)	S-5.0		0
ATD	Loose, wet, gray, slightly silty, fine SAND. (Natural)	S-7.5		0
10	Bottom of Boring at 9.5 Feet. Completed 8/4/88.			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-66

Boring Log 05/HB01

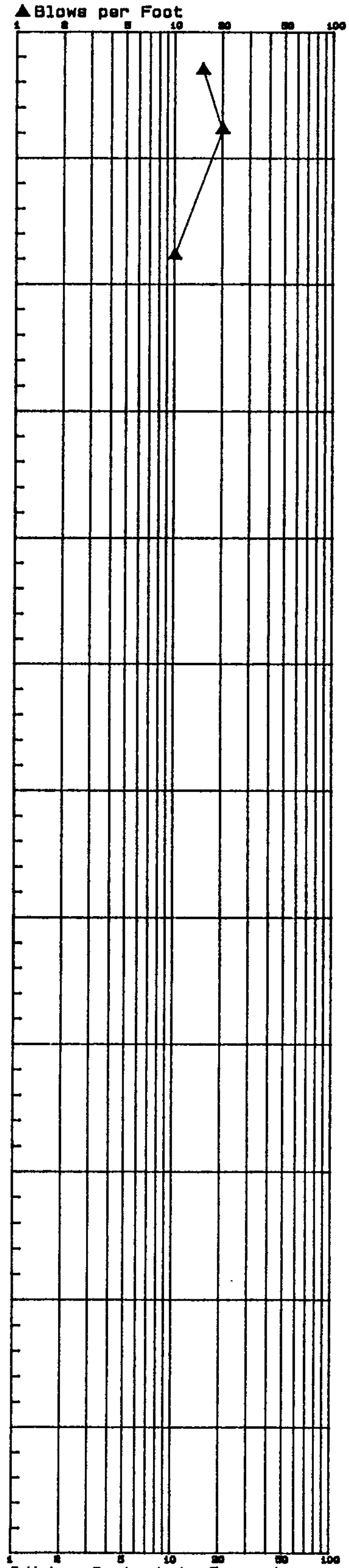
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over loose, moist to wet, dark brown, silty, very gravelly SAND with metal fragments, slag. (FILL)	0	S-0.5		3.5
Loose, wet, gray, silty SAND grading to medium stiff, wet, gray, sandy SILT with fairly strong gasoline-like odor. (Natural)		S-2.5	CA	50
	5	S-7.5		2.5
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-67

Boring Log 06/HB01

SOIL DESCRIPTIONS

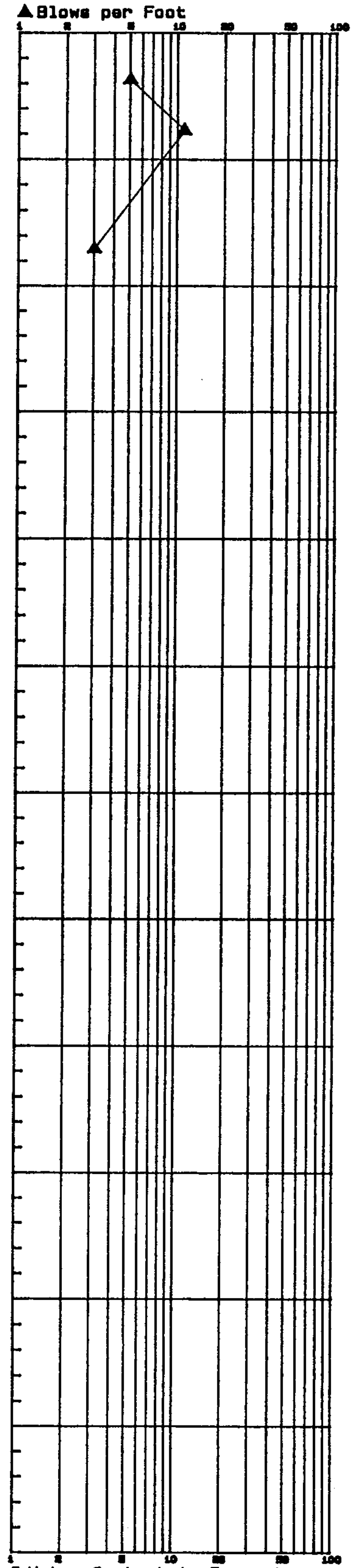
Ground Surface Elevation in Feet

Soil Description	Depth in Feet
0.5 feet CONCRETE over very loose, moist to wet, black, gravelly, silty SAND with some white mottling. (FILL)	0
Loose, wet, gray, slightly silty, fine SAND. (Natural)	5
Soft, wet, gray, sandy SILT. (Natural)	
Bottom of Boring at 9.0 Feet. Completed 7/27/88.	10

Sample	Depth	LAB TESTS	H-Nu
S-0.5	0.5	CA	55
S-2.5	2.5		34
S-7.5	7.5		6.5

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 July 1988

HART-CROWSER & associates, inc.

Figure C-68

Boring Log 07/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

0.5 feet CONCRETE over very loose, wet, dark brown, silty, very gravelly SAND. (FILL)

Very soft, wet, gray, slightly sandy SILT grading to wet, gray, silty, fine SAND. (Natural)

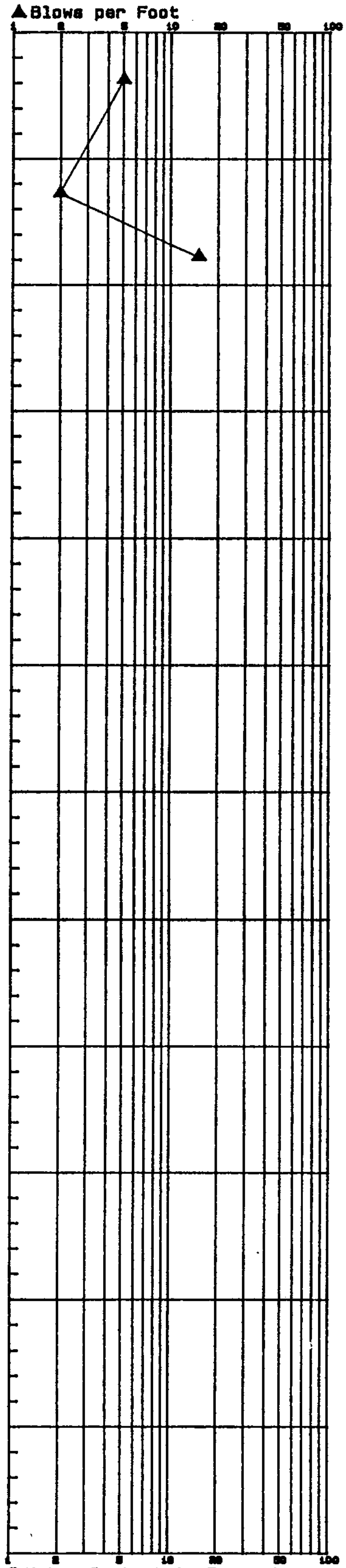
Bottom of Boring at 9.5 Feet. Completed 8/10/88.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Sample: S-0.5, S-5.0, S-7.5

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

LAB TESTS	H-Nu
	0
	0
CA	0

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-69

Boring Log 08/HB01

SOIL DESCRIPTIONS

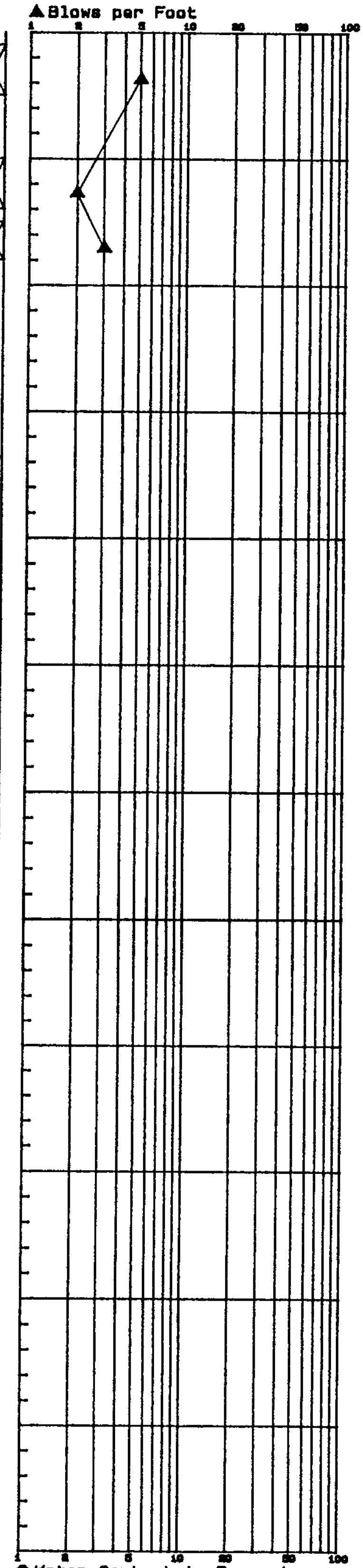
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	0.5 feet CONCRETE over very loose, moist, black, slightly silty, very gravelly SAND. (FILL)
	Very loose, wet, black, silty, very gravelly SAND. (Natural)
	Very loose, wet, gray, very silty, fine SAND. (Natural)
	Bottom of Boring at 9.0 Feet. Completed 8/2/88.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Sample	LAB TESTS	H-Nu
S-0.5		0.2
S-5.0	CA	2.5
S-7.5		0

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-70

Boring Log 09/HB01

SOIL DESCRIPTIONS

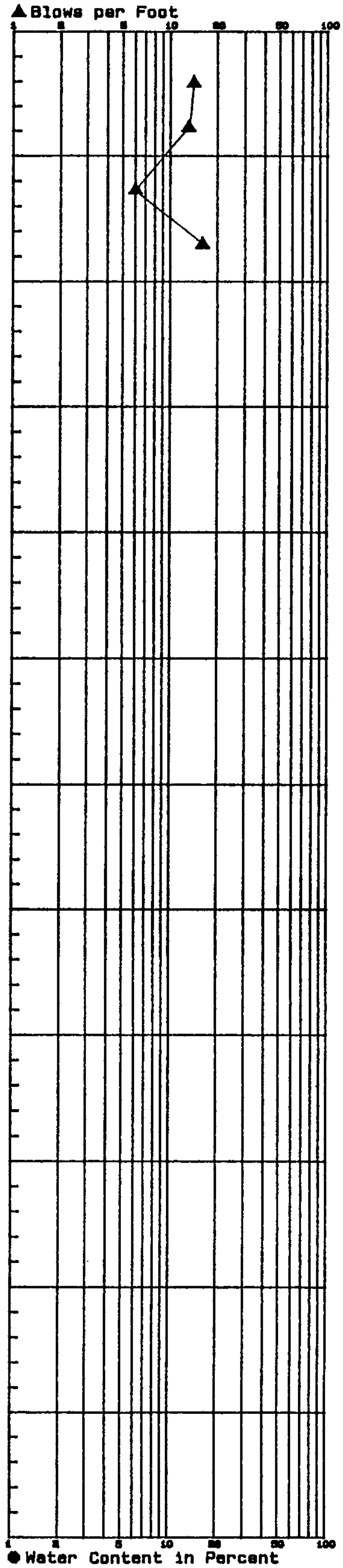
Ground Surface Elevation in Feet

Soil Description	Depth in Feet
0.7 feet CONCRETE over loose, moist, black, silty SAND with substantial organics, wood chunks. (FILL)	0
Very loose, wet, gray, very silty, fine SAND with some scattered organics, wood. (Natural)	5
Stiff, wet, gray SILT with trace fine sand. (Natural)	
Loose, wet, gray SAND. (Natural)	10
Bottom of Boring at 9.0 feet. Completed 8/1/88.	

Sample	Lab Tests	H-Nu
S-0.7	CA	0.3
*S-2.5		-
S-5.0		0
S-7.5		0

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

* No Recovery

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HART-CROWSER & associates, inc.

Figure C-71

Boring Log 010/HB01

SOIL DESCRIPTIONS

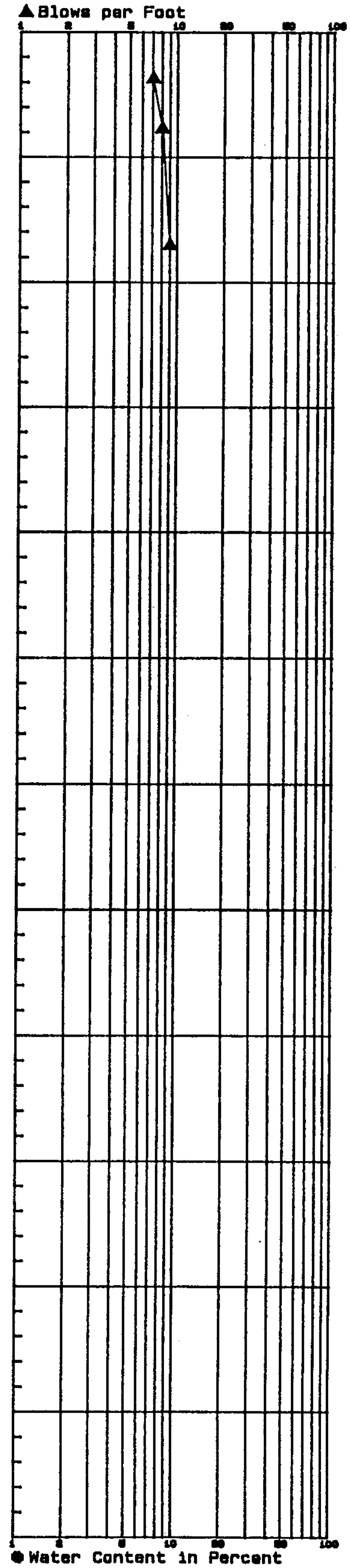
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist to wet, dark brown-black, silty SAND. (FILL)	0	S-0.5		0
Medium stiff, wet, gray, very sandy SILT with scattered organics. (Natural)	5	S-2.5	CA	0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/1/88.	10			

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-72

Boring Log 011/HB01

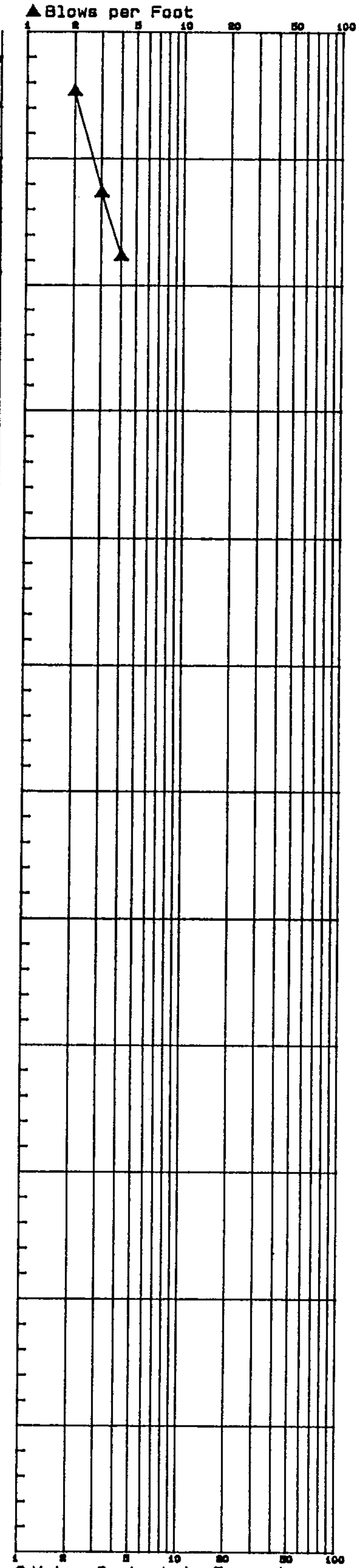
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
1.0 foot CONCRETE over very loose, wet, dark brown, slightly silty, gravelly SAND. (FILL)	0	S-1.0		0.2
Fibrous PEAT (Natural)				
Soft, wet, gray, sandy SILT. (Natural)	5	S-5.0		0
Soft, wet, gray, slightly sandy SILT to very sandy SILT. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/16/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-73

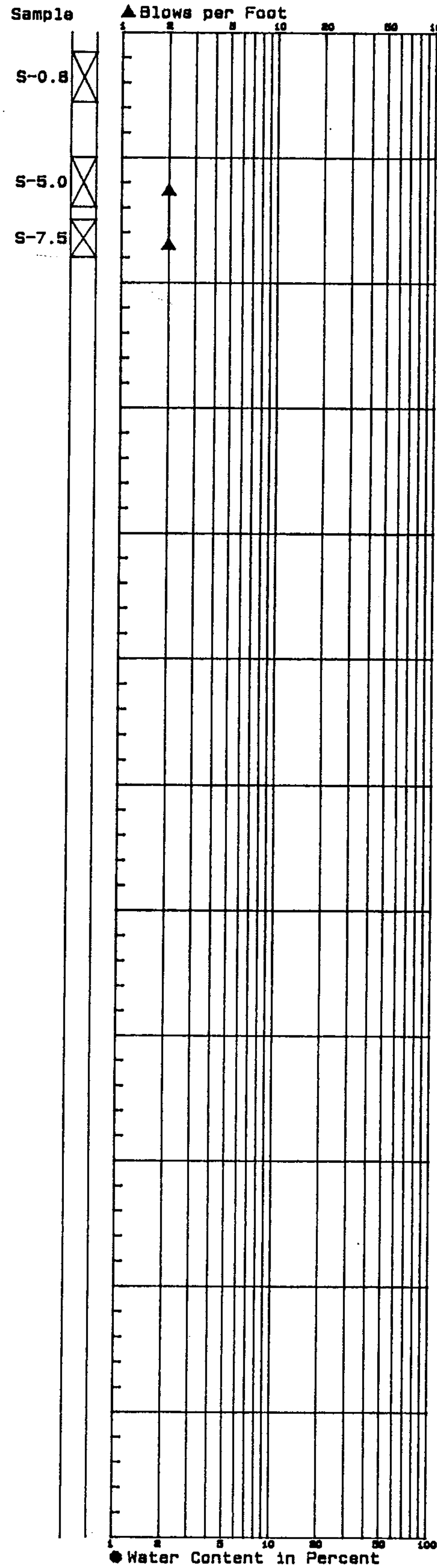
Boring Log P1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.8 feet CONCRETE over (loose), damp brown, sandy GRAVEL. (FILL)	0	S-0.8		0
Damp, brown ASH/SLAG. (FILL)				
Very soft, moist, gray, slightly sandy to sandy SILT grading to very loose, wet, gray, very silty, fine SAND. (Natural)	5	S-5.0	CA	0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/3/88.	10			

STANDARD PENETRATION RESISTANCE



Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-74

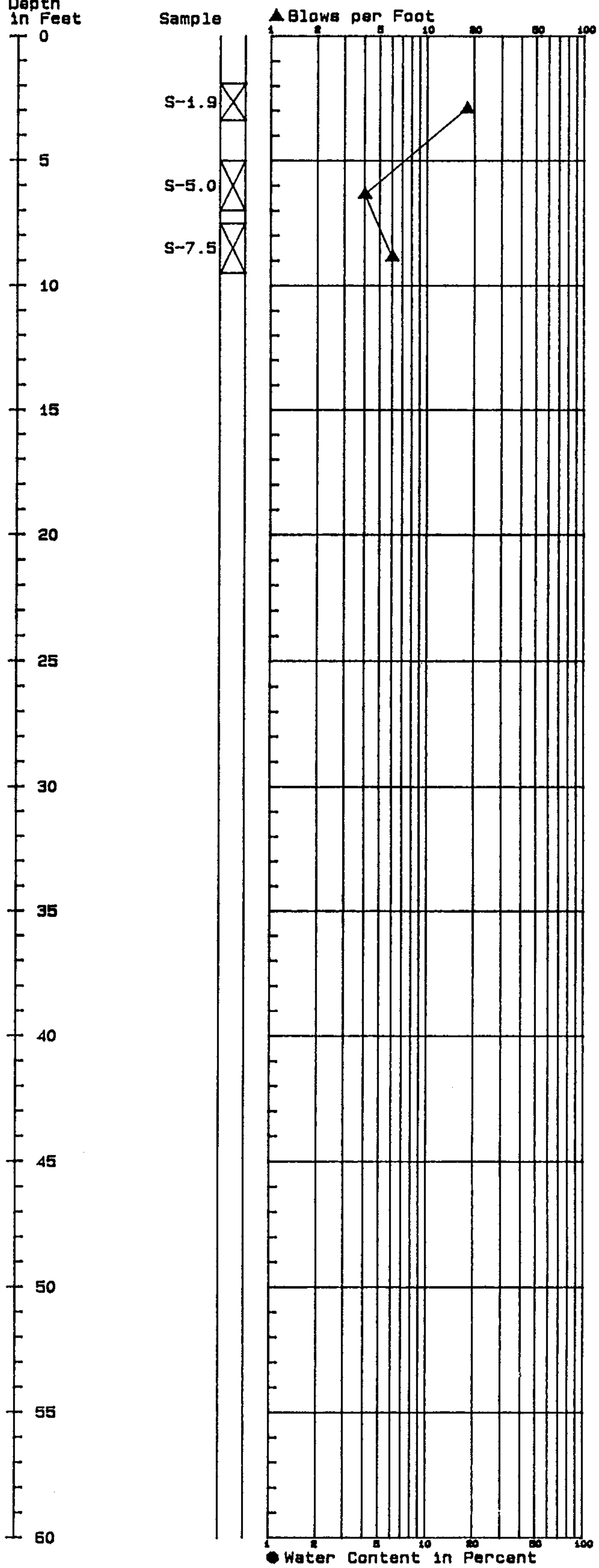
Boring Log P2/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over loose, moist to wet, brown, gravelly, silty SAND with white and tan mottling, some slag. (FILL)	0	S-1.9	CA	0.4
Soft, wet, gray, slightly sandy SILT grading to medium stiff, wet, gray, sandy SILT. (Natural)	5	S-5.0		0.3
		S-7.5		0.2
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-75

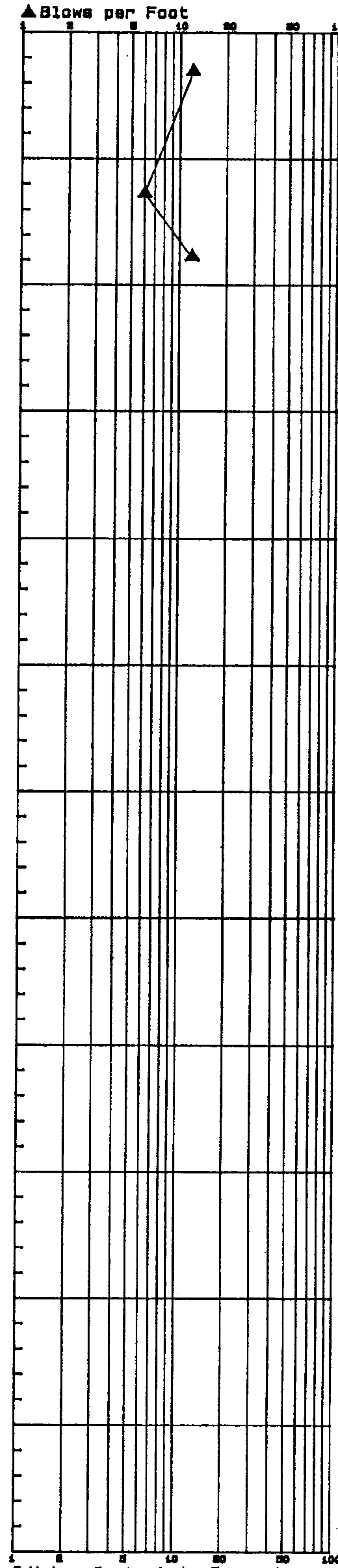
Boring Log P3/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample
0	0.5 feet CONCRETE over loose, moist, gray-black, slightly silty, sandy GRAVEL with faint diesel-like odor. (FILL)	S-0.5
	Medium stiff, wet, gray, slightly sandy SILT with some scattered organics. (Natural)	
5 (water level ▽ ATD)	Loose, wet, gray, slightly silty SAND. (Natural)	S-5.0
	Loose, wet, gray, silty, fine SAND. (Natural)	S-7.5
10	Bottom of Boring at 9.5 Feet. Completed 8/4/88.	

STANDARD PENETRATION RESISTANCE



Sample	LAB TESTS	H-Nu
S-0.5		4.5
S-5.0	CA	2.5
S-7.5		10

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-76

Boring Log P4/HB01

SOIL DESCRIPTIONS

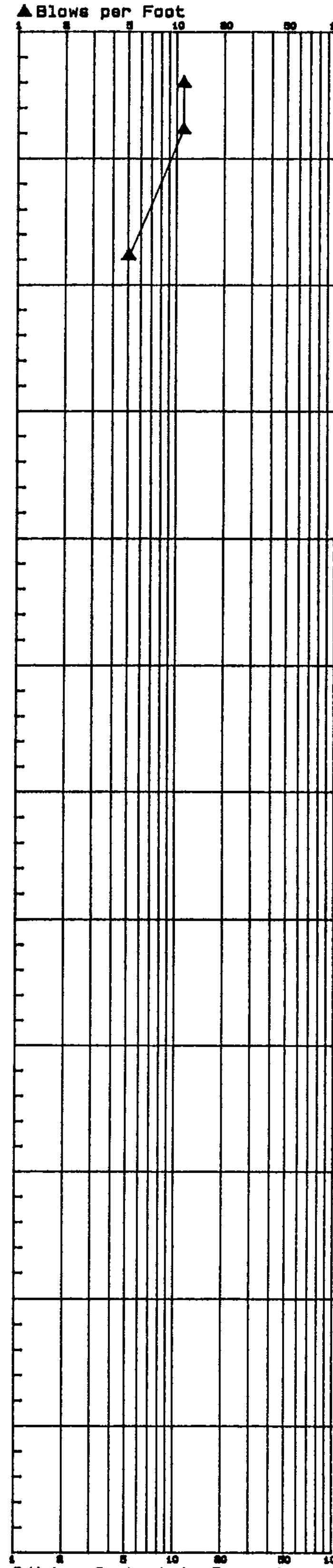
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
1.0 foot CONCRETE over loose, moist, brown-black, gray and black, slightly silty, sandy GRAVEL. (FILL)	0	S-1.0		0
Loose, wet, gray, very silty, fine SAND grading to soft, wet, gray, sandy SILT. (Natural)	5	S-2.5	CA	0
	ATD (ground water, approx. 9)	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/4/88.	10			

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-77

Boring Log P5/HB01

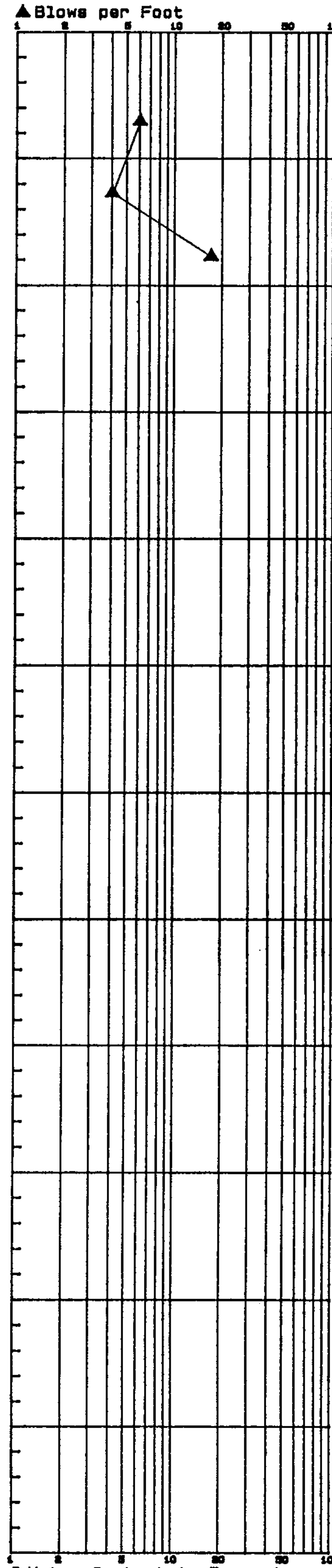
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet ASPHALT over very loose, slightly silty, sandy GRAVEL with cobbles. (FILL)	0			
Very loose, wet, gray, very silty, fine SAND. (Natural)		*S-2.5		0
Soft, wet, gray, slightly sandy SILT (Natural)	5	S-5.0	CA	0.2
Medium dense, wet, gray, silty, fine SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

* No Recovery

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-78

Boring Log P6/HB01

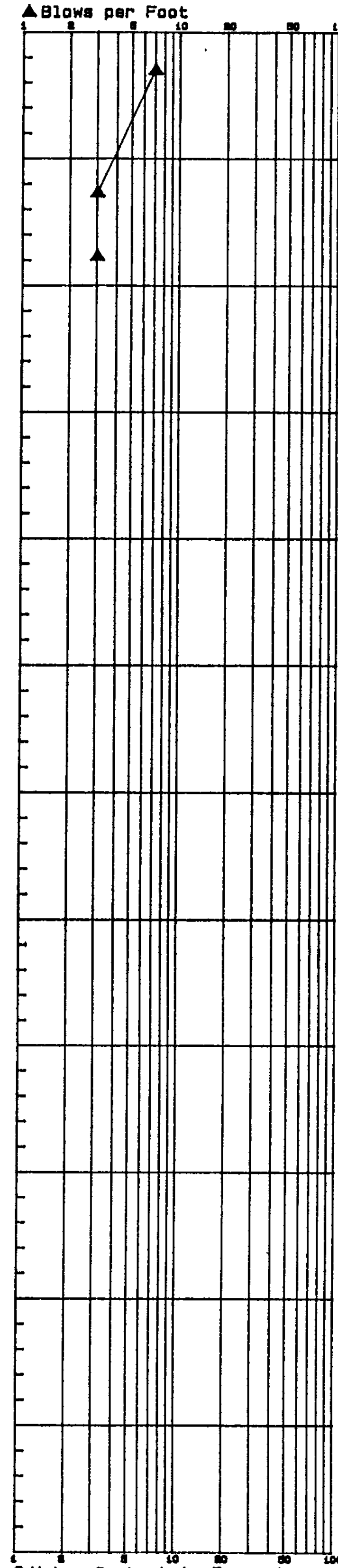
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over loose, moist, black, slightly silty, very sandy GRAVEL with brown mottling, cinders, brick fragments, slag. (FILL)	0	S-0.5	CA	0.5
Very loose, wet, gray, very silty, fine SAND. (Natural)	5	S-5.0		0
Very loose, wet, gray, silty, fine SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-79

Boring Log P7/HB01

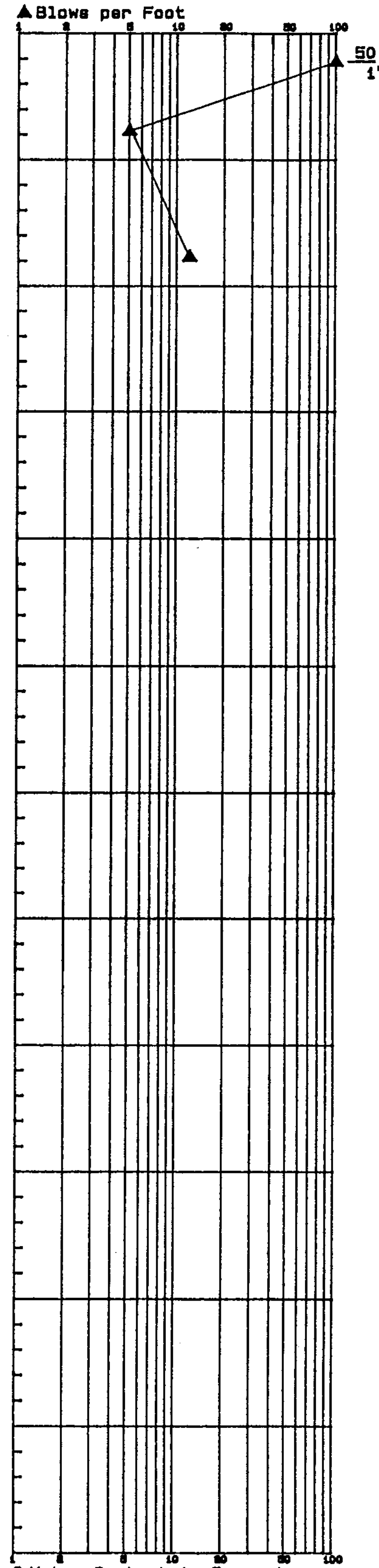
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over (very loose), moist, black, slightly silty, gravelly SAND. (FILL)	0	S-0.7	CA	0
Soft, wet, gray, sandy SILT grading to loose, wet, gray, very silty, fine SAND. (Natural)	5	S-2.5		3.5
		S-7.5		0.2
Bottom of Boring at 9.5 Feet. Completed 8/17/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-80

Boring Log P8/HB01

SOIL DESCRIPTIONS

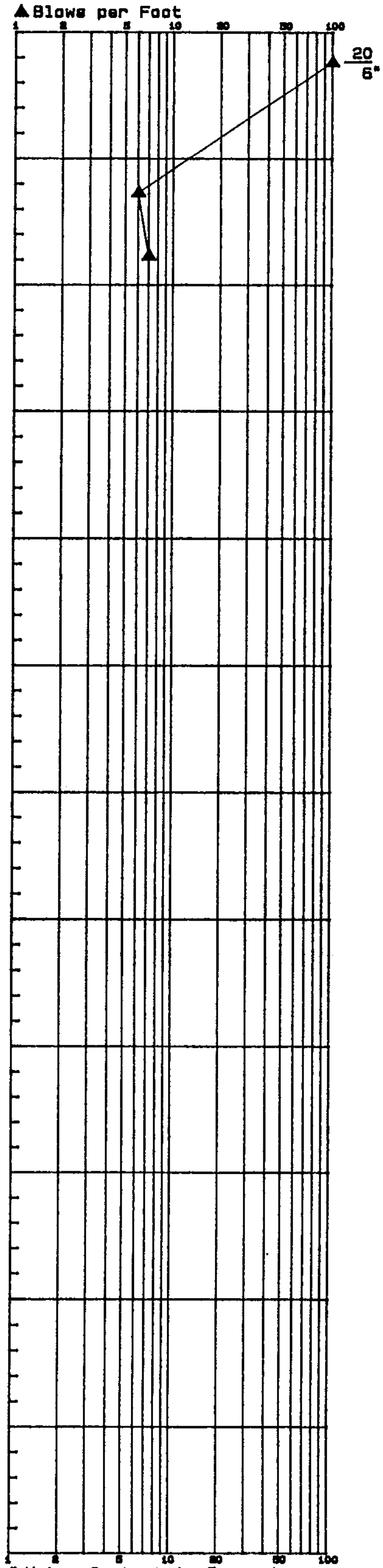
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet ASPHALT over (loose), wet, black, silty, very sandy GRAVEL. (FILL)	0	S-0.5		0.5
Soft, wet, gray, slightly sandy SILT (Natural)	5	S-5.0		0
Very loose, wet, gray, very silty, fine SAND. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/2/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-81

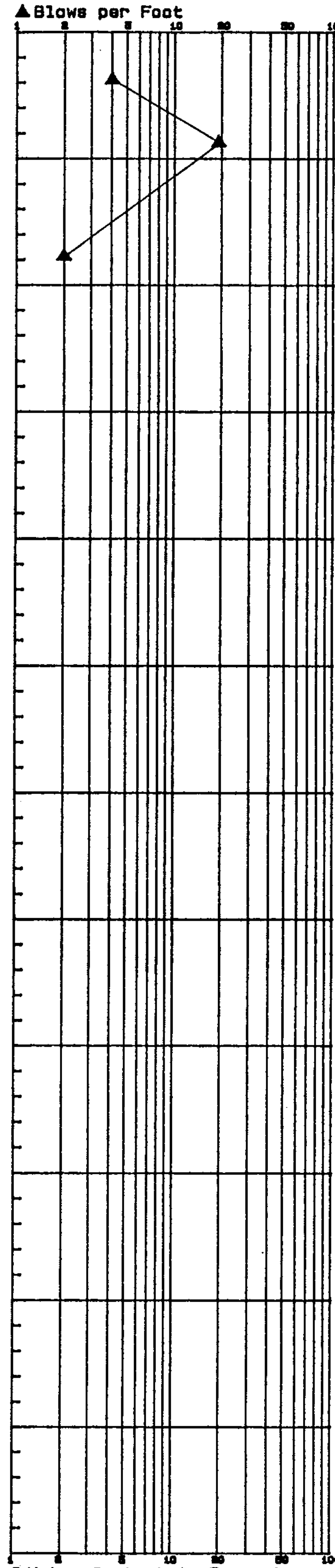
Boring Log P9/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, moist, reddish black, sandy GRAVEL. (FILL)	0	S-0.6		2
Medium dense, moist, gray, silty SAND with mixed organics, ash/brick debris grading to wet, gray, slightly silty SAND. (FILL/Natural)	5	S-3.0		0
Very loose, wet, gray, sandy GRAVEL. (Natural)	ATD	S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/10/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

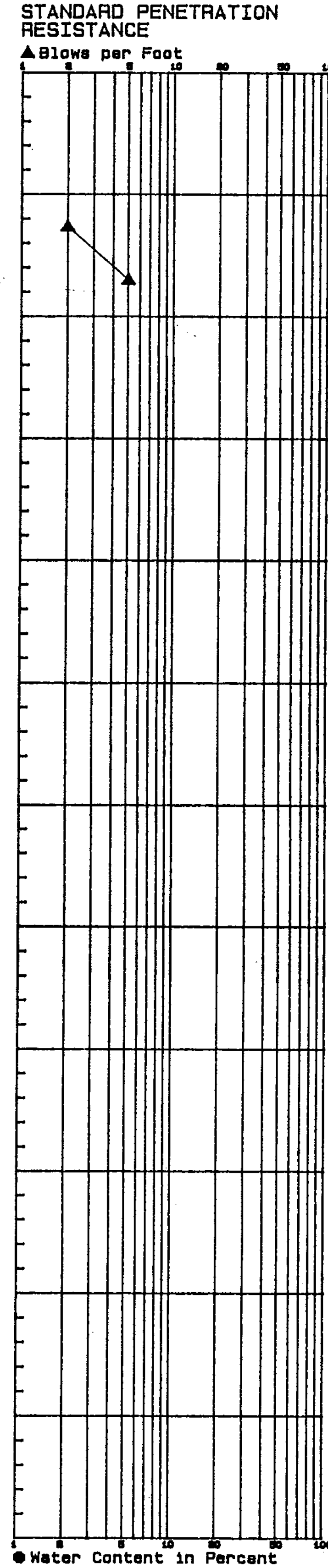
Figure C-82

Boring Log P10/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over moist, black-gray, gravelly, silty SAND. (FILL/Natural)	0	S-1.0	CA	17
Wet, brown PEAT. (Natural)				
Wet, gray-brown, sandy SILT with wood pieces, metal wire. (FILL/Natural)	5 (ATD)	S-5.0		6
Very loose to loose, wet, gray, silty SAND with coarse SAND lenses. (Natural)		S-7.5		1.5
Bottom of Boring at 9.0 Feet. Completed 8/10/88.	10			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-83

Boring Log Q2/HB01

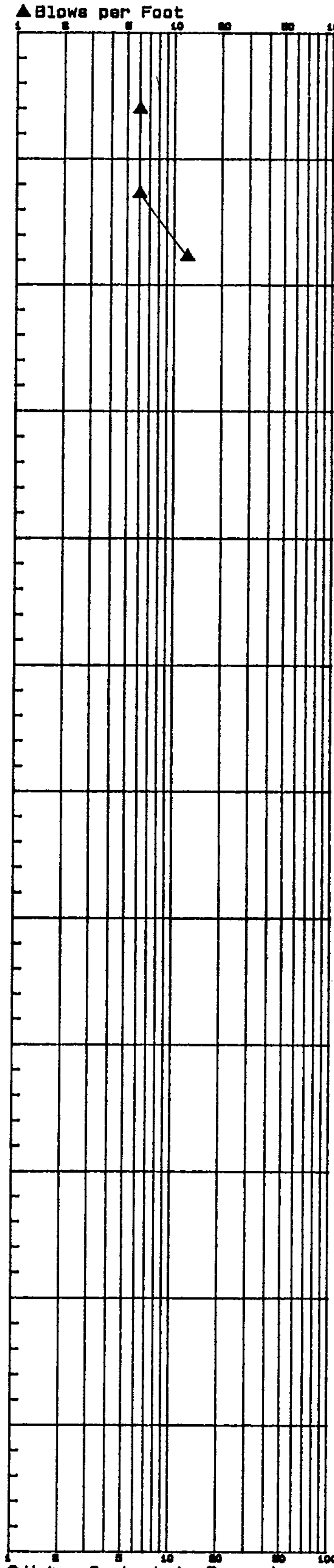
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.9 feet CONCRETE over moist, light brown-black, very gravelly SAND with slag, and white mottling. (FILL)	0			
Very loose, moist, light brown-black silty, gravelly SAND. (FILL)		S-2.0	CA	0
Soft, moist to wet, light brown SILT (FILL)	5	S-5.0		0
Soft, wet, brown-gray, slightly gravelly, very sandy SILT grading to loose, wet, gray, very silty SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-84

Boring Log Q3/HB01

SOIL DESCRIPTIONS

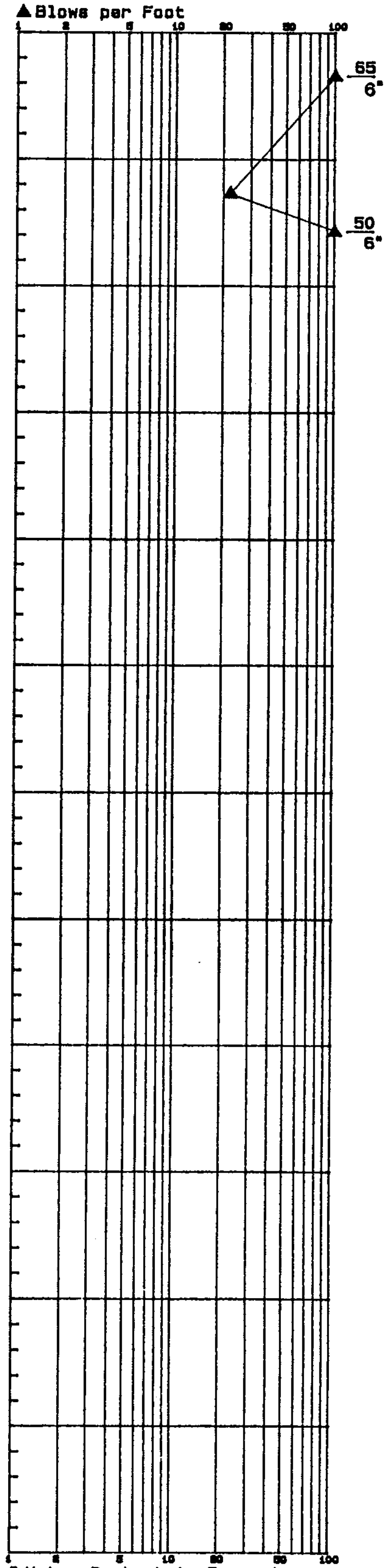
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over (loose), moist, light brown, slightly silty, slightly sandy GRAVEL with cobbles. (FILL)	0	S-0.5	CA	0
Stiff, wet, dark brown, slightly gravelly, sandy SILT. (Natural)	5	S-5.0		0
		S-7.5		0
Bottom of Boring at 8.0 feet. Completed 8/15/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

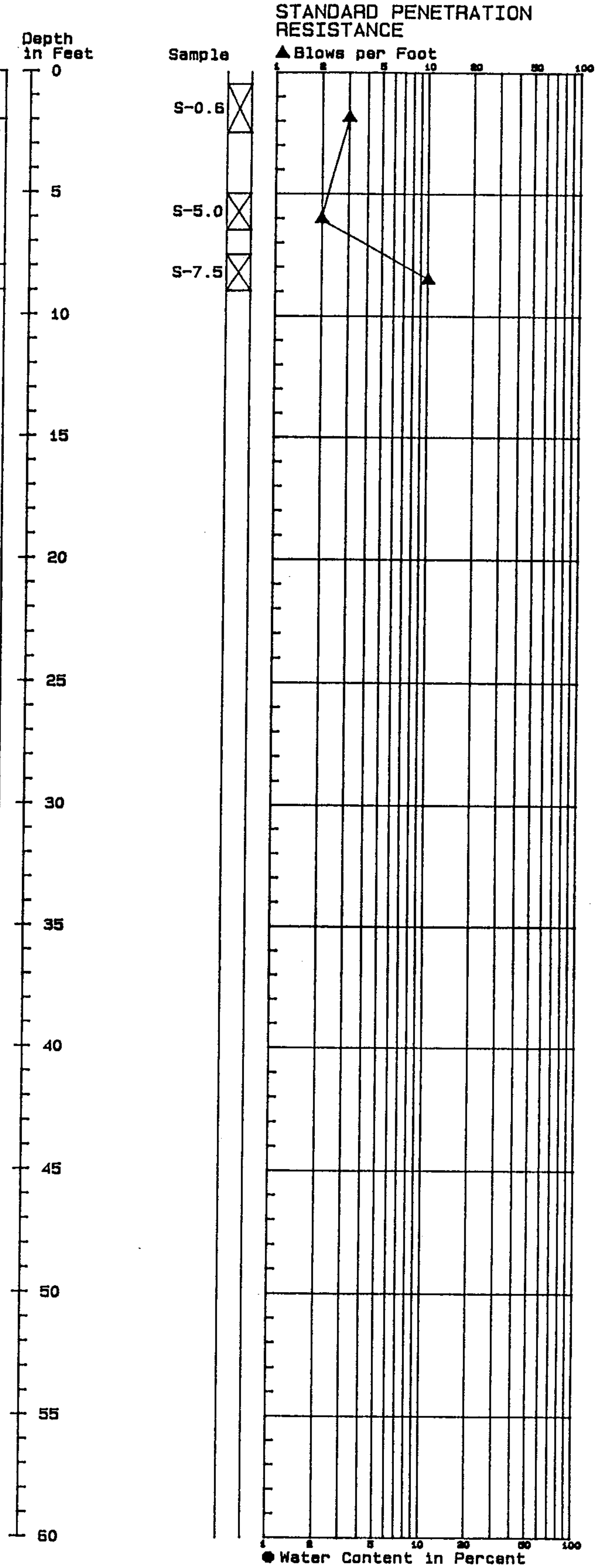
Figure C-85

Boring Log Q4/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over soft, damp, brown, sandy GRAVEL with mixed organics. (FILL)	0	S-0.6		1.0
Soft, damp, brown, slightly sandy SILT. (FILL)	5	S-5.0		0
Loose, wet, gray, sandy GRAVEL. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.0 Feet. Completed 8/8/88.	10			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-86

Boring Log Q6/HB01

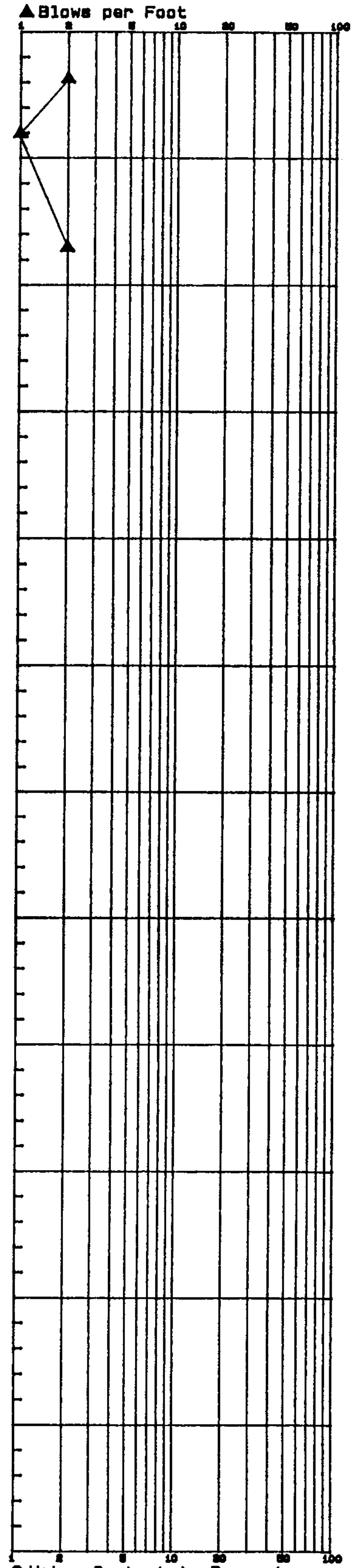
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, damp, black, gravelly SAND with wood and brick debris. (FILL)	0–3	*S-0.5		1.0
Very soft, wet, gray, clayey SILT. (Natural)	3–8	S-3.0	CA	0
Very loose, wet, gray, silty SAND. (Natural)	8–9	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/8/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

* No Recovery

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-87

Boring Log Q7/HB01

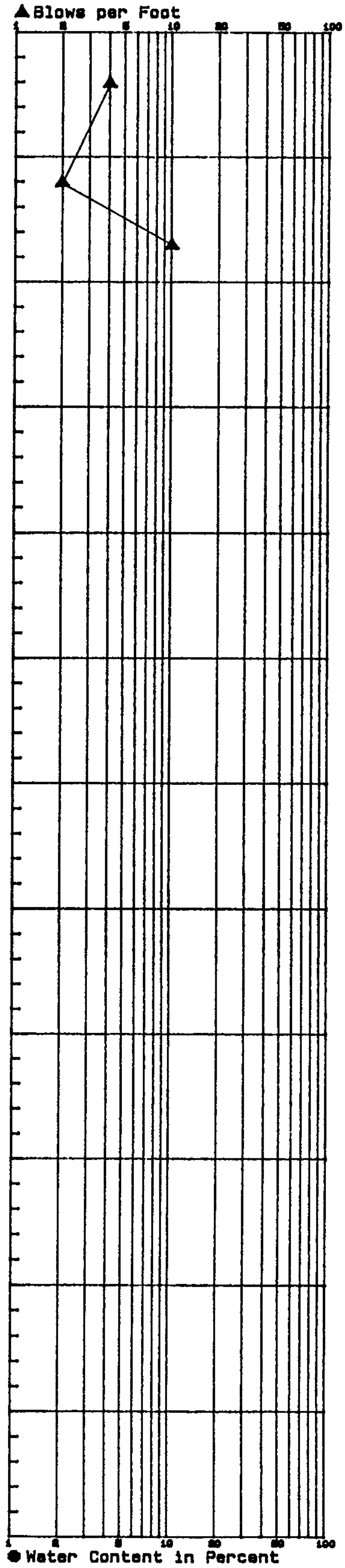
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over soft, damp, brown, sandy SILT with mixed organics, SAND lenses, and oily substance. (FILL)	0	S-0.7		35
Very loose, wet, gray, silty SAND. (Natural)	5	S-5.0	CA	40
Medium stiff, wet, gray, sandy SILT. (Natural)		S-7.5		55
Loose, wet, gray, silty SAND. (Naural)				
Loose, wet, gray, sandy GRAVEL with oily substance. (Natural)				
Bottom of Boring at 9.0 Feet. Completed 8/8/88.				

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-88

Boring Log Q8/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

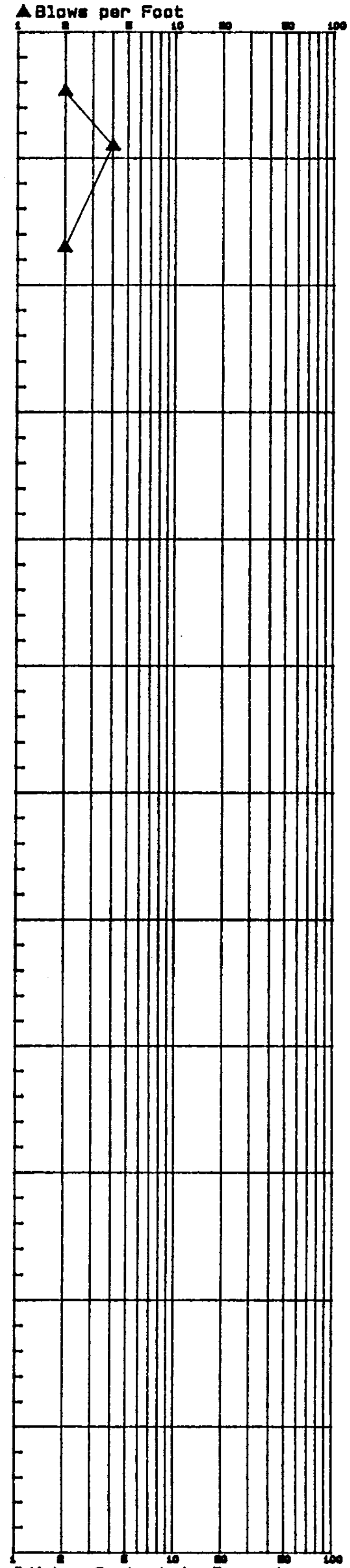
Soil Description	Sample	Lab Tests	H-Nu
0.5 feet ASPHALT over very loose, damp, brown, sandy GRAVEL with charcoal, slag, burnt material. (FILL)	S-1.0	CA	30
Very loose, damp, black-gray, sandy GRAVEL with slag. (Natural)	S-3.5		55
Soft, wet, gray, sandy SILT with oily substance. (Natural)			
Very loose, wet, gray, silty SAND with mixed organics. (Natural)	S-7.5		50
Soft, wet, gray, sandy SILT. (Natural)			
Very loose, wet, gray, silty SAND with gasoline-like odor. (Natural)			

Bottom of Boring at 9.0 Feet.
Completed 8/8/88.

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-89

Boring Log Q9/HB01

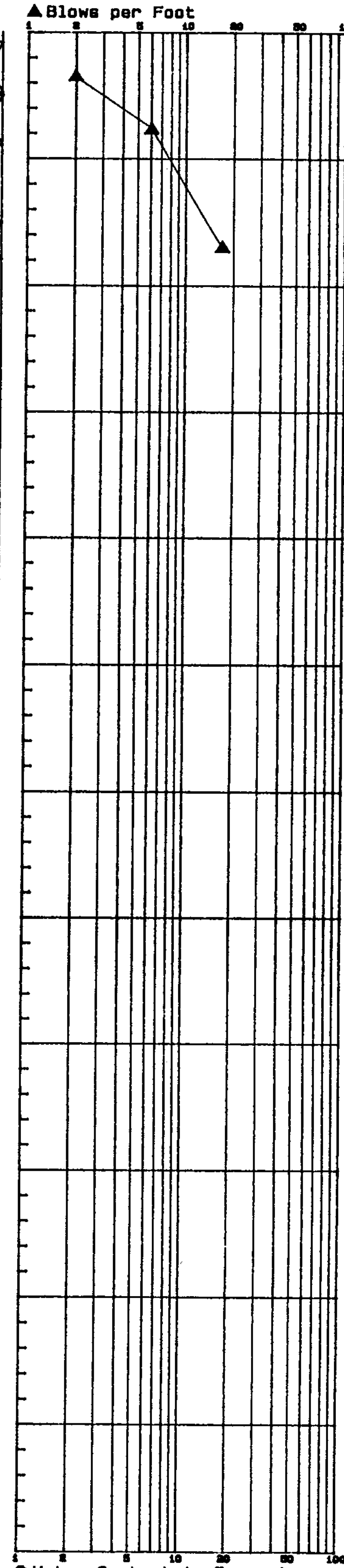
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over very loose, moist, black, slightly silty, gravelly SAND with orange and white particles, cinders, slag. (FILL)	0	S-0.4		0.2
Very loose, moist to wet, black, very silty, fine SAND with substantial fine roots. (FILL)	5	S-2.5	CA	18.5
PEAT. (Natural)	ATD			
Medium dense, wet, gray, very sandy, fine GRAVEL. (Natural)		S-7.5		3.5
Bottom of Boring at 9.0 Feet. Completed 8/2/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-90

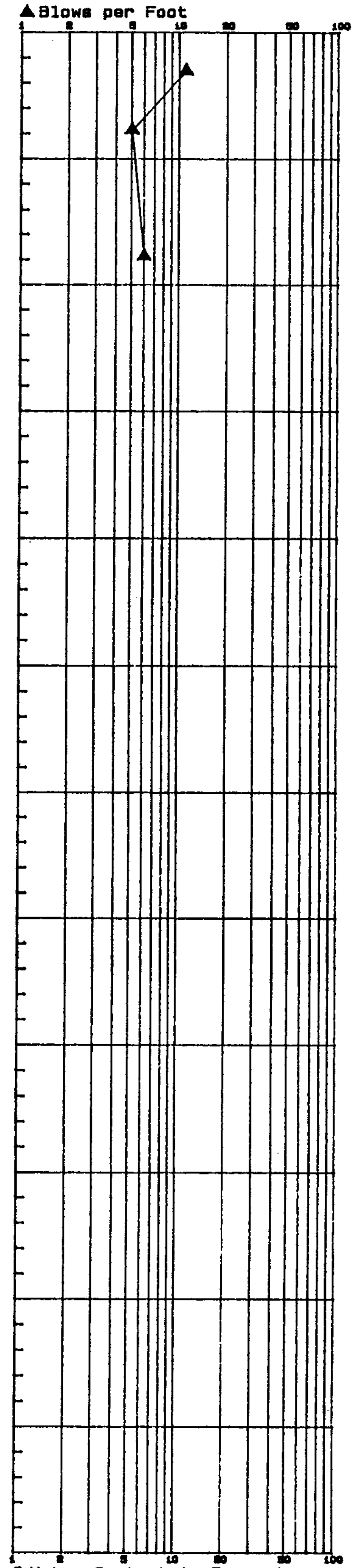
Boring Log Q10/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, wet, black, slightly gravelly, very silty, fine SAND with wood chunks, whitish particles, cinders. (FILL)	0	S-0.5		0.3
Very loose, wet, gray, very silty, fine SAND. (Natural)		S-2.5		0.2
Medium stiff, wet, gray, organic SILT. (Natural)		S-7.5	CA	0
Medium stiff, wet, gray, sandy SILT with organics, root fragments, and medium to fine SAND lenses. (Natural)	10			
Bottom of Boring at 9.5 Feet. Completed 8/8/88.				

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-91

Boring Log Q11/HB01

SOIL DESCRIPTIONS

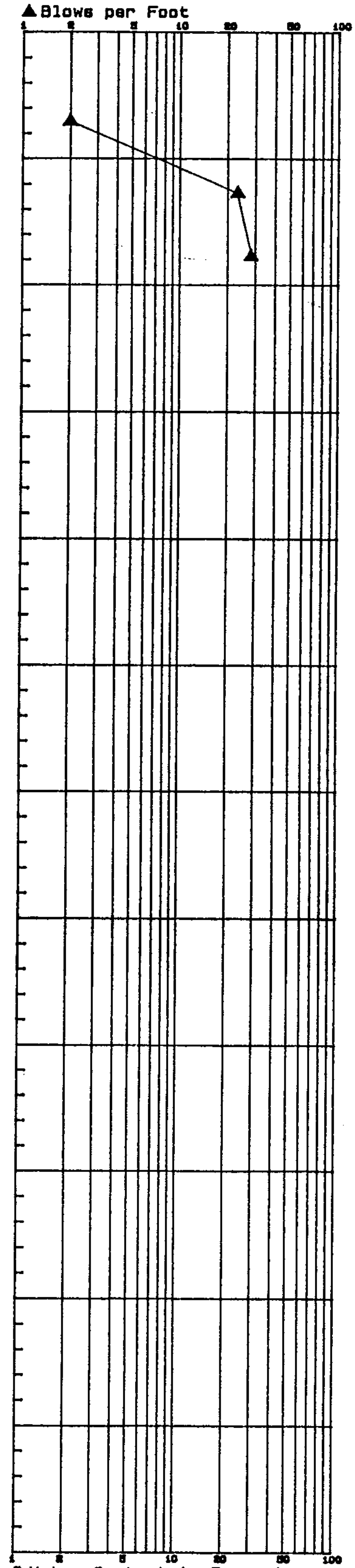
Ground Surface Elevation in Feet

Soil Description	Sample	Lab Tests	H-Nu
1.3 feet CONCRETE over light brown, moist, very sandy GRAVEL. (FILL)			
PEAT. (Natural)	S-2.5		0
Very soft, wet, brown-gray, slightly sandy SILT with substantial fibrous organics. (Natural)	S-5.0	CA	0
Loose, wet, gray, silty, fine SAND. (Natural)			
Loose, wet, dark gray, sandy GRAVEL. (Natural)	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/8/88.			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-92

Boring Log R1/HB01

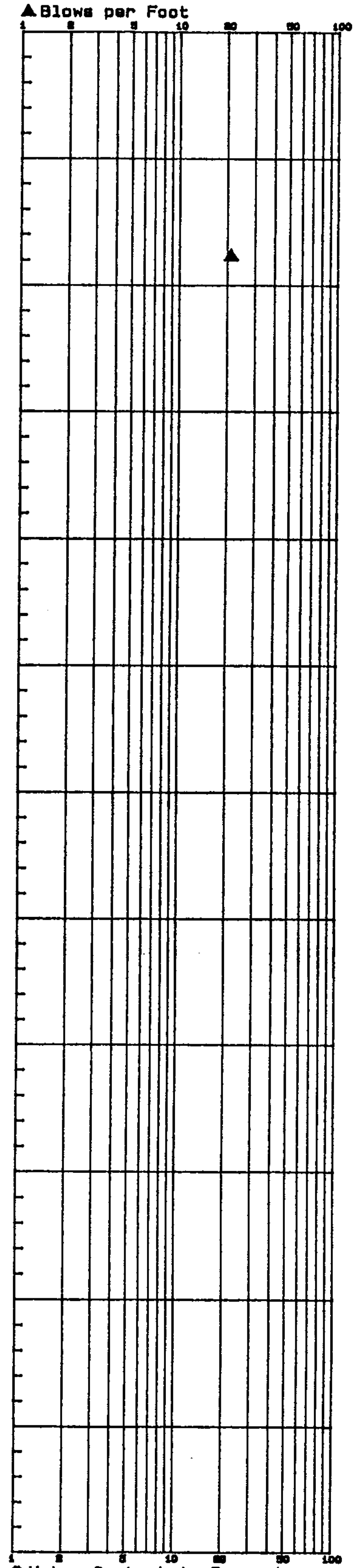
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
Dry, black, sandy GRAVEL. (FILL)	0			
Damp, brown, sandy SILT with rubble. (FILL)		S-0.6		0
Moist, brown, clayey SILT. (FILL)		S-2.5	CA	0
Moist, brown to gray, sandy, gravelly SILT. (FILL)	5			
Loose, wet, gray, slightly silty to silty, fine SAND with some organics and wood fragments. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/3/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-93

Boring Log R2/HB01

SOIL DESCRIPTIONS

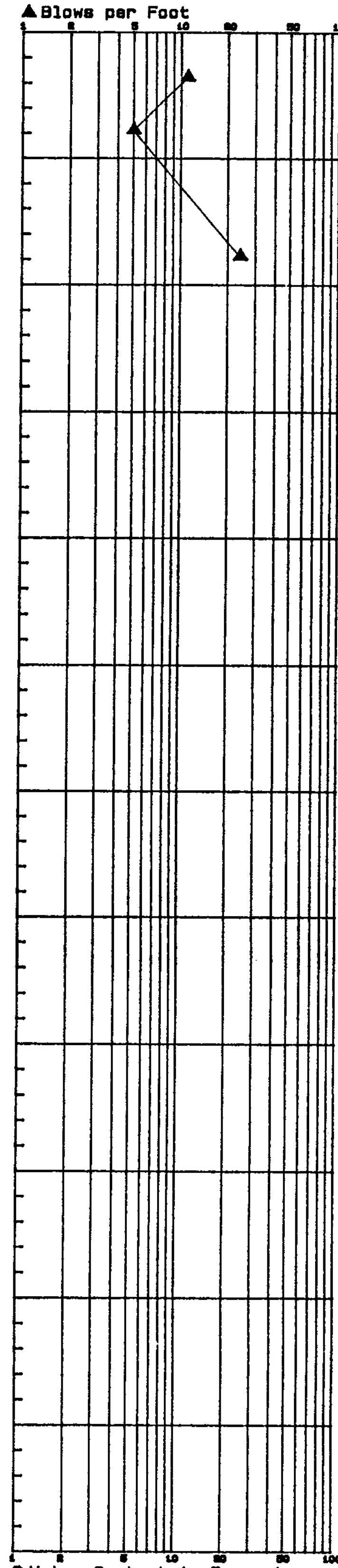
Ground Surface Elevation in Feet

Depth in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over medium stiff, moist to wet, light brown-dark brown slightly gravelly, sandy SILT with rust staining, slag. (FILL)	0	S-0.4		0
Soft, moist to wet, light gray, slightly sandy SILT with heavy orange mottling and rust stains grading to stiff, wet, dark brown-very sandy SILT		S-2.5		0
	5	S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/15/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-94

Boring Log R3/HB01

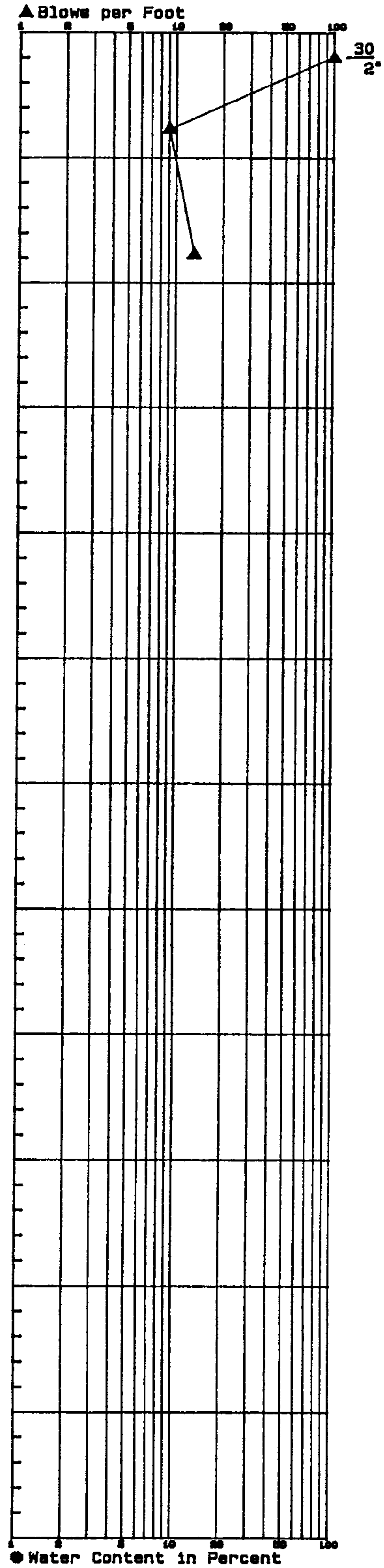
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over (medium dense) moist, brown, slightly silty, sandy GRAVEL with cobbles. (FILL)	0	S-0.5		0.2
Medium stiff, moist to wet, black-dark brown, gray, slightly gravelly, sandy SILT. (FILL?)		S-2.5	CA	0.5
Loose, wet, gray, silty, fine SAND.	5	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/15/88.	10			

STANDARD PENETRATION RESISTANCE

▲Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-95

Boring Log R4/HB01

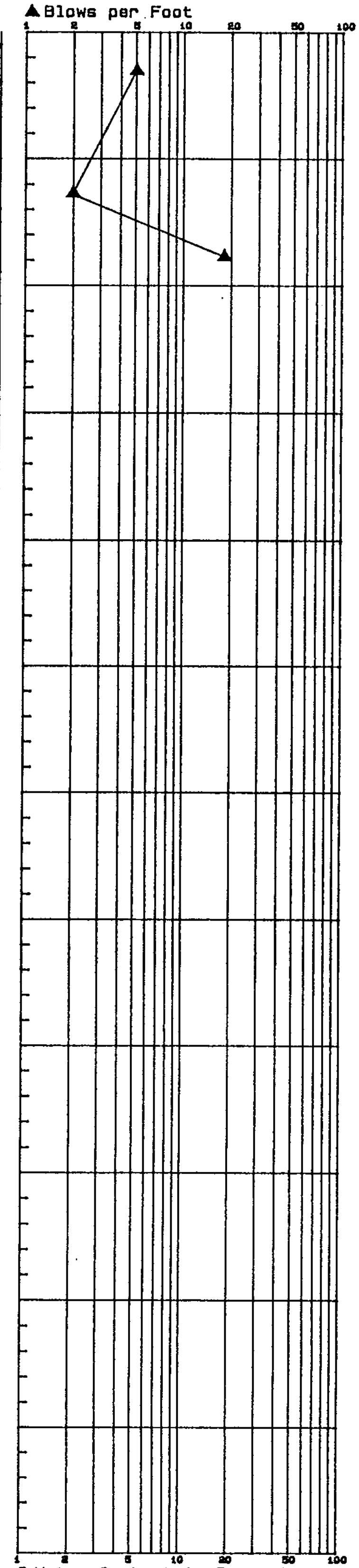
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.5 feet CONCRETE over very loose, wet, brown-black, slightly silty, sandy GRAVEL. (FILL)	S-0.5	CA	2.5
5	Very soft, wet, gray, sandy SILT. (Natural)	S-5.0		6.0
	Medium dense, wet, gray, silty, fine SAND. (Natural)	S-7.5		6.5
9.5	Bottom of Boring at 9.5 Feet. Completed 8/5/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-96

Boring Log R6/HB01

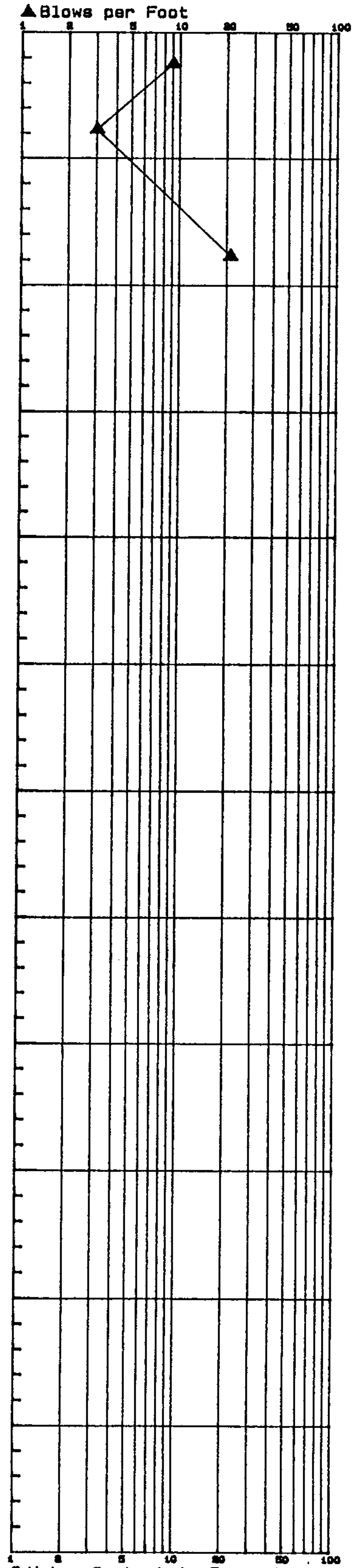
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0–4.8	0.3 feet ASPHALT over moist to wet, brown-black, slightly silty, sandy GRAVEL with cinders, slag, white powdery particles. (FILL)	S-0.2	CA	0
		S-2.5		0
5	Medium dense, wet, gray SILT with organics. (Natural)			
	Very loose, wet, gray, very sandy GRAVEL. (Natural)	S-7.5		0
9.5	Bottom of Boring at 9.5 Feet. Completed 8/5/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-97

Boring Log R7/HB01

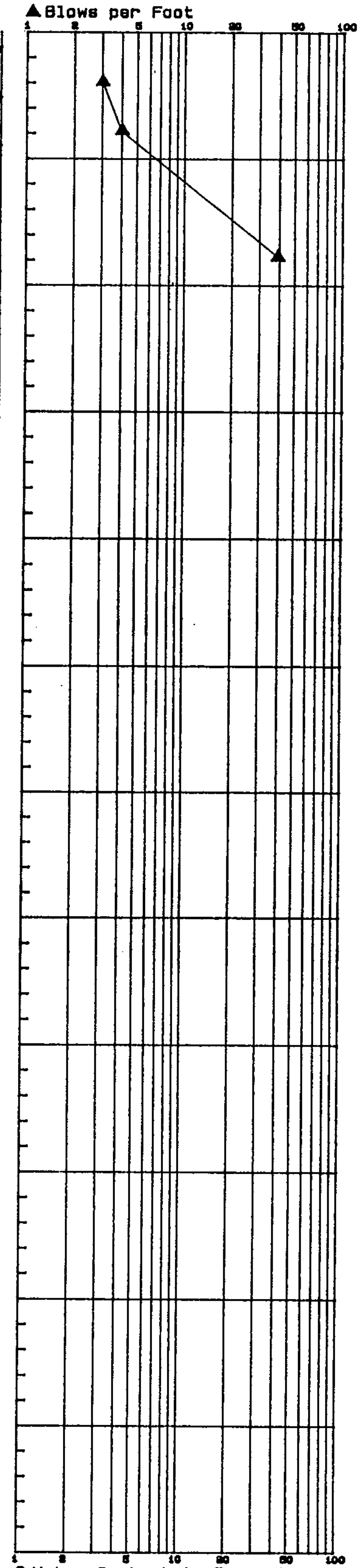
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over wet, brown, black, slightly silty, very gravelly SAND with whitish particles. (FILL)	0	S-0.6	CA	1.2
Very loose, wet, black, slightly silty, very sandy GRAVEL. (FILL)		S-2.5		1.0
Medium dense, wet, black, sandy SILT (FILL?)	5			
Very loose, wet, black-gray, very sandy, fine GRAVEL. (Natural)	ATD	S-7.5		0.2
Bottom of Boring at 9.5 Feet. Completed 8/17/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-98

Boring Log R8/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

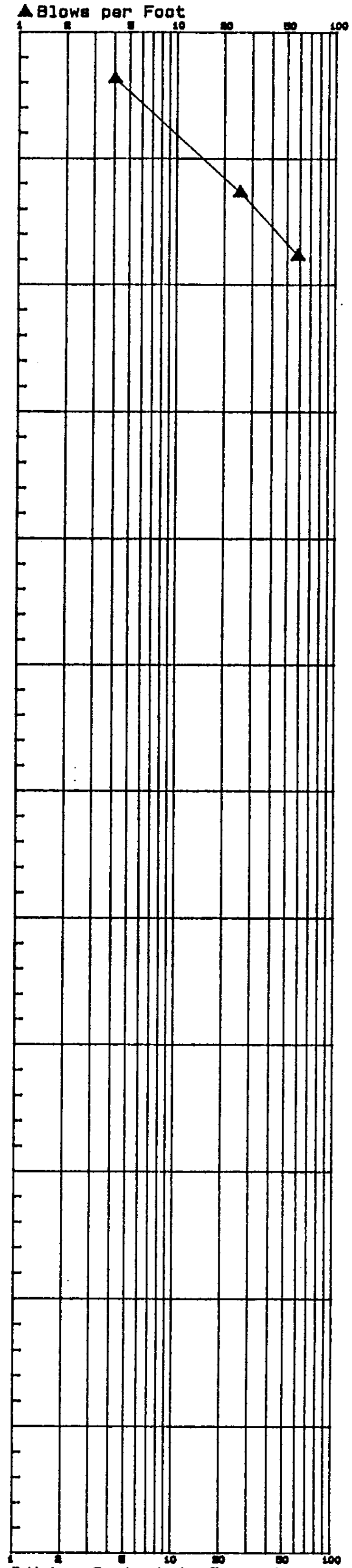
Soil Description	Depth in Feet
0.5 feet CONCRETE over very loose, moist, dark brown, slightly silty, sandy GRAVEL with wood fragments, and whitish particles. (FILL)	0
Loose, moist to wet, dark brown-gray slightly silty, very sandy GRAVEL. (FILL/Natural)	5
Medium stiff, wet, dark brown-gray, very sandy SILT. (Natural)	ATD
Medium dense, wet, brown-gray, very gravelly SAND. (Natural)	
Bottom of Boring at 9.5 Feet. Completed 8/16/88.	10

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Sample	LAB TESTS	H-Nu
S-0.5		18
S-5.0	CA	5
S-7.5		0.7

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-99

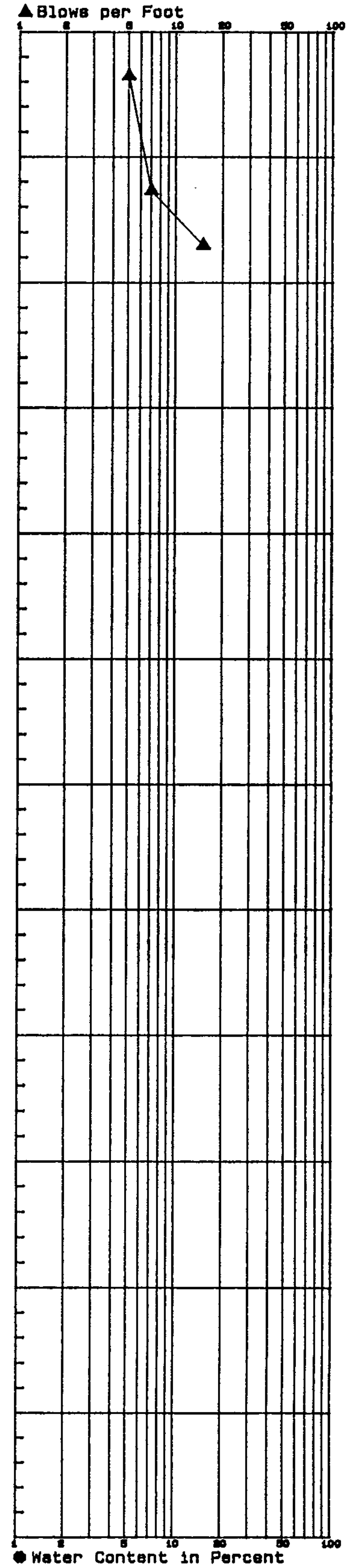
Boring Log R9/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over very loose, wet, black, slightly silty, very gravelly SAND. (FILL)	0	S-0.4	CA	16
Loose, wet, gray, silty, fine SAND with substantial fine roots. (Natural)	5	S-5		0.3
Wet, gray PEAT. (Natural)				
Loose, wet, gray, slightly gravelly SAND with silt lumps and chunks of wood. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/2/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 Ausut 1988

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Figure C-100

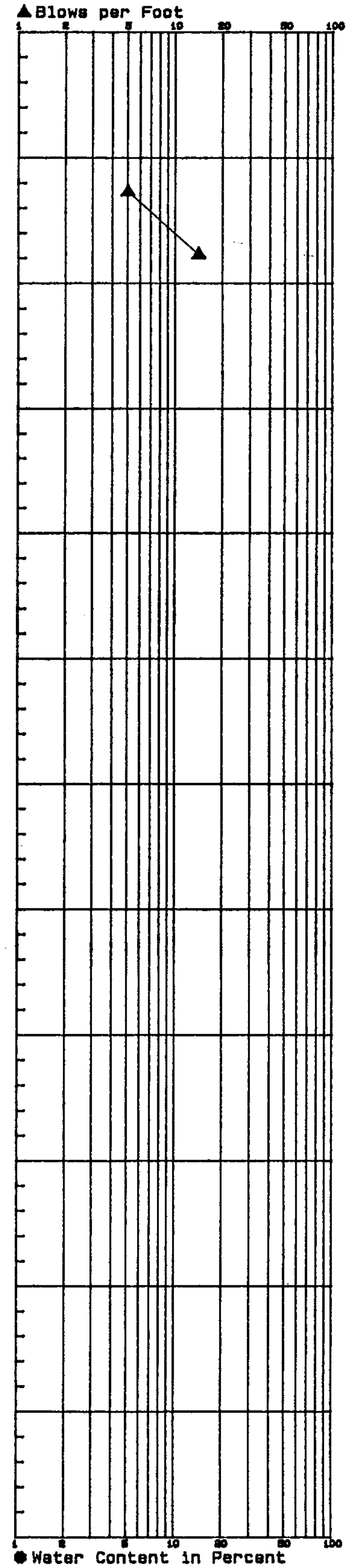
Boring Log R10/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over moist, dark brown-black, silty, very gravelly SAND with slag, rubble, cinders. (FILL)	0	S-0.8		8.5
Soft, wet, brown and gray, slightly gravelly, sandy SILT with substantial organics, small wood pieces. (Natural)	5 (water level ATD)	S-5.0	CA	4.5
Loose, wet, gray, silty SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/15/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-101

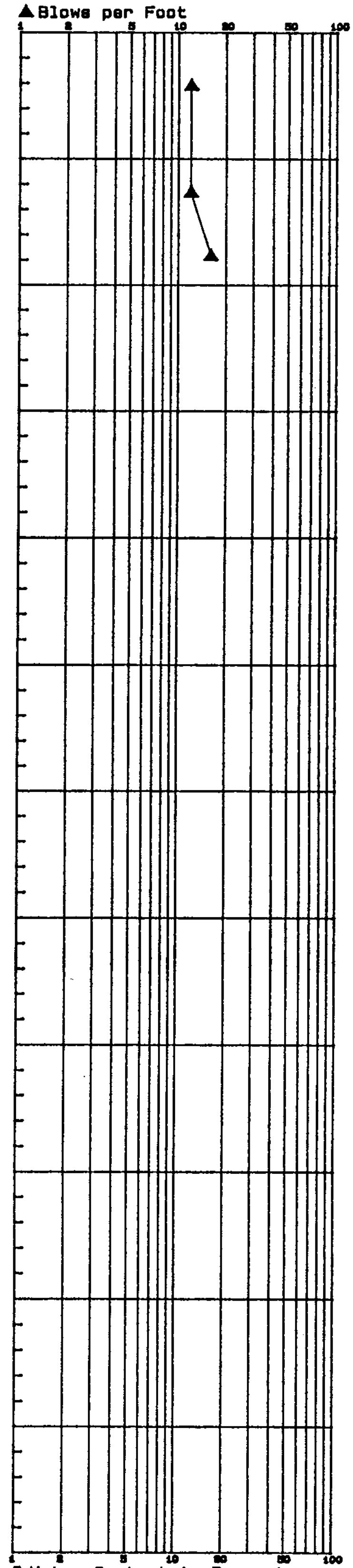
Boring Log R11/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	1.1 foot CONCRETE over loose, moist, dark brown, silty, very gravelly SAND with some small metal fragments (FILL)	S-1.1		0
5	PEAT.			
	Loose, wet, gray, silty SAND interlayered with stiff, wet, gray, very sandy SILT. (Natural)	S-5.0		0
	Loose, wet, gray, slightly gravelly, silty, fine SAND. (Natural)	S-7.5	CA	0
10	Bottom of Boring at 9.5 Feet. Completed 8/9/88.			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-102

Boring Log S2/HB01

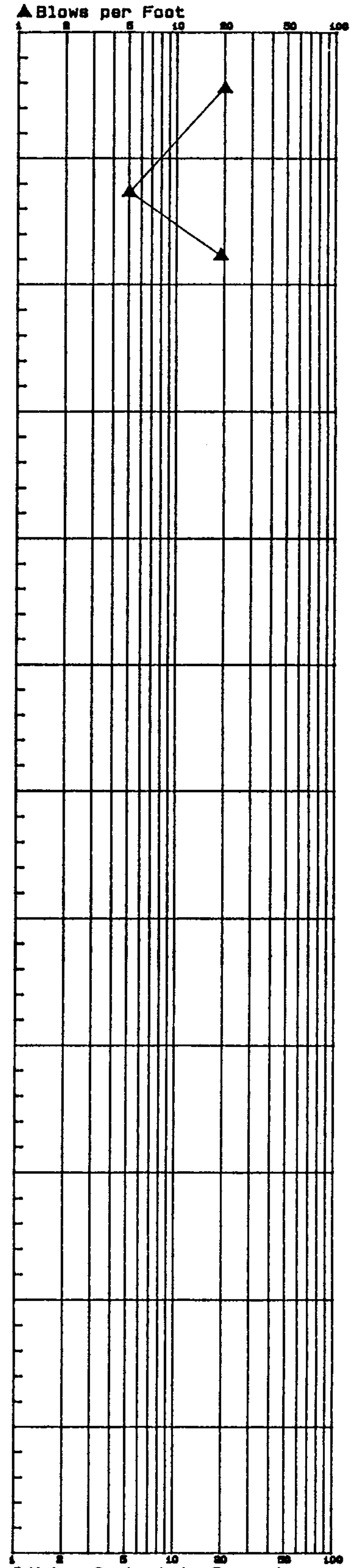
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	CONCRETE.			
	Medium dense, moist, dark gray, very sandy GRAVEL. (FILL)	S-1.2	CA	1.5
	Medium dense, moist, dark gray, very sandy, very silty GRAVEL with brick fragments, pieces of wood. (FILL)			
5	Medium stiff, moist to wet, gray, slightly gravelly, sandy SILT grading to meidum dense, wet, gray, very gravelly SAND. (Natural)	S-5.0		1.5
ATD		S-7.5		1.5
10	Bottom of Boring at 9.5 Feet. Completed 8/4/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-103

Boring Log S3/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

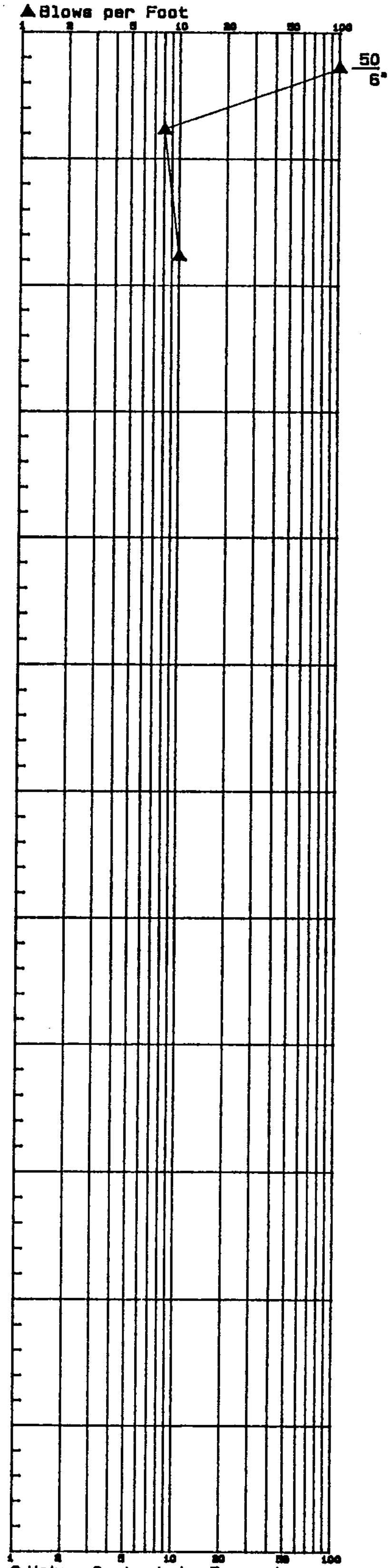
Depth in Feet

Soil Description	Depth (ft)	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over loose, moist, brown, slightly silty, sandy GRAVEL. (FILL)	0–6.5	*S-0.7		0
		S-2.5		0
Medium stiff, wet, black-gray, slightly sandy SILT grading to medium stiff, wet, gray, very sandy SILT. (Natural)	6.5–9.5	S-7.5	CA	0

Bottom of Boring at 9.5 Feet.
Completed 8/15/88.

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

* No Recovery

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-104

Boring Log S4/HB01

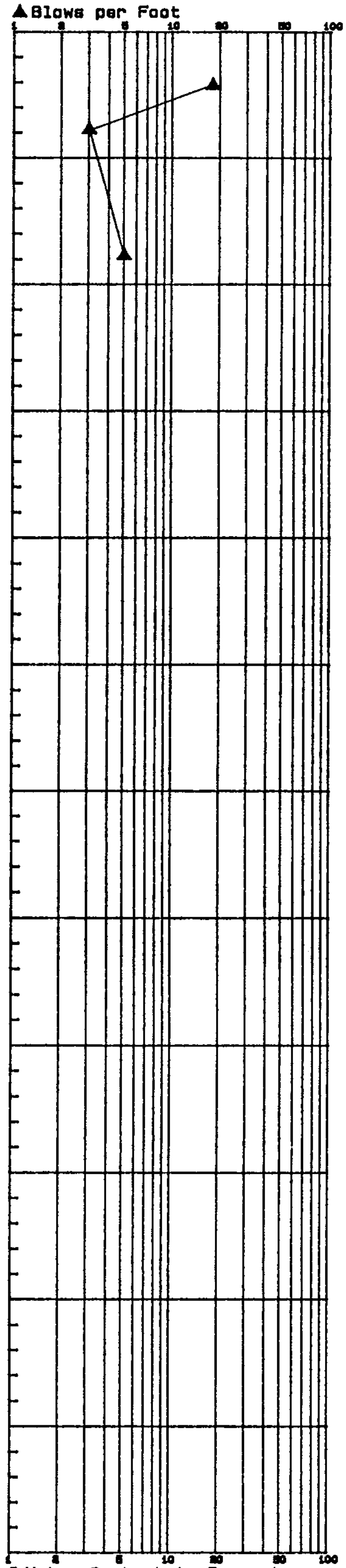
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Descriptions	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over COBBLES up to 6-inch-diameter.	0			
Loose, wet, dark brown, slightly silty, sandy GRAVEL with cobbles. (FILL)		S-1.1		0
		S-2.5	CA	0
Soft, wet, brown-gray, slightly sandy SILT. (Natural)	5			
Soft, wet, gray SILT. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-105

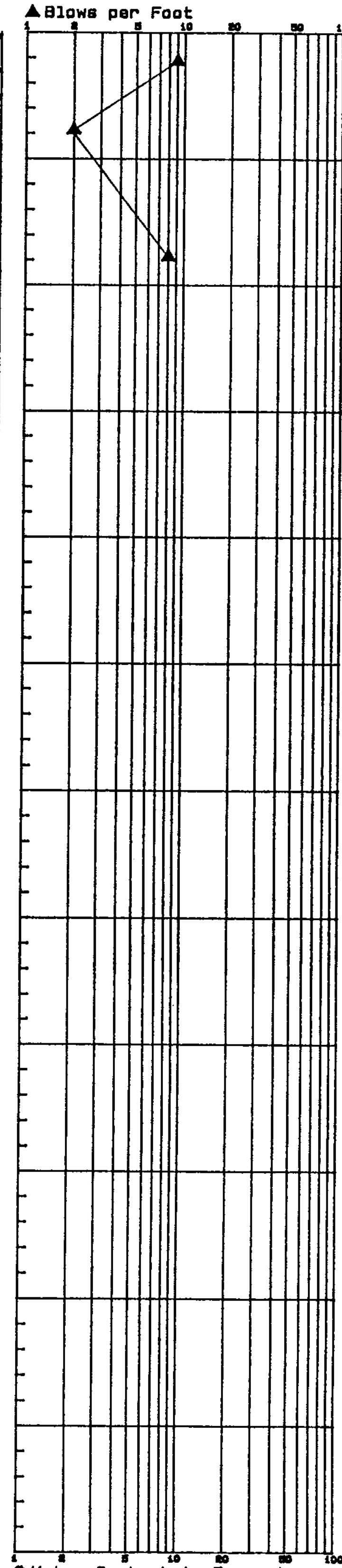
Boring Log S5/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	LAB TESTS	H-Nu
0.2 feet ASPHALT over loose, moist to wet, brown-black, slightly silty, very sandy GRAVEL with brick fragments. (FILL)	0	S-0.1	CA	0
Very loose, wet, brown-gray, silty, very sandy GRAVEL. (Natural)		S-2.5		0
Medium dense, wet, gray, sandy SILT. (Natural)	5	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10 ATD			

STANDARD PENETRATION RESISTANCE
▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-106

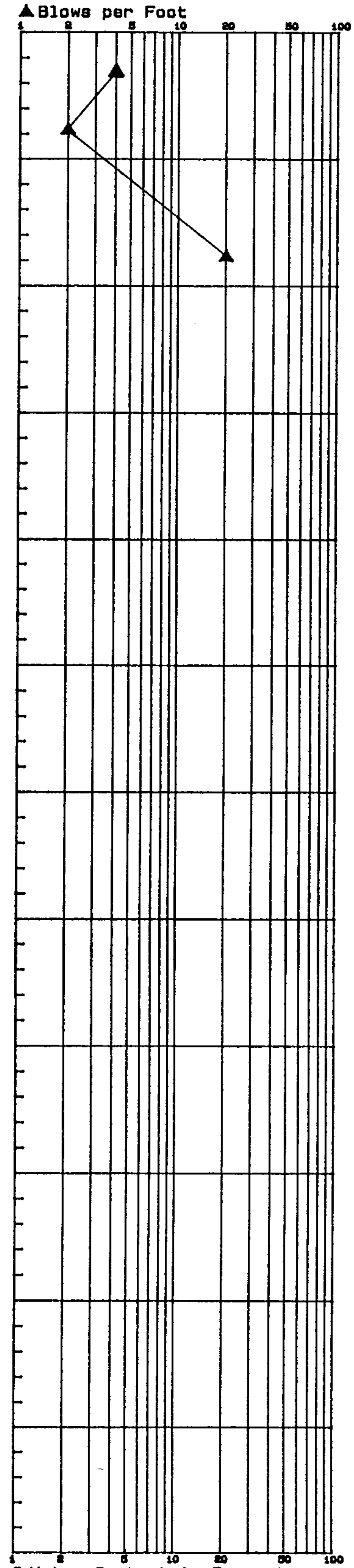
Boring Log S6/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over very loose, moist, dark brown, slightly silty, very gravelly SAND with slag, brick fragments. (FILL)	0	S-0.3		0
Very soft, moist, dark brown SILT. (FILL)		S-2.5		0
Very soft, wet, gray, sandy SILT with substantial yellow mottling grading to loose, wet, gray, very silty, fine SAND. (Natural)	5	S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/16/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-107

Boring Log S8/HB01

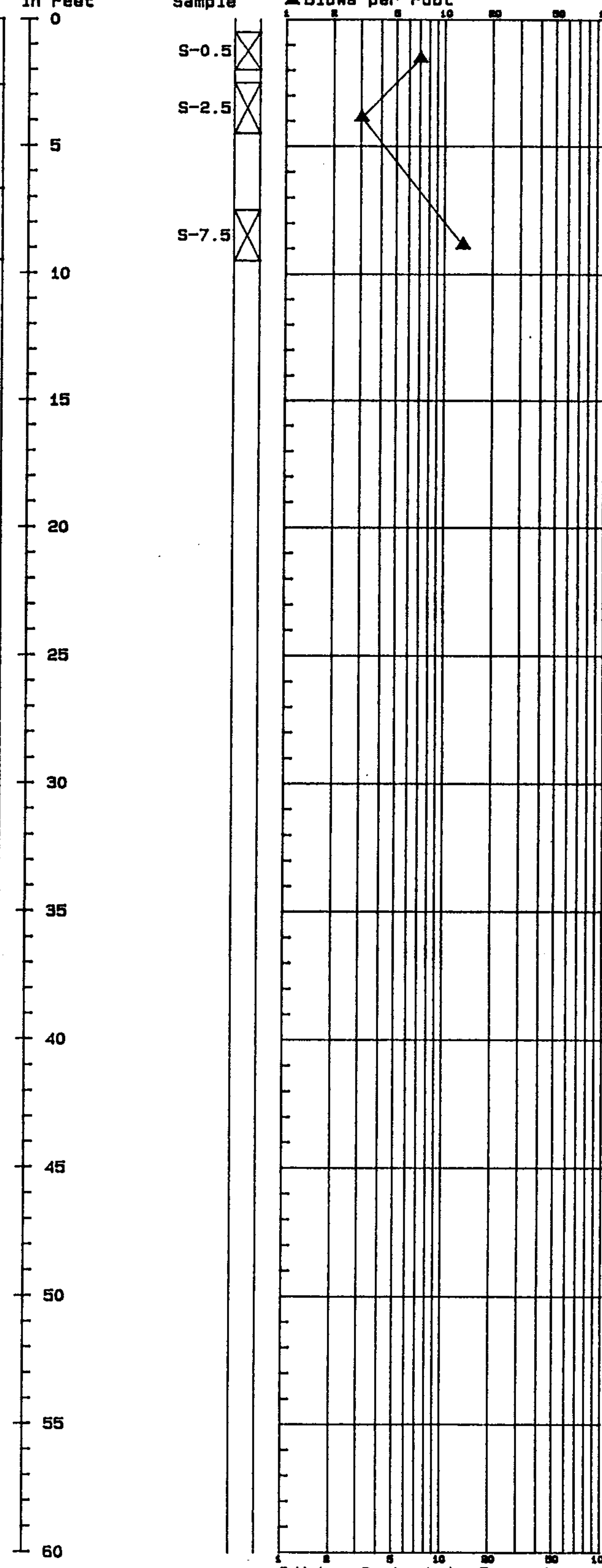
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.5 feet CONCRETE over very loose, wet, brown, slightly gravelly, silty SAND with scattered small chunks of slag. (FILL)	0	S-0.5		0.2
Very loose, wet, gray, very silty, fine SAND. (Natural)		S-2.5	CA	116
Stiff, wet, gray, sandy SILT. (Natural)		S-7.5		1.0
Bottom of Boring at 9.5 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-108

Boring Log S9/HB01

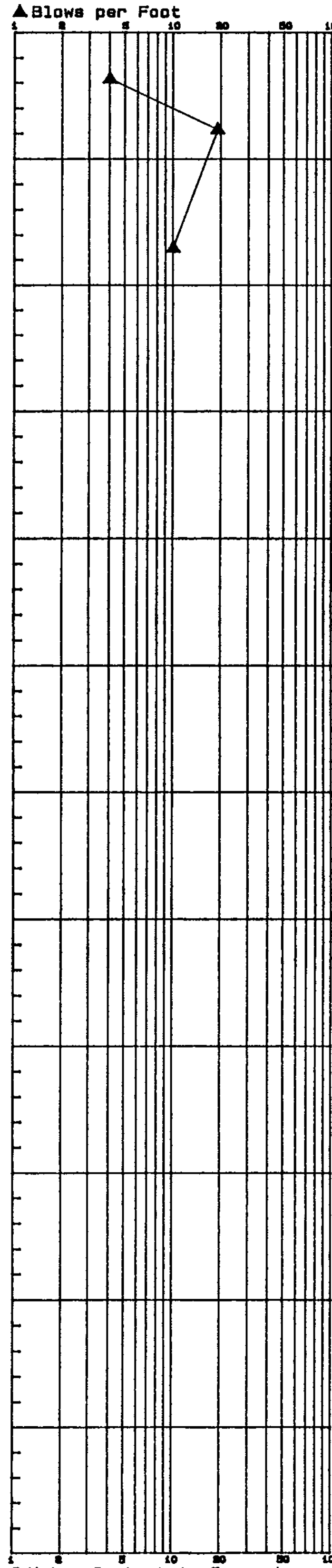
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.5 feet CONCRETE over very loose, moist to wet, black, slightly silty, very gravelly SAND. (FILL)	S-0.5		0
	Medium dense to loose, moist to wet, gray, silty, fine SAND with substantial fine roots. (Natural)	S-2.5		0
ATD		S-7.5	CA	0
9.0	Bottom of Boring at 9.0 Feet. Completed 8/2/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-109

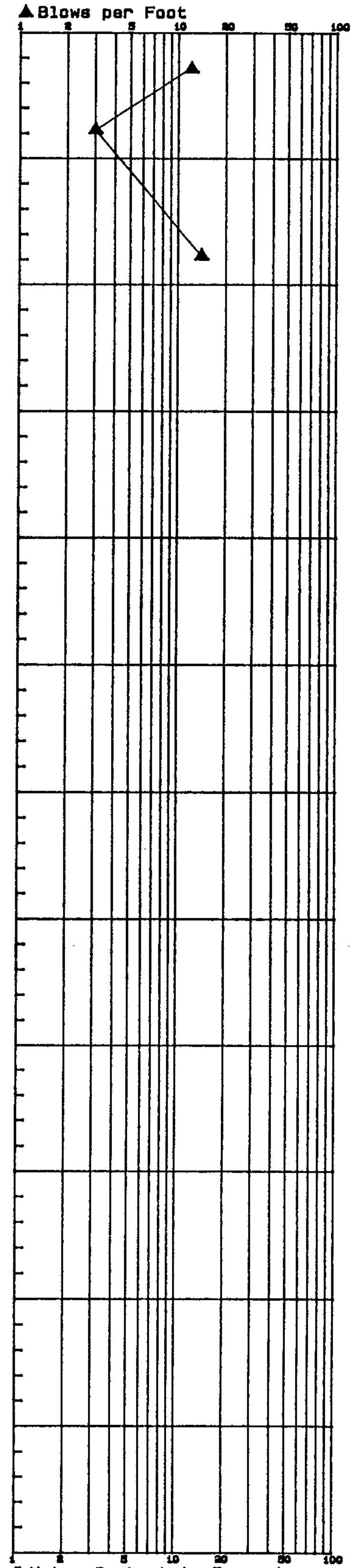
Boring Log T2/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over loose, moist, brown, silty, gravelly SAND. (FILL)	0–2	S-0.4		0
Soft, wet, gray, sandy SILT with gasoline-like odor grading to stiff, wet, gray, slightly sandy SILT. (Natural)	2–8 (water level ATD at ~8)	S-2.5	CA	65
		S-7.5		38
Bottom of Boring at 9.5 Feet. Completed 8/4/88.	9.5			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-110

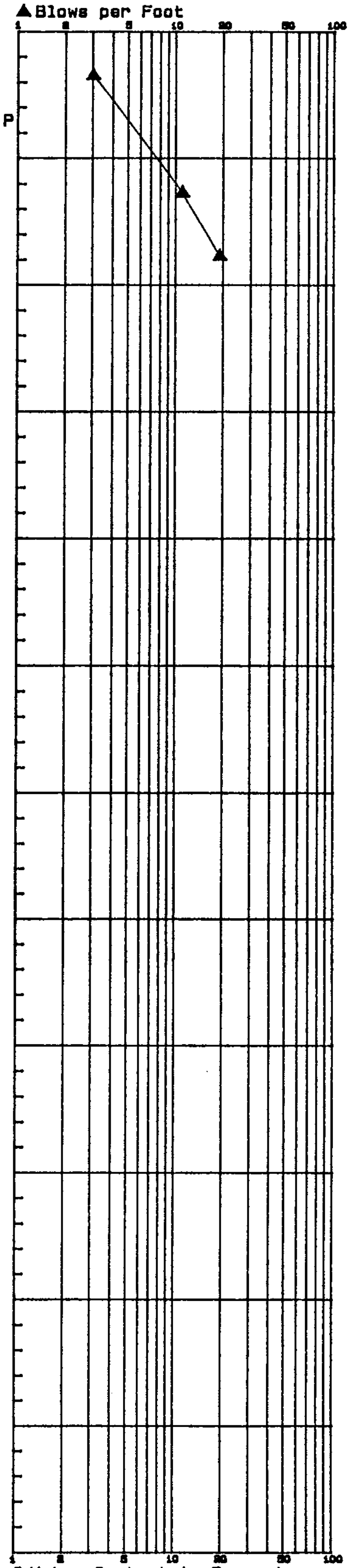
Boring Log T3/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over very loose, moist to wet, brown, silty, very gravelly SAND with some black mottling. (FILL)	0	S-0.7		0.5
Very loose, wet, gray and brown, slightly silty, sandy GRAVEL grading to medium dense, wet, gray, slightly silty, gravelly SAND with strong gasoline odor and hydrocarbon sheen.		*S-2.5 P		
	5 (ATD)	S-5.0		45
		S-7.5	CA	54
Bottom of Boring at 9.5 Feet. Completed 8/4/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

* No Recovery

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-111

Boring Log T4/HB01

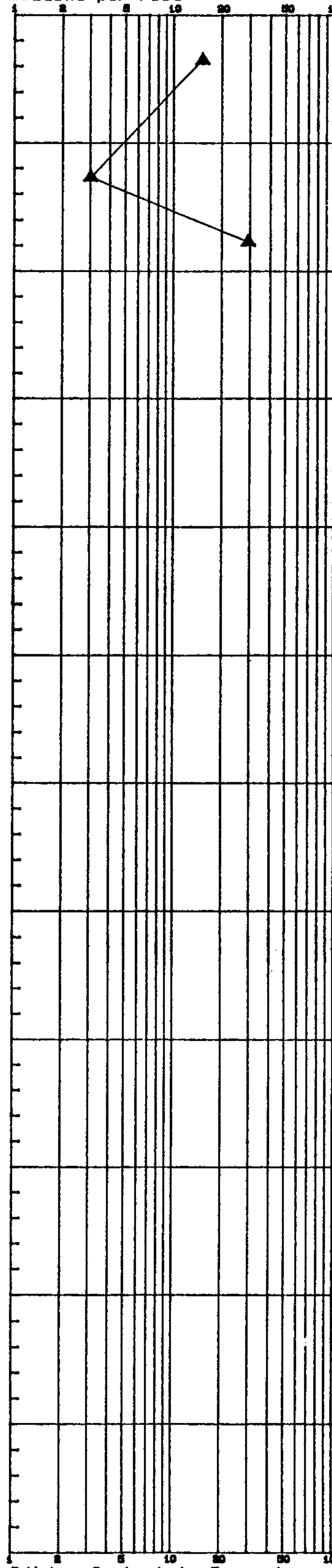
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.6 feet CONCRETE over loose, wet, dark brown, gravelly, very silty, fine SAND. (FILL)	0	S-0.4		0.7
Very loose, wet, gray, silty, fine SAND with scattered organics. (Natural)	5 (ATD)	S-5.0		0
Medium dense, wet, gray, slightly sandy GRAVEL. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

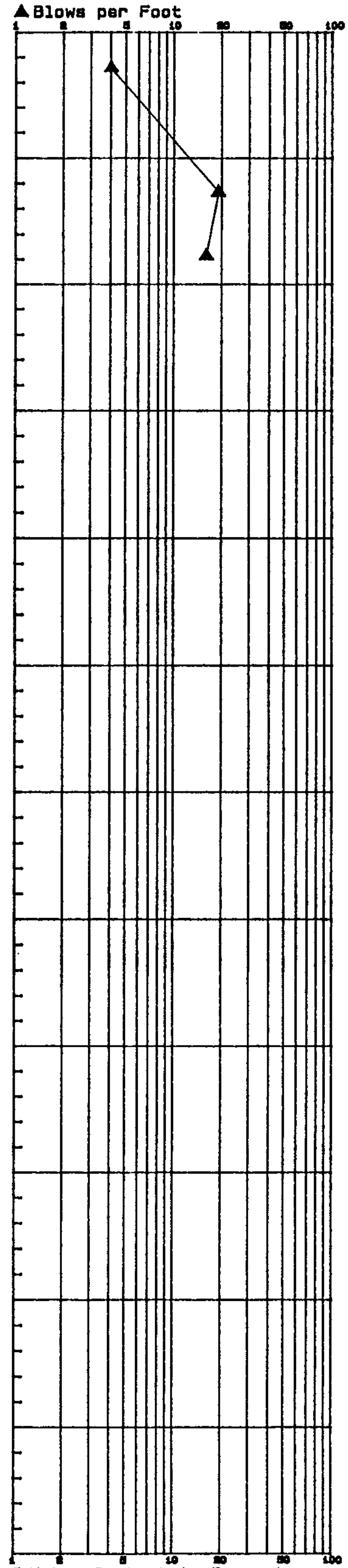
Figure C-112

Boring Log T5/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
0.4 feet CONCRETE over very loose, moist, black, slightly silty, very sandy GRAVEL with rubble. (FILL)	0	S-0.4	CA	0
Medium dense, wet, brown, slightly gravelly, medium to fine SAND. (Natural)	5 (ATD)	S-5.0		0
Loose, wet, gray, very sandy, fine GRAVEL. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/5/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-113

Boring Log T6/HB01

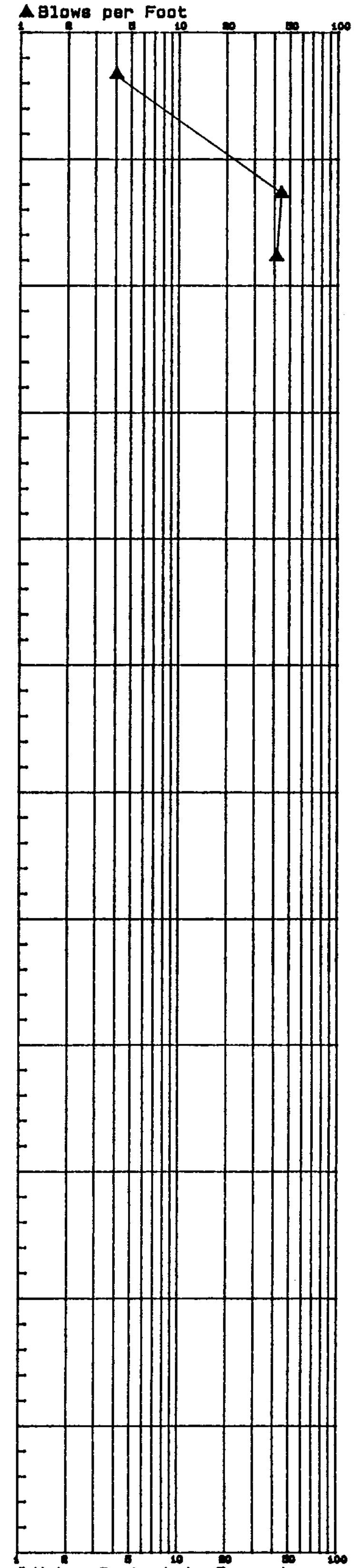
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet CONCRETE over sandy SILT - TOPSOIL. (FILL)	0	S-0.3		0
Very loose, moist, black, slightly silty, very sandy GRAVEL with cinders (FILL)				
Soft, moist, black SILT. (Natural)	5	S-5.0	CA	0
Medium dense, moist, light brown, very gravelly SAND with orange staining grading to medium dense, wet, gray, slightly sandy GRAVEL.		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/16/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-114

Boring Log T8/HB01

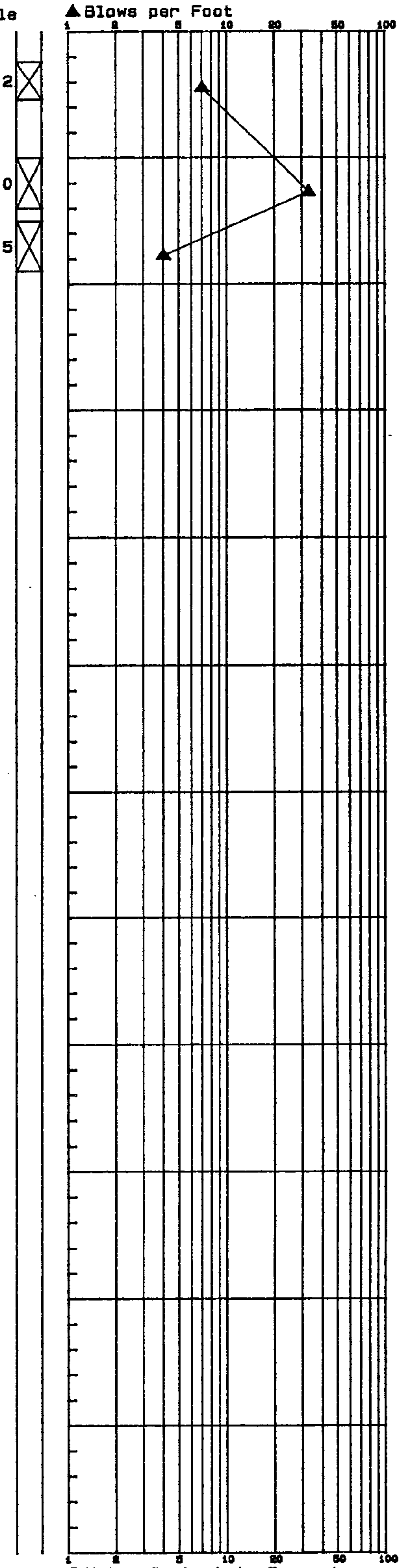
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Sample	Lab Tests	H-Nu
CONCRETE.			
Very loose, damp to moist, light brown, very gravelly SAND. (FILL)	S-1.2	CA	1.0
Very stiff, wet, brown-gray, very sandy SILT interlayered with PEAT. (Natural)	S-5.0		0
Medium dense, wet, brown-gray, very sandy GRAVEL. (Natural)			
Very loose, wet, gray, gravelly, very silty, fine SAND. (Natural)	S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/9/88.			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

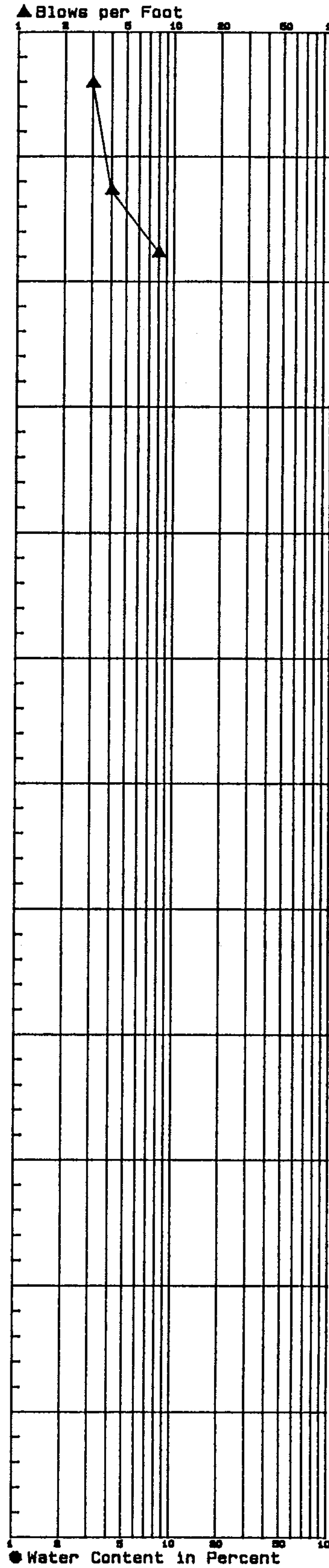
Figure C-115

Boring Log T9/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Standard Penetration Resistance (Blows per Foot)	Lab Tests	H-Nu
0.7 feet CONCRETE over very loose, moist, dark brown, slightly silty, very gravelly SAND with slag, cinders, rust staining. (FILL)	0	S-0.7			0
Moist, dark brown PEAT. (Natural)					
Soft, wet, gray, slightly sandy SILT grading to medium stiff, wet, gray, very sandy SILT. (Natural)	5	S-5.0		CA	0
		S-7.5			0
Bottom of Boring at 9.5 Feet. Completed 8/15/88.	10				



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-116

Hart Crowser
J-1639-09

TEST PIT LOGS -
HART CROWSER (1988)
FIGURES C-135 THROUGH C-173

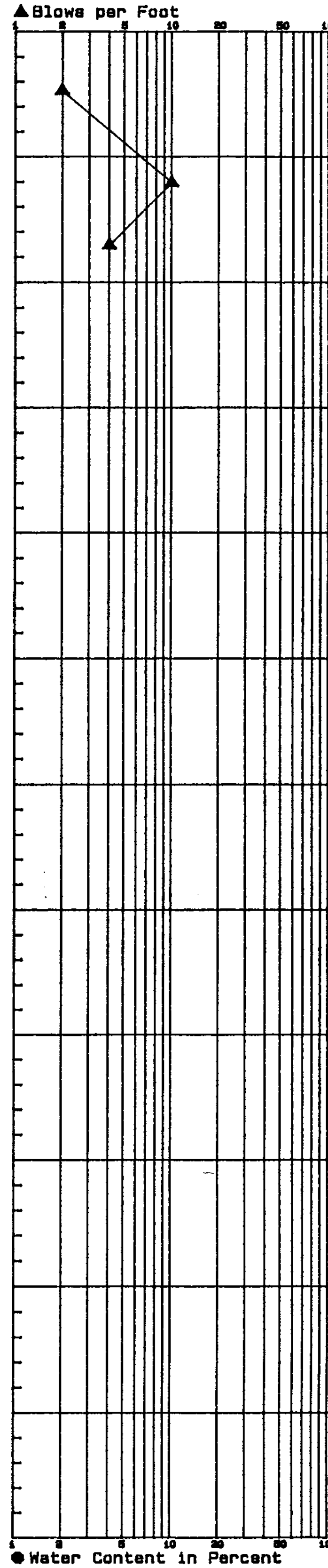
Boring Log T11/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet CONCRETE over very loose, damp, black-red, sandy GRAVEL with brick debris. (FILL)	0	S-1.0	CA	0
Moist, brown PEAT. (FILL)				
Medium stiff, moist, gray, sandy SILT with mixed organics. (Natural)	5	S-5.0		0
Loose, wet, gray, silty SAND with mixed organics. (Natural)				
Very loose, wet, gray, slightly silty, coarse to fine SAND. (Natural	ATD	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-117

Boring Log T12/HB01

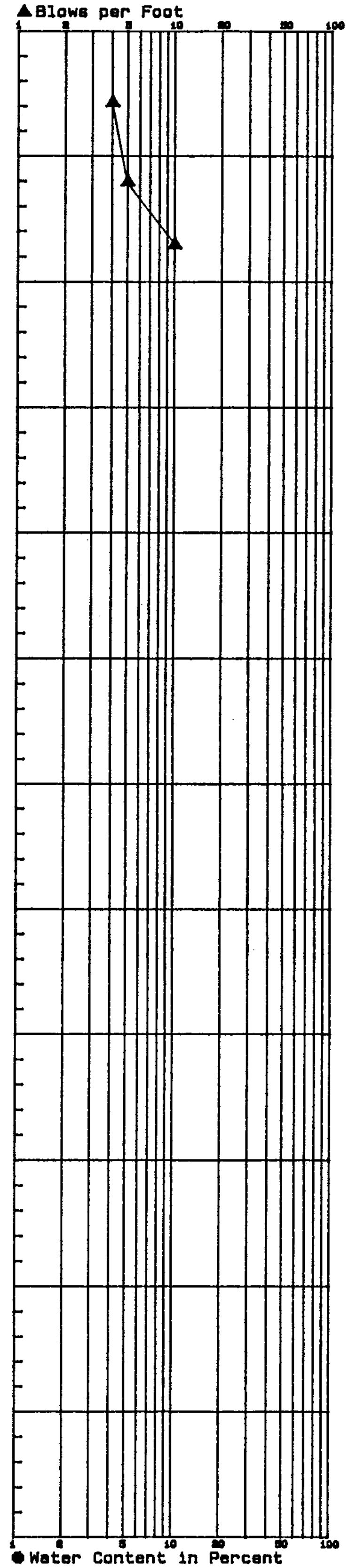
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet
0.5 feet CONCRETE over very loose, damp, gray-black, sandy GRAVEL. (FILL)	0
Soft, damp to wet, gray, sandy SILT interlayered with BRICK DEBRIS and charred wood. (FILL)	5
Very loose, wet, gray, silty SAND. (Natural)	ATD
Loose, wet, gray, coarse SAND. (Natural)	
Bottom of Boring at 9.0 Feet. Completed 8/9/88.	10

Sample	Lab Tests	H-Nu
S-1.5		0.5
S-5.0	CA	0
S-7.5		0

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-118

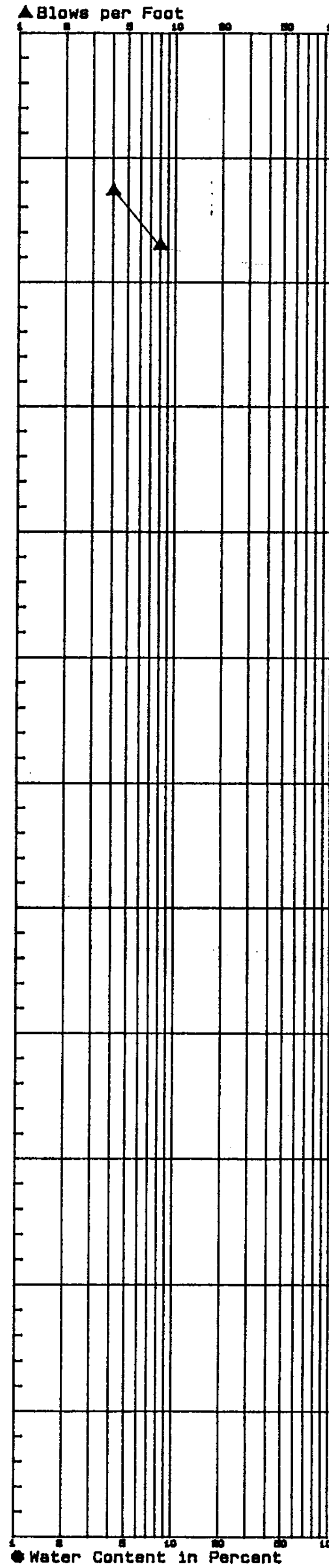
Boring Log U1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over CONCRETE.	0			
Damp, brown, sandy GRAVEL. (FILL)		S-1.0		2.5
Wet, gray, gravelly, sandy SILT with brick debris and wood pieces. (FILL)				
Soft to medium stiff, wet, gray, slightly clayey, sandy SILT with strong gasoline-like odor. (Natural)	5	S-5.0		60
		S-7.5	CA	37
Bottom of Boring at 9.0 Feet. Completed 8/3/88.	10			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-119

Boring Log U2/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet

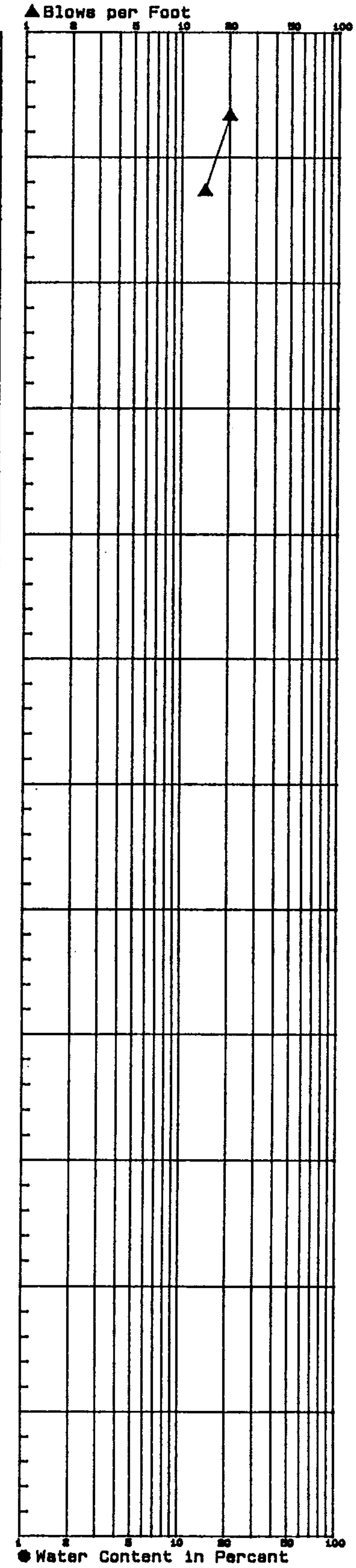
Medium dense, dry to damp, brown, sandy GRAVEL. (FILL)

Hydrocarbon odor —

Bottom of Boring at 9.5 Feet.
Completed 8/11/88.

Sample: S-2.0, S-5.0, S-7.5

STANDARD PENETRATION RESISTANCE



LAB TESTS: CA

H-Nu

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-120

Boring Log U3/HB01

SOIL DESCRIPTIONS

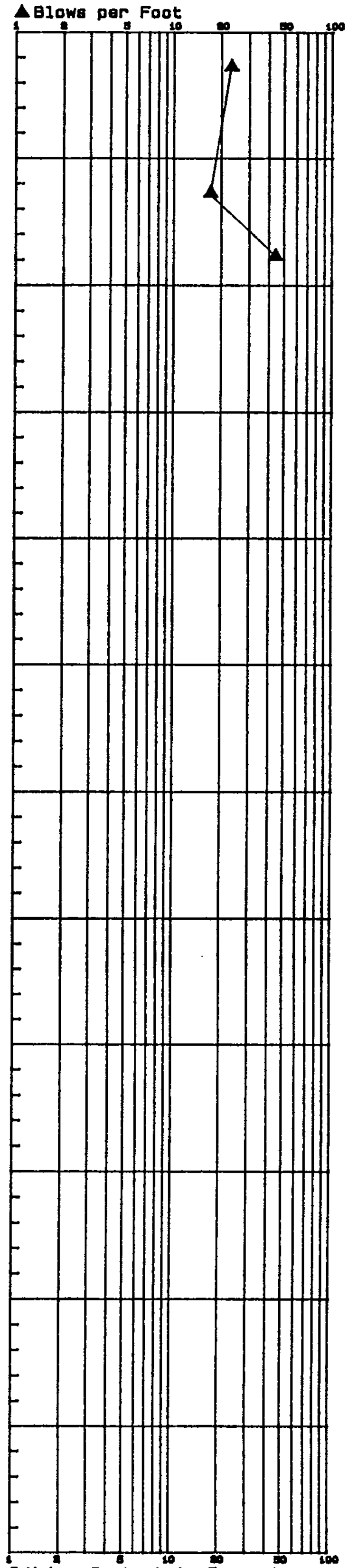
Ground Surface Elevation in Feet

Soil Description	Depth in Feet
Loose, damp to moist, light brown, slightly silty, very sandy GRAVEL. (FILL)	0
Loose, wet, gray, very silty, fine SAND with gasoline-like odor. (Natural)	5
ATD (ground water level)	
Medium dense, wet, gray, slightly sandy GRAVEL. (Natural)	
Bottom of Boring at 9.5 Feet. Completed 8/17/88.	10

Sample	LAB TESTS	H-Nu
S-0.0		0
	N/A	
S-5.0		20
S-7.5		21

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

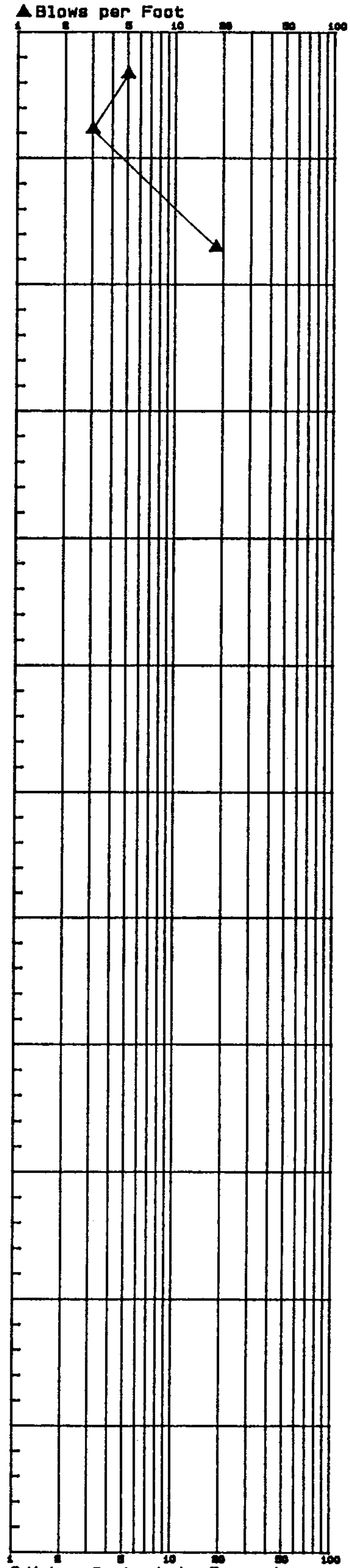
Figure C-121

Boring Log U5/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over very loose, moist to wet, dark brown, gravelly, very silty SAND with some possible cinders. (FILL)	0	S-0.3		0
Very loose, moist, black, slightly silty, slightly gravelly, medium to fine SAND with white particles. (FILL)	5 (ATD)	S-2.5	N/A	0
Medium dense, wet, gray, very gravelly SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-122

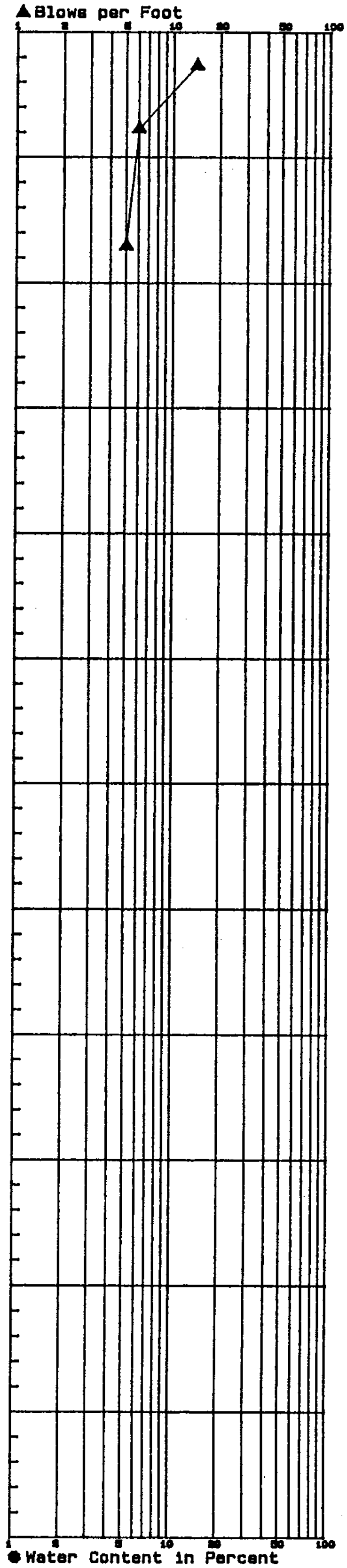
Boring Log V1/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.3 feet ASPHALT over loose, damp, brown, very gravelly SAND. (FILL)	S-0.3	CA	0
	Soft, moist to wet, brown, very sandy SILT with gray mottling and rust staining. (Natural)	S-2.5		0
	Soft, wet, gray, sandy SILT. (Natural)	S-7.5		0
9.0	Bottom of Boring at 9.0 Feet. Completed 8/3/88.			

STANDARD PENETRATION RESISTANCE



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-123

Boring Log V3/HB01

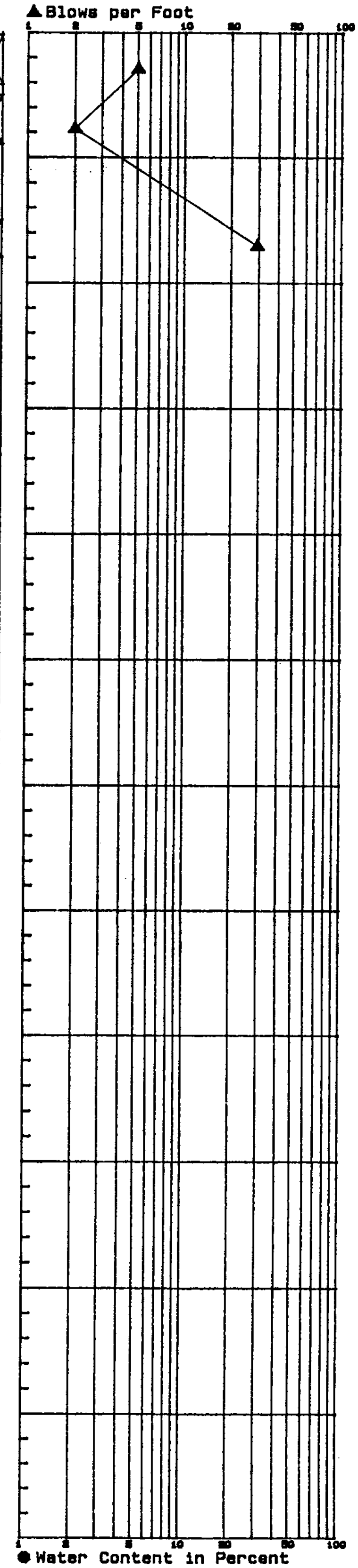
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.4 feet ASPHALT over very loose, damp to moist, brown, slightly silty very sandy GRAVEL. (FILL)	0	S-0.1		0
Soft, moist to wet, gray-brown, very sandy SILT. (Natural)		S-2.5	CA	0
Medium dense, wet, gray, sandy GRAVEL. (Natural)	5	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-124

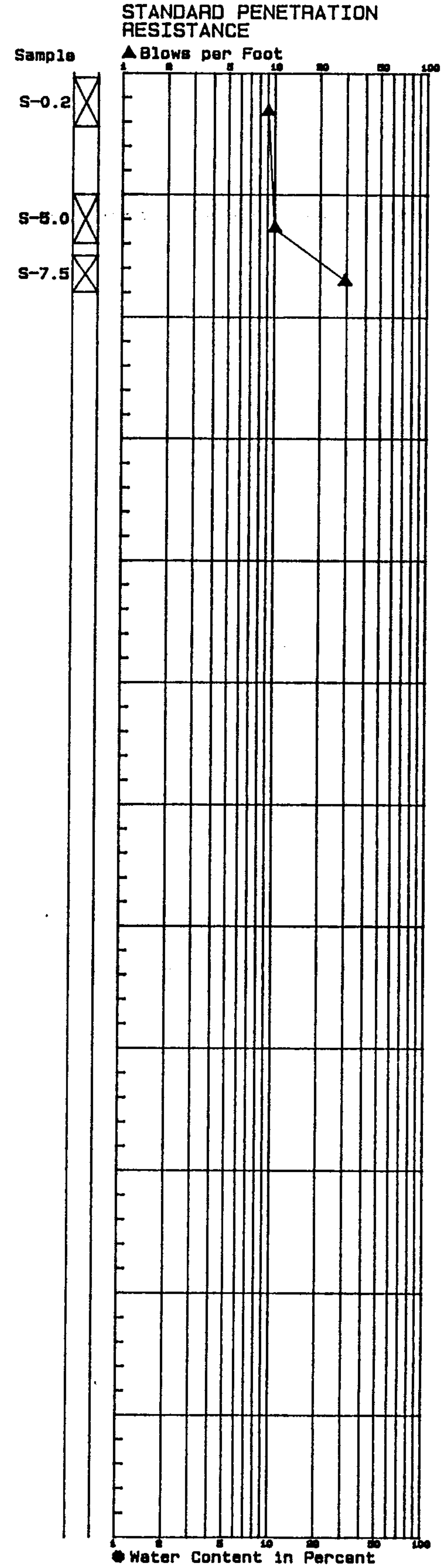
Boring Log V5/HB01

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0	0.3 feet ASPHALT over loose, moist to wet, black and brown, silty, very gravelly SAND. (FILL)
~4	Loose, moist to wet, brown-gray, slightly gravelly, very silty SAND. (Natural)
~7.5 (ATD water level ~7)	Medium dense, wet, brown, sandy GRAVEL. (Natural)
9	Bottom of Boring at 9.0 Feet. Completed 7/28/88.

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60



LAB TESTS	H-Nu
CA	0
	0
	0

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-125

Boring Log V7/HB01

SOIL DESCRIPTIONS

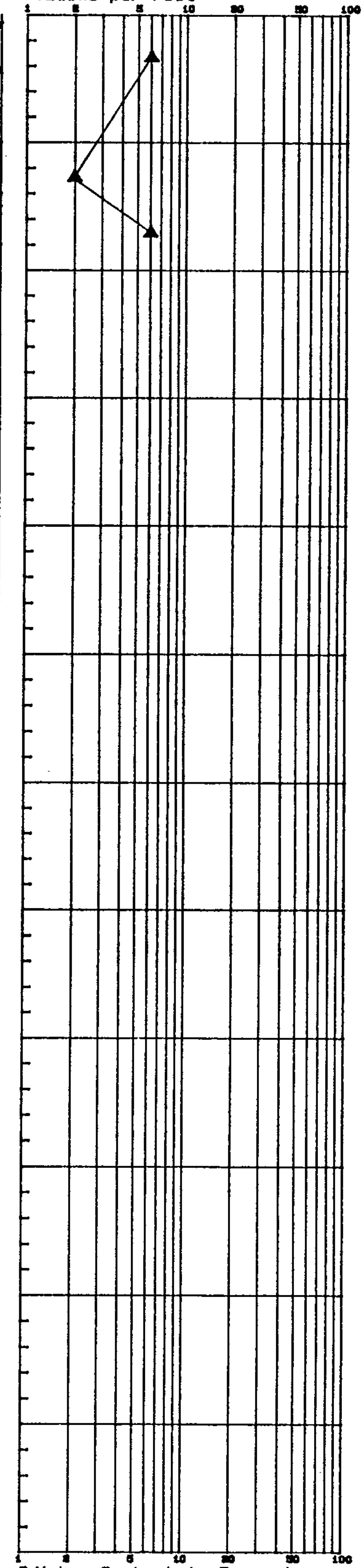
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over very loose, moist, brown, slightly silty, very sandy GRAVEL. (FILL)	0	S-0.5		0
Soft, wet, brown-gray, very sandy SILT grading to very loose, wet, gray, slightly silty SAND with trace organics. (Natural)	5	S-5.0	CA	0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-126

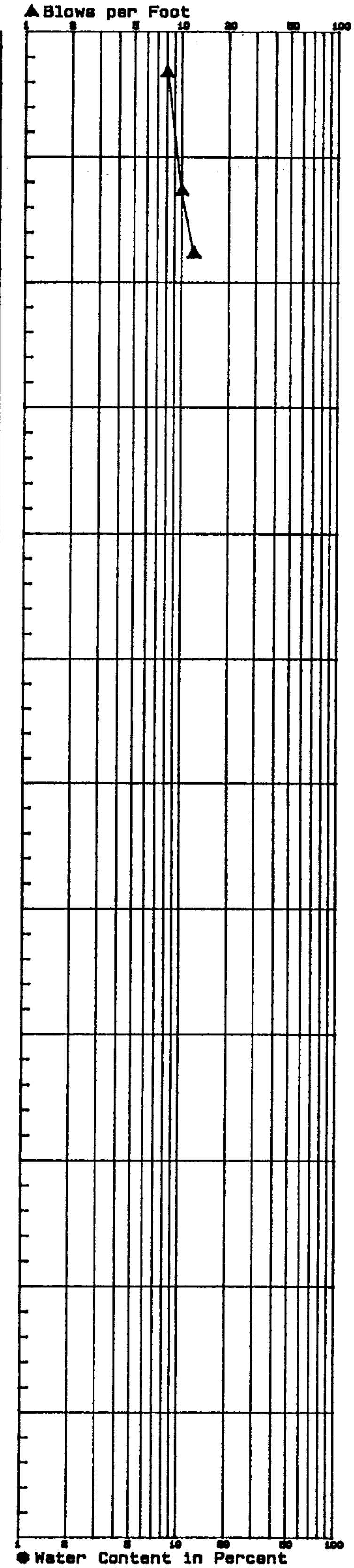
Boring Log V9/HB01

SOIL DESCRIPTIONS Ground Surface Elevation in Feet	Depth in Feet	Sample	LAB TESTS	H-Nu
0.6 feet CONCRETE over very loose, wet, brown, gravelly, silty SAND with tan mottling, cinders. (FILL)	0	S-0.6	CA	0.3
Very loose, wet, gray, very silty, fine SAND. (Natural)	5	S-5.0		0.2
Very loose, wet, gray, very silty SAND. (Natural)		S-7.5		0
Bottom of Boring at 9.5 Feet. Completed 8/9/88.	10			

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-127

Boring Log V11/HB01

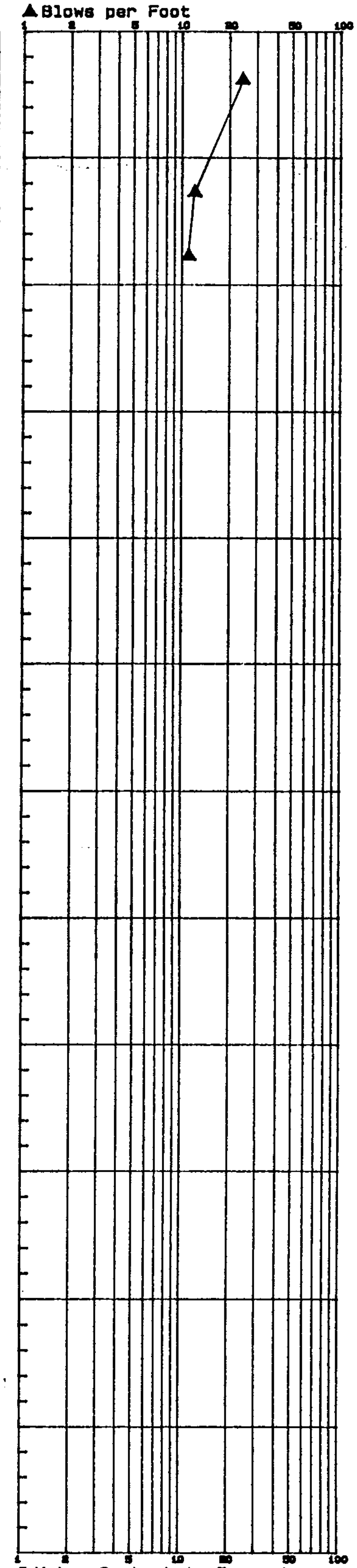
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description	Sample	Lab Tests	H-Nu
0	0.7 feet CONCRETE over loose, wet, gray, slightly gravelly SAND with scattered fine gravels and silt lumps. (Natural)	S-0.8		0
	Very loose, wet, gray, silty SAND grading to medium stiff, wet, gray, sandy SILT. (Natural)	S-5.0		1.5
		S-7.5	CA	0.3
10	Bottom of Boring at 9.5 Feet. Completed 8/9/88.			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-128

Boring Log W3/HB01

SOIL DESCRIPTIONS

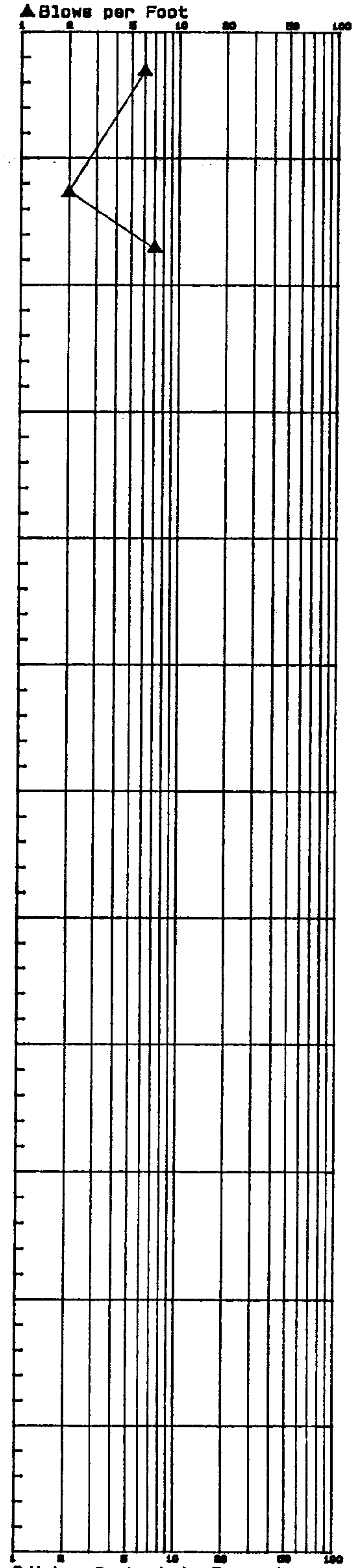
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over very loose, moist, brown, gravelly, very silty SAND with rust stains. (FILL)	0	S-0.2	CA	0
Very loose, wet, brown to gray, very silty, fine SAND with some rust staining. (Natural)	5	S-5.0		0
		S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure C-129

Boring Log W5/HB01

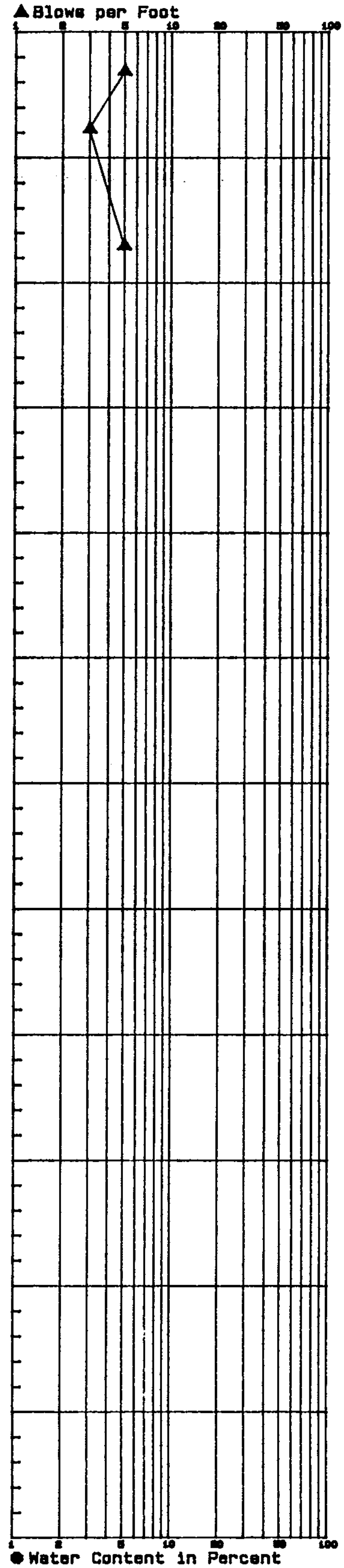
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.3 feet ASPHALT over very loose, damp to moist, brown-gray, silty, very sandy GRAVEL. (FILL)	0	S-0.2		0
Soft, moist to wet, brown, sandy SILT with rust stains. (Natural)		S-2.5		0
	5			
Very loose, wet, brown-gray, silty, fine SAND with rust stains. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-130

Boring Log W7/HB01

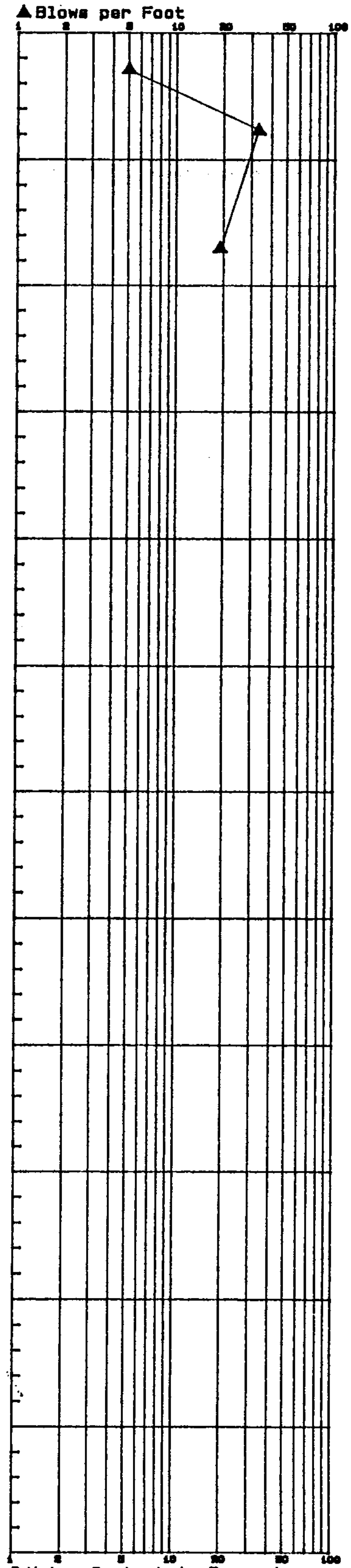
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	LAB TESTS	H-Nu
0.2 feet ASPHALT over very loose, moist to wet, brown, sandy GRAVEL. (FILL)	0	S-0.1		0
Soft, moist to wet, brown, sandy SILT. (FILL)		S-2.5	CA	0
Soft, moist to wet, brown SILT. (Natural)	5			
Medium dense, light brown, slightly silty, very gravelly SAND with orange mottling grading to medium	ATD	S-7.5		0
Bottom of Boring at 9.0 Feet. Completed 7/28/88.	10			

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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HART-CROWSER & associates, inc.

Figure C-131

Boring Log W9/HB01

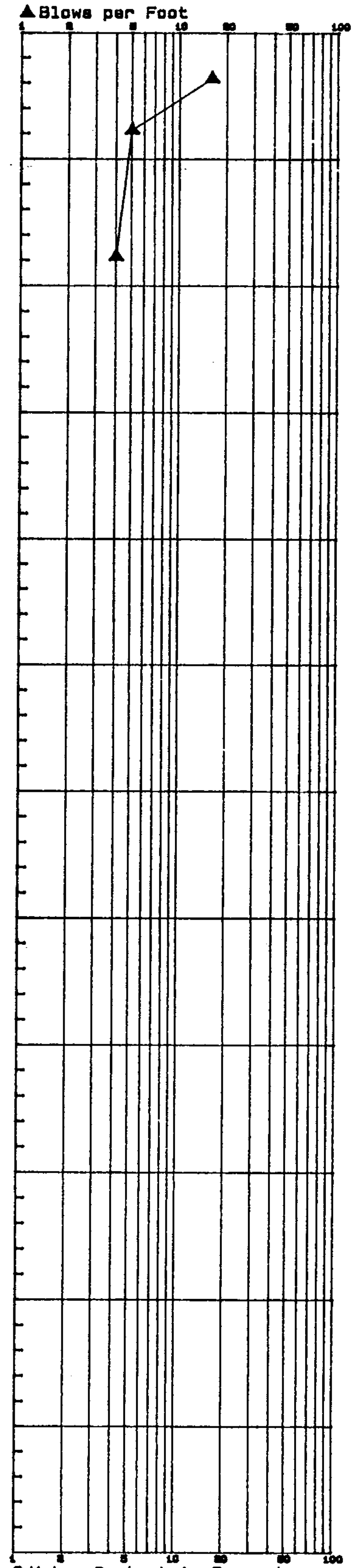
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.7 feet CONCRETE over loose, moist, dark brown, slightly silty, sandy GRAVEL with cinders, powdery white particles. (FILL)	0	S-0.8		0
Soft, moist, dark brown, clayey SILT (Natural)		S-2.5		0
Very loose, wet, gray, very silty, fine SAND. (Natural)	5			
Soft, wet, gray SILT. (Natural)		S-7.5	CA	0
Bottom of Boring at 9.5 Feet. Completed 8/9/88.	10			

STANDARD PENETRATION RESISTANCE

▲Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-132

Boring Log W11/HB01

SOIL DESCRIPTIONS

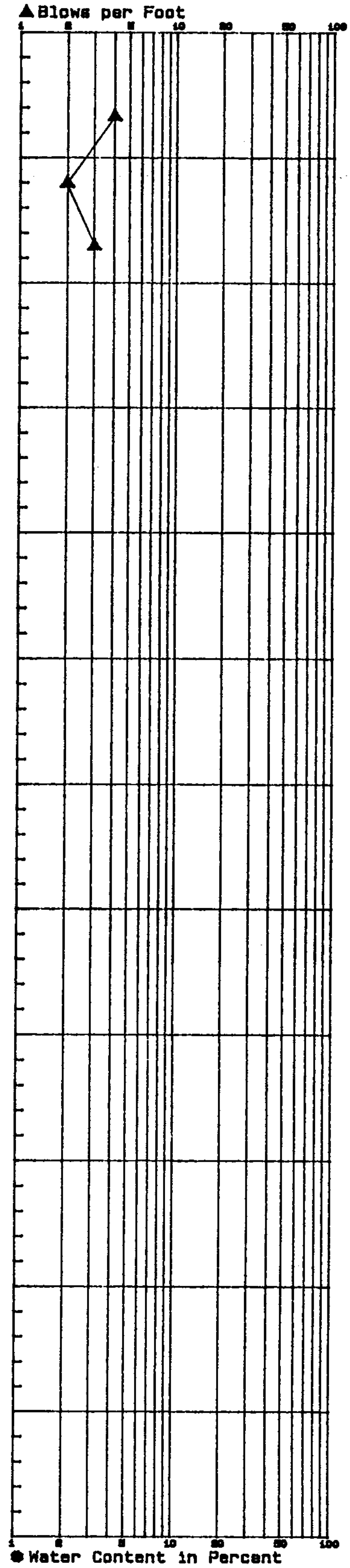
Ground Surface Elevation in Feet

Soil Description	Depth in Feet	Sample	Lab Tests	H-Nu
0.8 feet CONCRETE over damp, black-red BRICK DEBRIS and GRAVEL. (FILL/Natural)	0			
Soft, moist, gray, slightly sandy SILT. (FILL/Natural)		S-2.0	CA	0
Very loose, wet, gray-red, silty SAND. (FILL/Natural)	5	S-5.0		0
Very soft, wet, gray, sandy SILT interlayered with very loose, wet, gray with some red, silty SAND. (Natural)		S-7.5		0

Bottom of Boring at 9.0 Feet.
Completed 8/9/88.

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-10 August 1988

HART-CROWSER & associates, inc.

Figure C-133

Boring Log W12/HB01

SOIL DESCRIPTIONS

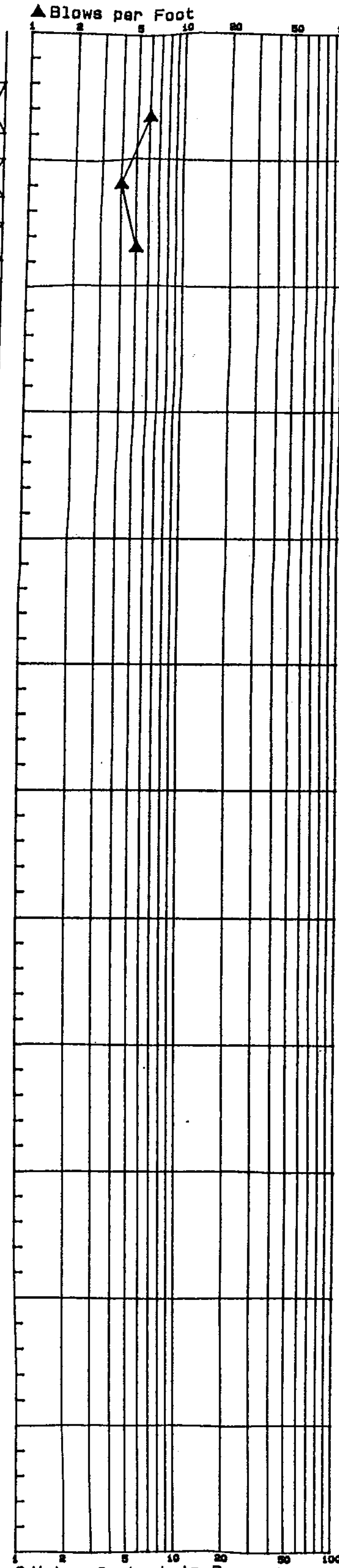
Ground Surface Elevation in Feet

Soil Description	Depth in Feet
0.3 feet ASPHALT over very loose, damp, brown, sandy GRAVEL. (FILL)	0
Very loose, damp, brown, slightly silty SAND with SILT lenses. (FILL)	
Very loose, moist, brown, slightly gravelly SAND. (Natural)	5
Soft, wet, gray-brown to gray, sandy SILT. (Natural)	
Very loose, wet, brown, silty SAND. (Natural)	10
Bottom of Boring at 9.0 Feet. Completed 8/9/88.	

Sample	Lab Tests	H-Nu
S-2.0		0
S-5.0		0
S-7.5	CA	0

STANDARD PENETRATION RESISTANCE

▲ Blows per Foot



● Water Content in Percent

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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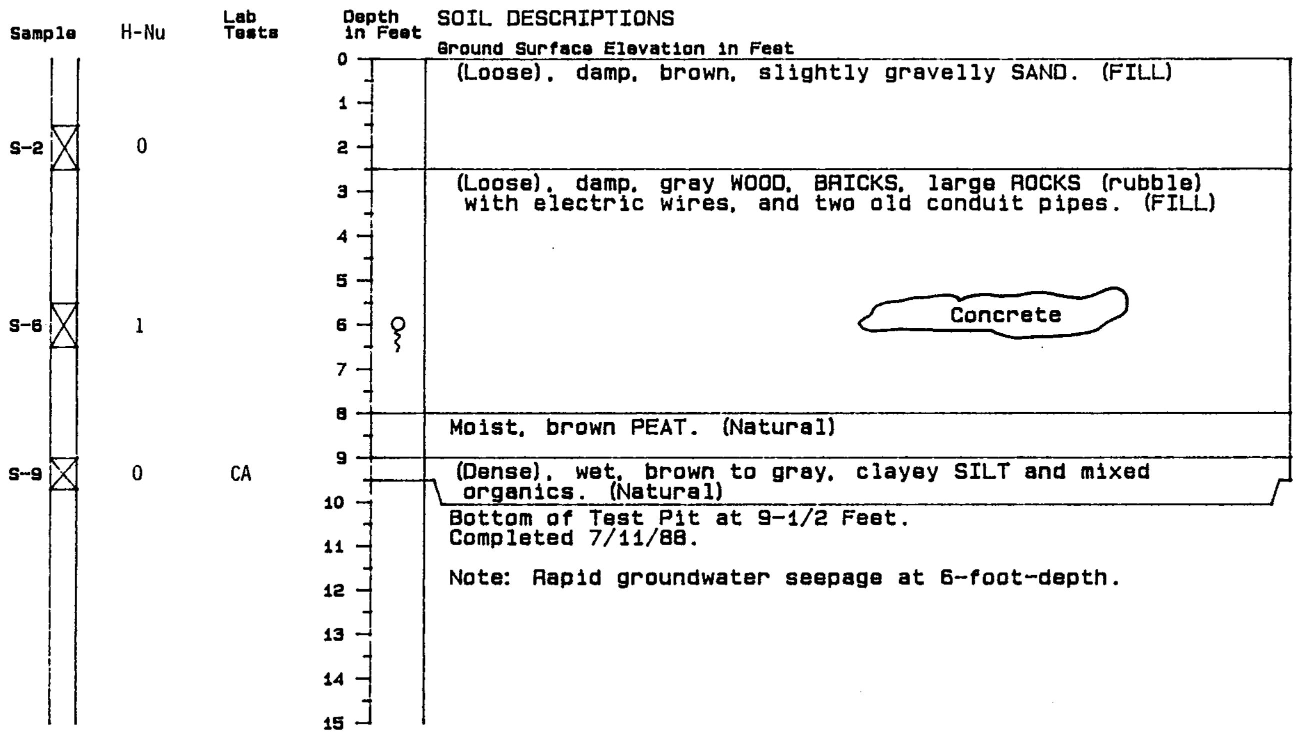
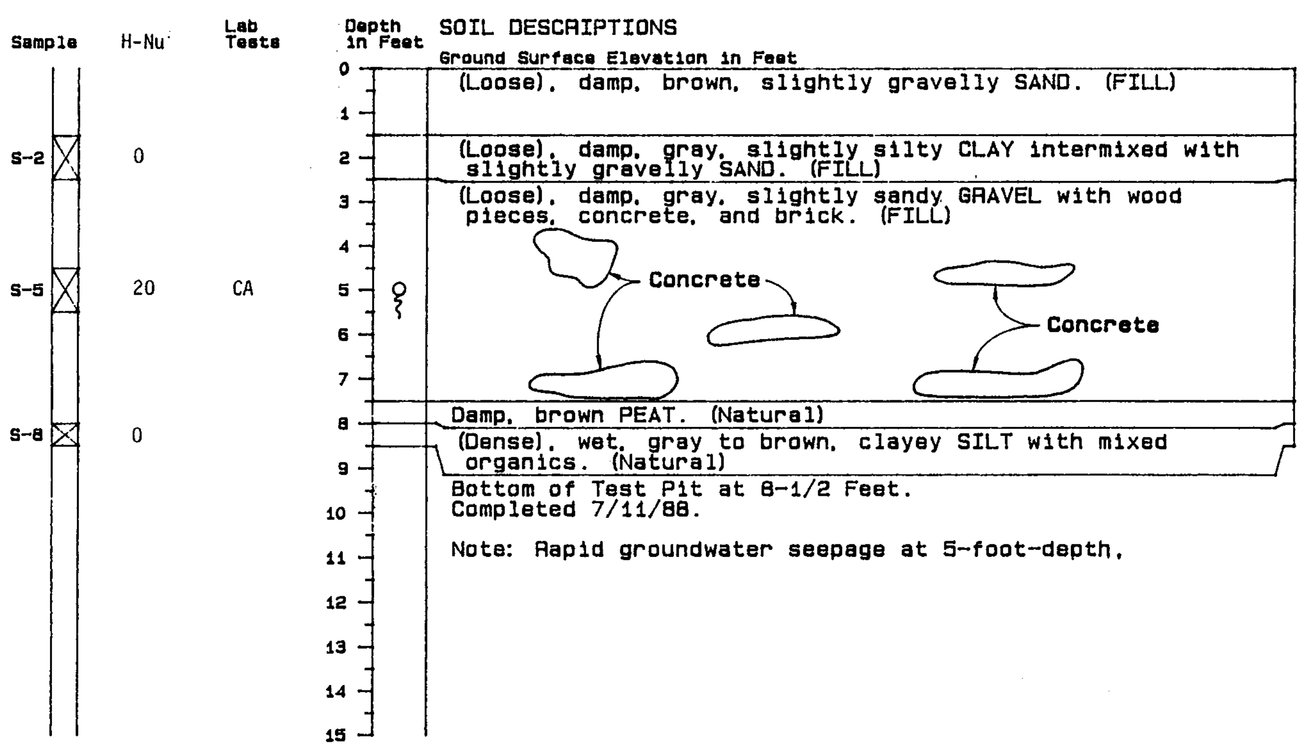
HART-CROWSER & associates, inc.

Figure C-134

Test Pit Log A1/HT01



Test Pit Log A3/HT01



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log A5/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1	0		1
S-4	2	CA	4
S-7	.5		7

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), dry, brown, slightly silty, gravelly SAND. (SW) (FILL)

Wood plank

(Loose), damp, gray, sandy GRAVEL with bricks, slag, large rocks, wood pieces. (FILL)

(Loose), damp, gray, slightly sandy, clayey SILT and mixed organics. (Natural)

(Loose), wet, gray, slightly silty SAND with solvent-like odor.

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/8/88.

Note: Groundwater seepage at 5-1/2-foot-depth.

Test Pit Log A7/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0	CA	2
S-5	0		5
S-8	0		8.5

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Medium dense), damp, brown SAND.

(Loose), damp, black, silty, gravelly SAND to slightly gravelly, silty, medium to fine SAND with cemented sand chunks (oil-like saturated sand), large rocks, brick, little scrap metal.

(Loose), moist, brown PEAT.

(Medium dense), wet, gray, slightly sandy, clayey SILT.

(Medium dense), wet, gray, slightly silty SAND to slightly sandy SILT (ML) with SAND lenses and moderate organics.

Bottom of Test Pit at 9 Feet.
Completed 7/8/88.

Note: Groundwater seepage at 6-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log A9/HT01

Sample	H-Nu	Lab Tests
S-3	0	
S-5	0	
S-7	0	CA

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), dry, brown, slightly sandy GRAVEL. (FILL)

(Loose), damp, brown, gravelly SAND. (FILL)

Moist, gray, medium to fine sandy, clayey SILT. (FILL?)

Wet, gray-brown, slightly gravelly, silty SAND with SILT lenses, peat, and moderate organics. (Natural)

Wet, gray, gravelly SAND. (Natural)

Bottom of Test Pit at 7-1/2 Feet.
Completed 7/8/88.

Note: Groundwater seepage at 7-foot-depth.

Test Pit Log A11/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-4	0	CA
S-7	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Asphalt Log

Damp, brown SAND matrix with wood fragments and cobbles.

Moist, brown-black, clayey, silty SAND with some wood fragments and signs of product. (FILL?)

Wet, gray, silty SAND with some peat and wood fragments. (Natural)

Bottom of Test Pit at 7 Feet.
Completed 6/28/88.

Test Pit Log B5/HT01

Sample	H-Nu	Lab Tests
S-3	25	CA
S-6	1	
S-7.5	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), dry, brown, slightly silty, gravelly SAND. (FILL)

(Loose), moist, black, gravelly SAND with metal filings, pieces of barrel, scrap metal, wire, ash, burnt wood, rocks, brick, and plastic. (FILL)

Moist, dark brown PEAT with moderate roots. (Natural)

(Medium dense), wet, light brown, slightly sandy, clayey SILT and organic SILT with moderate peat, and mixed organics. (Natural)

Bottom of Test Pit at 7-1/2 Feet.
Completed 7/8/88.

Note: Groundwater seepage at 4-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log B7/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	.2		2
S-5	.2		5
S-7	0	CA	7

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Description
0–1.5	Thin layer of ASPHALT at 1/2-foot-depth in dry, brown, gravelly SAND with scrap metal, bricks, and rock.
1.5–5	Damp, black, slightly silty, gravelly SAND and silty, medium to fine SAND (SP) with cemented clay and white sand chunks (oil-like saturated sand), scrap metal. Concrete. Wood sticks
5–6	Damp, brown, slightly gravelly, silty SAND with substantial black oil-like substance.
6–6.5	Wet, gray, slightly sandy, clayey SILT.
6.5–8	Wet, gray, slightly gravelly, slightly silty SAND.

Bottom of Test Pit at 8 Feet.
Completed 7/8/88.

Note: Groundwater seepage at 7-1/2-foot-depth.

Test Pit Log B9/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	7	CA	2
S-4	80		4

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Description
0–1.5	Dry, brown, gravelly, silty SAND. (FILL)
1.5–4.5	Damp, dark brown, gravelly, silty SAND. (FILL) Wood, Buckets, Scrap metal

Bottom of Test Pit at 4-1/2 Feet.
Completed 6/17/88.

Test Pit Log B11/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1	0		1.5
S-4	0		4
S-8	0	CA	8

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Description
0–2	Dry, brown COBBLES and GRAVEL (> 6 inches) over moist, brown, clayey, silty SAND to fine SAND. (FILL)
2–5	Moist, brown COAL, ASH, and CINDER BRICKS with some fine to medium sand. (FILL)
5–7	Wet, brown PEAT. (Natural) Log or large piece of wood, roots.
7–9	Wet, black, clayey, silty, fine to medium SAND. (Natural)

Bottom of Test Pit at 9 Feet.
Completed 6/28/88.

Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log B12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0	Dry, brown, silty GRAVEL. (FILL)
S-1	0		1	(Dense), dry to damp, brown, slightly sandy, gravelly SILT with interbedded SILT/GRAVEL. (Natural)
S-5	0	CA	5	Bottom of Test Pit at 5 Feet. Completed 6/28/88.

Test Pit Log C1/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0	1/2 foot of dry, brown over moist, brown to gray, gravelly, silty SAND with fire bricks, large rocks, wood and pieces of metal. (FILL)
S-2			2	
			3	Wet, black, silty CLAY - appears oily.
S-4	.3		4	Wet, gray, slightly clayey, silty, fine SAND.
S-9	0	CA	9	
			10	Bottom of Test Pit at 10 Feet. Completed 6/27/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log C3/HT01

Sample	H-Nu	Lab Tests
S-1	2.5	CA
S-2.5	12	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	Dry, brown, gravelly, silty SAND. (FILL)
1–2.5	Damp, dark gray, slightly gravelly, silty SAND with bricks, metal straps and pieces, wire, buckets, piece of drum, and rock. (FILL)
2.5–5.5	Damp to wet, black to gray, silty SAND with oily substance. (FILL)
5.5–6	Wet, gray, silty SAND. (Natural SOIL)

Bottom of Test Pit at 6 Feet.
Completed 6/27/88.

Note: Groundwater seepage encountered at 2-1/2-foot-depth.

Test Pit Log C5/HT01

Sample	H-Nu	Lab Tests
S-2	15	
S-4	0	CA
S-6	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1.5	Dry, brown FILL material, predominately gravel with fine to coarse sand. Concrete slab.
1.5–3	Moist, brown to gray GRAVEL mixed with fire bricks, wood logs (ASH) in a moist, black, medium to coarse SAND (Foundary Sand) matrix.
3–4.3	Wet, silver (metallic), gravelly SAND with metal slag and scraps. (FILL)
4.3–7	Wet, gray to brown, silty, fine to medium SAND. (Natural)

Bottom of Test Pit at 7 Feet.
Completed 6/27/88.

Note: Groundwater seepage at bottom of pit.

Test Pit Log C7/HT01

Sample	H-Nu	Lab Tests
S-1	0	CA
S-3	.5	
S-6	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	Dry, brown, silty, sandy GRAVEL. (FILL)
1–2.3	Dry, gray, coarse Foundary SAND with some gravel. (FILL)
2.3–4	Moist, black, silty SAND with minor clay mixed with gravel, some wood fragments, bricks, and metal rods (1/4-inch-diameter). (FILL)
4–7	Wet, gray to black, gravelly, coarse SAND. (Natural)

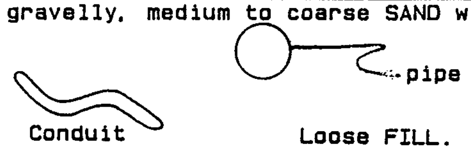
Bottom of Test Pit at 7 Feet.
Completed 6/27/88.

Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log C9/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
			0–2	Dry, brown, sandy GRAVEL with large pebbles. (FILL)
S-2	.5			
S-4	45		2–9	Wet, gray to black, gravelly, medium to coarse SAND with some fine SAND.
S-8	40	CA		
			9	Bottom of Test Pit at 9 Feet. Completed 6/27/88.



Loose FILL.
Caves in easily.

Note: Groundwater seepage at bottom of pit.

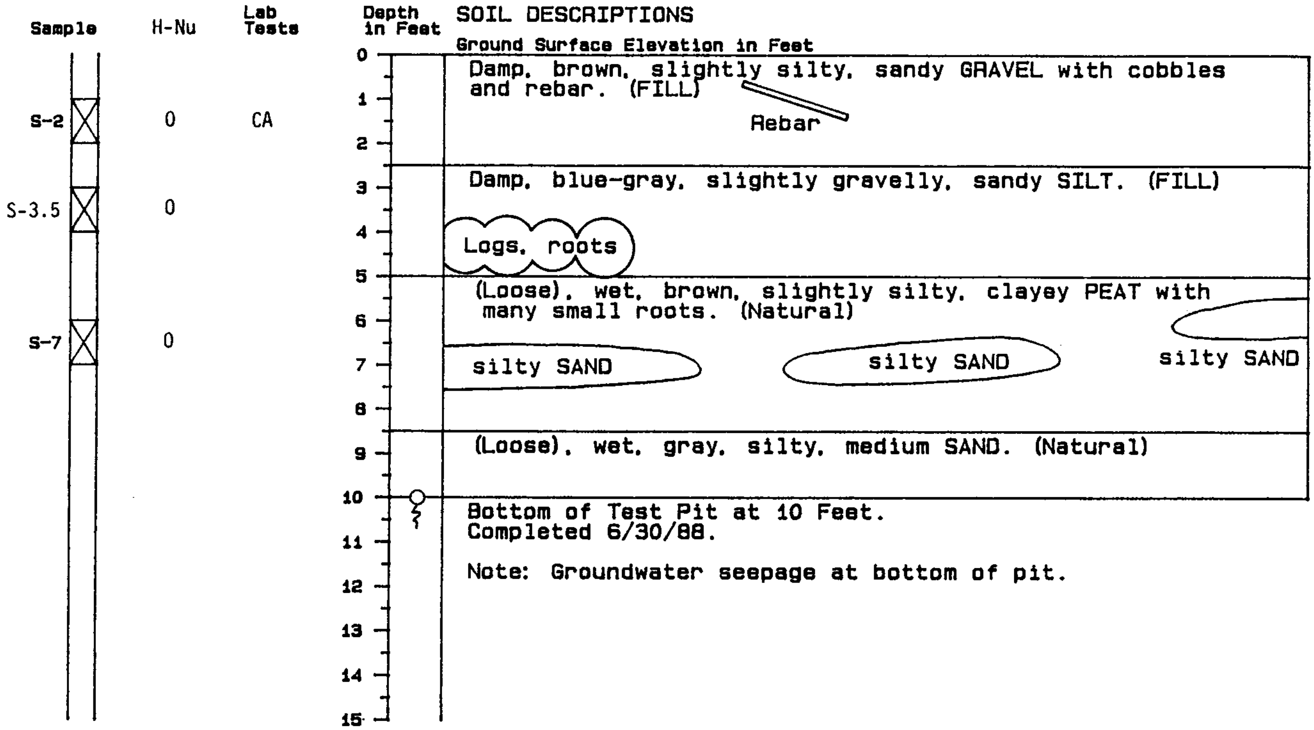
Test Pit Log C11/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
S-1.5	0		0–2	1/2 foot of dry, brown, predominately GRAVEL over a thin layer of dry, brown CINDERS, ASH over dry, brown, gravelly, fine to medium SAND. (FILL)
S-4	0	CA	2–5	Moist, black CINDERS, ASH, COAL, and BRICK. (FILL)
			5–6.5	Wet, brown PEAT mixed with silty clay and wood pieces (6 inches long). (Natural)
S-7	0		6.5–8	Wet, black, gravelly, medium SAND. (Natural)
			8	Bottom of Test Pit at 8 Feet. Completed 6/28/88.

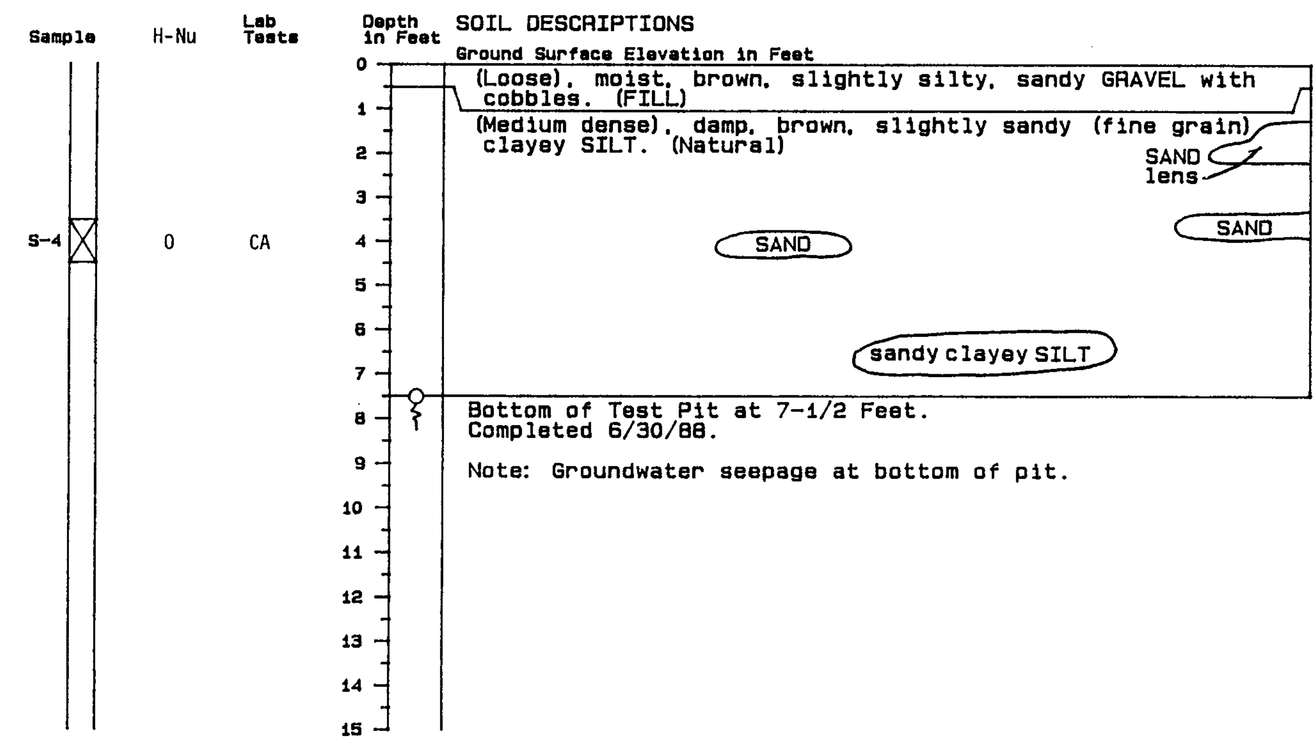
Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log C12/HT01



Test Pit Log C13/HT01



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure C-142

Test Pit Log D1/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0		2
S-5	0	CA	5
S-8	0		8

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Descriptions
0–1	Dry, brown, slightly sandy GRAVEL.
1–4	(Loose), damp, brown to black, slightly silty, gravelly SAND with scrap metal, bricks, large pieces of metal, concrete, wood, and large rocks. (FILL)
4–5	Moist, brown PEAT lens at 4-foot-depth. (Loose), moist, gray, slightly sandy, clayey SILT with mixed organics. (Natural)
5–7	(Loose), wet, gray, slightly silty SAND. (Natural)
7–9	(Loose), wet, gray, slightly sandy, clayey SILT. (Natural)

Bottom of Test Pit at 9 Feet.
Completed 7/7/88.

Note: Groundwater seepage at bottom of pit.

Test Pit Log D3/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-3	1	CA	3
S-5	0		5
S-9	0		9

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Descriptions
0–1	(Loose), dry, brown, slightly, sandy GRAVEL. (FILL)
1–4	(Loose), moist, brown to black, slightly silty, gravelly SAND with bricks, large rocks, metal wire, slag. (FILL) Metal
4–5.5	(Loose), moist, gray to brown, slightly sandy, clayey SILT with mixed organics. (Natural)
5.5–7	(Loose), wet, gray, slightly silty SAND. (Natural)
7–9	(Loose), wet, gray, slightly sandy, clayey SILT. (Natural)

Bottom of Test Pit at 9 Feet.
Completed 7/7/88.

Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log D5/HT01

Ground Surface Elevation in Feet

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0–1	(Loose), dry, brown, slightly sandy GRAVEL. (FILL)
S-2	0		1–3.3	(Loose), damp, gray to black, slightly silty, gravelly SAND with concrete pieces, brick, large rocks, and scrap metal. (FILL)
			3.3–3.5	Damp, brown PEAT.
S-4	2	CA	3.5–4.5	(Loose), damp, gray, slightly fine sandy, clayey SILT with organics intermixed. (Natural)
S-1	0		4.5–10	(Loose), wet, gray, slightly silty, fine SAND with interbedded clayey SILT. (Natural)

Wood

Bottom of Test Pit at 10 Feet.
Completed 7/7/88.

Note: Slow groundwater seepage at 9-foot-depth.

Test Pit Log D7/HT01

Ground Surface Elevation in Feet

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0–1.5	(Loose), dry, brown, slightly sandy GRAVEL. (FILL)
S-2	.5		1.5–2.5	(Loose), damp, black, gravelly SAND with slag, wood, brick, and ash. (FILL)
			2.5–3	Damp, gray, slightly silty SAND.
			3–3.5	Damp, brown PEAT.
S-4	0		3.5–7	(Loose), damp, gray, slightly silty SAND. (Natural)
S-7	0	CA	7–9	Wet, gray, slightly clayey, silty SAND.
			9–9.5	Wet, gray, slightly silty SAND.

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/11/88.

Note: Slow groundwater seepage at 7-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log D9/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0		2
S-5	0	CA	5
S-8	0		8

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

(Loose), dry, brown, slightly sandy GRAVEL. (FILL)

Gray GRAVEL layer.

Damp, gray, slightly silty, fine SAND.

Wood

Moist, brown PEAT.

pipe

(Loose), moist, gray, slightly silty, fine SAND. (Natural)

(Loose), moist, gray, slightly sandy, clayey SILT.

(Loose), wet, gray, slightly silty, coarse SAND.

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/12/88.

Note: Slow groundwater seepage at 7-1/2-foot-depth.

Test Pit Log D11/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1.5	0	CA	1.5
S-4	0		4
S-8	0		8

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

(Dense), dry, brown, slightly silty, sandy GRAVEL. (FILL

Dry, light gray ASH.

Moist, gray to black CINDERS, ASH, COAL, and BRICK. (FILL)

Wet, brown PEAT. (Natural)

(Loose), wet, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 9 Feet.
Completed 6/28/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log D12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-3	0		3
S-7	.5	CA	7
S-1	0		10

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1	Damp, brown, slightly gravelly, sandy, clayey SILT. (FILL)
1–5	(Medium dense), moist, blue-green, slightly sandy, clayey SILT. (FILL)
5–9.5	(Loose), wet, brown PEAT layer in a sandy, SILT matrix, with wood and log fragments, many twigs and roots. (Natural)
9.5–10	(Medium dense), moist, gray, slightly clayey, sandy SILT. (Natural)

Bottom of Test Pit at 10 Feet.
Completed 6/30/88.

Test Pit Log D13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-3	0	CA	3
S-6.5	0		6.5
S-8	0		8

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1	(Loose), damp, brown, slightly silty, sandy GRAVEL with some cobbles. (FILL)
1–6	(Medium dense), moist, blue gray, silty SAND. (FILL)
6–7.5	(Loose), moist, brown, slightly sandy PEAT layer with twigs, root fragments in a silty CLAY matrix. (Natural)
7.5–8.5	(Loose), wet, gray, silty SAND (predominately fine grain). (Natural)

Bottom of Test Pit at 8-1/2 Feet.
Completed 6/30/88.

Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure C-146

Test Pit Log E5/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
			0–1	(Loose), dry, brown, slightly silty, slightly sandy GRAVEL. (FILL)
S-2	0		1–4	(Loose), damp, black, slightly silty, sandy GRAVEL with ash, brick, concrete debris, wood, and slag. (FILL)
S-4.5	0		4–10	(Loose), damp, gray, slightly silty SAND. (Natural)
S-8	0	CA		

Bottom of Test Pit at 10 Feet.
Completed 7/11/88.

Note: Slow groundwater seepage at 5-1/2-foot-depth.

Test Pit Log E6/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
			0–1	(Very loose), dry, brown, slightly sandy GRAVEL. (FILL)
S-2	1.5	CA	1–2.5	(Very loose), damp, black, gravelly SAND with brick, concrete, and ash. (FILL)
			2.5–5.5	(Loose), moist, gray, slightly silty SAND. (Natural) — (Loose) FILL. Pipe
S-5	0		5.5–6.5	Moist, gray, slightly sandy, clayey SILT.
S-8	0		6.5–8.5	Moist, gray, slightly silty SAND.
			8.5–9	Wet, gray, slightly clayey, silty SAND.

Bottom of Test Pit at 9 Feet.
Completed 7/11/88.

Note: Slow groundwater seepage at 8-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log E7/HT01

Sample	H-Nu	Lab Tests
S-1	0	
S-2.5	0	CA
S-6	0	

Depth in Feet: 0–15

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Dry, brown, silty, sandy GRAVEL. (FILL)

Damp, black, gravelly, silty SAND (possible ash).

Damp, brown, silty SAND with pieces of brick. (FILL)

Wet, gray, clayey, silty SAND.

Bottom of Test Pit at 8-1/2 Feet.
Completed 6/17/88.

Test Pit Log E8/HT01

Sample	H-Nu	Lab Tests
S-1	0	
S-4	0	CA
S-7	0	

Depth in Feet: 0–15

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

(Loose), dry, brown, sandy GRAVEL with scrap metal, and wood (some charred). (FILL)

(Loose), damp, gray, slightly silty SAND. (Natural)

(Loose), damp, gray, sandy, clayey SILT.

Wet, gray, slightly silty SAND.

Wet, gray, slightly sandy, clayey SILT.

(Loose), wet, gray, slightly silty SAND.

Bottom of Test Pit at 10 Feet.
Completed 7/11/88.

Note: Slow groundwater seepage at 8-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log E10/HT01

Sample	H-Nu	Lab Tests
S-4	1	CA
S-6	0	
S-8	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), damp, brown to red, slightly sandy GRAVEL. (FILL)

Damp and gray with wood, wire, scrap metal and an old bucket.

Becomes damp and black.

Moist, black, slightly silty, gravelly SAND.

Wet, brown PEAT. (Natural)

Wet, gray, slightly silty, fine SAND with mixed organics (Natural)

Wet, gray, clayey SILT. (Natural)

Wet, gray, slightly silty, coarse to fine SAND. (Natural

Bottom of Test Pit at 8-1/2 Feet.
Completed 7/14/88.

Note: Slow groundwater seepage at 6 and 8-foot-depth.

Test Pit Log E11/HT01

Sample	H-Nu	Lab Tests
S-4	0	CA
S-8	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Dry, brown, silty, sandy GRAVEL.

Moist, black, slightly silty, gravelly SAND with ash and brick.

Wet, brown PEAT.

Wet, brown, slightly sandy, silty CLAY.

Wet, gray, silty SAND.

Bottom of Test Pit at 8 Feet.
Completed 6/28/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log F1/HT01

Sample	H-Nu	Lab Tests
S-2	0	CA
S-4	0	
S-7	0	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–3	(Dense), damp, brown to black, gravelly SAND with brick, scrap metal, slag, and wire mesh. (FILL)
3–4.5	(Medium dense), damp, gray, slightly clayey, sandy SILT.
4.5–9.5	(Medium dense), moist, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/13/88.

Note: Slow groundwater seepage at 8-foot-depth.

Test Pit Log F3/HT01

Sample	H-Nu	Lab Tests
S-2	.5	
S-4	2	CA
S-8	0	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–0.5	Dry, brown, sandy GRAVEL.
0.5–2.5	(Loose), damp, black, slightly gravelly SAND with bricks debris, scrap metal, ash, soil, and wood. (FILL)
2.5–3	Damp, brown PEAT.
3–3.5	Damp, gray, slightly sandy, slightly clayey SILT.
3.5–8	(Loose), moist, gray, slightly silty SAND. (Natural)
8–9.5	(Loose), wet, gray, clayey SILT with mixed organics. (Natural)
9.5–10	(Loose), wet, gray, slightly silty SAND.

Bottom of Test Pit at 10 Feet.
Completed 7/12/88.

Note: Rapid groundwater seepage at 9-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log F4/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	Dry, brown, slightly sandy GRAVEL. (FILL)
S-3	0		1–4	(Loose), damp, black, gravelly SAND with brick, ash, slag, and concrete. (FILL)
			4–4.5	Moist, brown PEAT.
S-5	0		4.5–8	(Loose), moist, gray, slightly silty SAND. (Natural)
S-8	0	CA	8–9.5	(Loose), wet, gray, clayey SILT. (Natural)

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/12/88.

Note: Slow groundwater seepage at 8-foot-depth.

Test Pit Log F5/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	Dry, brown, slightly sandy GRAVEL.
S-2	0		1–2	(Loose), damp, black, slightly sandy GRAVEL with bricks, slag, ash, concrete debris, and large rocks. (FILL)
			2–4	(Loose), damp, black to gray, slightly silty SAND and mixed debris. (FILL)
			4–8	1/4 foot of hard, green ROCK material.
S-5	0	CA		(Loose), moist, gray, slightly silty SAND. (Natural)
S-8	0		8–9.5	(Loose), wet, gray, slightly sandy, clayey SILT. (Natural)

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/12/88.

Note: Very slow groundwater seepage (oily) at 3-foot-depth, and slow at 8-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log F8/HT01

Sample	H-Nu	Lab Tests
S-1	0	
S-2	1.6	CA
S-5	0	

SOIL DESCRIPTIONS (Depth in Feet)

Ground Surface Elevation in Feet

- 0–1.5: (Loose), damp, brown, slightly sandy GRAVEL with charcoal. (FILL)
- 1.5–3: Damp, gray, slightly sandy, clayey SILT. (Natural)
- 3–6: (Medium dense), moist, gray, slightly silty SAND.

Bottom of Test Pit at 6 Feet.
Completed 7/13/88.

Note: Groundwater seepage at bottom of pit.

Test Pit Log F9/HT01

Sample	H-Nu	Lab Tests
S-2	.2	
S-5	1.5	
S-7	1.5	CA

SOIL DESCRIPTIONS (Depth in Feet)

Ground Surface Elevation in Feet

- 0–1: (Loose), damp, brown, slightly silty, gravelly SAND. (FILL)
- 1–2.5: (Dense), damp, black, slightly silty, gravelly SAND with slag, metal filings, piece of graphite, and old water pipes at 1-1/2-foot-depth. (FILL)
- 2.5–3: Damp, brown PEAT.
- 3–5: (Loose), damp, gray, slightly silty, fine to coarse SAND (Natural)
- 5–6: (Loose), moist, gray, slightly sandy, clayey SILT with mixed organics.
- 6–7: (Loose), moist, gray, slightly silty SAND.

Bottom of Test Pit at 7 Feet.
Completed 7/14/88.

Note: Very slow groundwater seepage at 6-1/2-foot-depth.

Test Pit Log F11/HT01

Sample	H-Nu	Lab Tests
S-3	0	
S-5	.5	CA
S-7	0	

SOIL DESCRIPTIONS (Depth in Feet)

Ground Surface Elevation in Feet

- 0–1.5: 1/2 foot FILL over 1/4 foot ASH over (loose), dry, brown gravelly, clayey SILT. (FILL)
- 1.5–4.5: (Medium dense), damp, black COAL, SLAG, CINDERS, and ASH with possible signs of product. (FILL)
- 4.5–5.8: (Loose), moist, brown PEAT with clay and wood fragments. (Natural)
- 5.8–8: (Loose), wet, gray, silty, medium to coarse SAND. (Natural)

Bottom of Test Pit at 8 Feet.
Completed 6/29/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log F12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	(Dense), dry, brown, silty, sandy GRAVEL. (FILL)
			1–4	Damp, brown, slightly clayey, sandy SILT. (FILL)
S-3	0	CA	3–4	
			4–5.5	Damp, gray, slightly clayey, sandy SILT. (FILL)
			5.5–6	Damp, gray to brown PEAT.
			6–8	Damp, gray to brown, slightly clayey, sandy SILT. (FILL)
S-7	0		6.5–7.5	
			8–11	Wet, brown PEAT. (Natural)
S-1	0		10–11	
			11–11.5	(Loose), wet, gray, slightly silty SAND.

Bottom of Test Pit at 11-1/2 Feet.
Completed 7/1/88.

Test Pit Log F13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1.5	(Loose), damp, brown, slightly silty, sandy GRAVEL. (FILL)
			1.5–5	(Dense), damp, brown, slightly gravelly, sandy SILT. (FILL)
S-2	0		1.5–2.5	
S-4	80		3–4	
			5–8.5	Wood fragments at 5-foot-depth. (Dense), damp, brown, sandy SILT. (FILL)
S-8	130	CA	7–8	
			8.5–9	(Loose) PEAT. (Natural)

Bottom of Test Pit at 9 Feet.
Completed 6/30/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log G3/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
			0–1	(Loose), dry, brown, slightly sandy GRAVEL. (FILL)
S-2	6		1–2.5	(Loose), damp, black, slightly gravelly SAND with concrete, and scrap metal debris. (FILL)
			2.5–4	PEAT — Moist, gray, slightly sandy, clayey SILT with mixed organics. — PEAT
S-4	9	CA	4–7	(Loose), moist, gray, slightly silty SAND. (Natural)
S-7	0		7–9.5	(Loose), wet, gray, slightly sandy, clayey SILT with mixed organics.

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/12/88.

Note: Slow groundwater seepage at 7-foot-depth.

Test Pit Log G7/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
S-1	0		0–1.5	(Medium dense), damp, brown, slightly silty, sandy GRAVEL with coal and charcoal. (FILL)
S-4	30	CA	1.5–6.5	(Medium dense), damp, gray, sandy, clayey SILT. (Natural)
			6.5–7	(Medium dense), moist, gray, silty SAND.
S-7	3		7–10	(Medium dense), moist, gray, sandy, clayey SILT.

Bottom of Test Pit at 10 Feet.
Completed 7/13/88.

Note: Slow groundwater seepage at 6-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log G10/HT01

Sample	H-Nu	Lab Tests
S-3	1	CA
S-4	0	
S-7	0	

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet

- Damp, brown, sandy GRAVEL.
- Damp, light gray, silty SAND.
- (Loose), damp, gray, sandy GRAVEL with scrap metal, and wood. (FILL)
- (Dense), moist, black, sandy GRAVEL. (FILL)
- Moist, black PEAT. (Natural)
- Moist, brown, slightly sandy, clayey SILT. (Natural)
- Wet, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 8 Feet.
Completed 7/14/88.

Note: Slow groundwater seepage at 7-foot-depth.

Test Pit Log G11/HT01

Sample	H-Nu	Lab Tests
S-1	0	
S-5	0	
S-7	0	CA

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet

- (Loose), dry, brown, sandy GRAVEL. (FILL)
- (Loose), damp, black COAL, SLAG, CINDERS, and ASH with coal fragments (1 to 2-inch-length). (FILL)
- (Loose), moist, brown PEAT in a silty CLAY matrix. (Natural)
- (Loose), wet, gray, silty, medium to coarse SAND. (Natural)

Bottom of Test Pit at 8 Feet.
Completed 6/29/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log H1/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
S-1	1	CA	0–1.5	(Dense), damp, brown to black, gravelly SAND with brick, scrap metal, and wood. (FILL)
S-4	0		1.5–5	(Medium dense), damp, gray, slightly clayey, sandy SILT with mixed organics. (Natural)
S-7	0		5–9.5	(Medium dense), moist, gray, slightly silty SAND.
			9.5–10	Wet, gray, slightly sandy, clayey SILT.

Bottom of Test Pit at 10 Feet.
Completed 7/13/88.

Note: Very slow groundwater seepage at 8-1/2-foot-depth.

Test Pit Log H6/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
S-1	0		0–1.5	(Loose), damp, brown to black, slightly silty, sandy GRAVEL with brick, metal, coal, and charcoal. (FILL)
S-4	0		1.5–7	(Medium dense), damp, gray, sandy, clayey SILT. (Natural)
S-7	0	CA	7–8	Moist, gray, silty SAND.
			8–10	Moist, gray to brown, sandy, clayey SILT with mixed organics.

Bottom of Test Pit at 10 Feet.
Completed 7/13/88.

Slow groundwater seepage at 7-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log H7/HT01

Sample	H-Nu	Lab Tests
S-1	0	CA
S-3	0	
S-5	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	(Loose), damp, brown to black COAL and CHARCOAL. (FILL)
1–3.5	(Medium dense), damp, gray and brown mottled, sandy, clayey SILT. (Natural)
3.5–4.5	Moist, gray, silty, fine SAND.
4.5–5.5	Moist, gray, sandy, clayey SILT.

Bottom of Test Pit at 5-1/2 Feet.
Completed 7/13/88.

Note: Slow groundwater seepage at bottom of pit.

Test Pit Log H10/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-4	0	
S-7	0	CA

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1.5	(Loose), damp, brown, slightly sandy GRAVEL. (FILL)
1.5–2.5	Wet, gray, slightly sandy GRAVEL.
2.5–3	Wet, brown PEAT.
3–6	Wet, gray, slightly clayey SILT with SAND lenses.
6–8	Wet, gray, slightly silty SAND.

Bottom of Test Pit at 8 Feet.
Completed 7/14/88.

Note: Medium groundwater seepage at 7-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Test Pit Log H11/HT01

Ground Surface Elevation in Feet

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0–1.5	(Loose), dry, brown, silty, sandy GRAVEL. (FILL)
S-3	.5		1.5–6	Moist, black to brown, slightly silty SAND with cinders ash, fire bricks, wood fragments, and large coal and slag fragments. (FILL)
S-5.5	9	CA	5.5–6.5	Oily substance, signs of product, metal scraps.
S-7	1		6–8	(Loose to medium stiff), wet, brown PEAT in a silty CLAY matrix with root fragments (~1 to 2-foot-length). (Natural)
			8–9.5	(Loose), wet, gray, silty SAND. (Natural)

Bottom of Test Pit at 9-1/2 Feet.
Completed 6/29/88.

Test Pit Log H12/HT01

Ground Surface Elevation in Feet

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS
			0–0.5	Dry, brown, slightly silty, slightly sandy GRAVEL. (FILL)
S-2	0		0.5–4.5	Damp, gray to brown, slightly sandy, clayey SILT. (FILL)
S-4	0	CA		
			4.5–6.5	Damp, brown, gravelly, silty SAND with peat, wood, metal and brick pieces. (FILL)
			6.5–8	Damp, brown PEAT. (Natural)
S-8	0		8–9.5	(Loose), moist, gray, slightly silty SAND with some interbedded peat. (Natural)

Bottom of Test Pit at 9-1/2 Feet.
Completed 7/1/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log H13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	(Loose), dry, brown, slightly silty, sandy GRAVEL. (FILL)
			1–2	(Loose), dry, brown, slightly silty, gravelly SAND.
S-2	0	CA	2–3	(Dense), damp, brown, silty, fine SAND with some gravel.
S-4	0		3–8	(Dense), damp, brown to gray, slightly gravelly, slightly clayey, sandy SILT.
S-6	0		~6.5	Rock and wood pieces.
			8–9	Damp, dark brown PEAT. (Natural)
			9–10	(Loose), damp, gray, slightly silty SAND with interbedded PEAT. (Natural)

Bottom of Test Pit at 10 Feet.
Completed 7/1/88.

Note: Groundwater seepage encountered at 9-foot-depth.

Test Pit Log I5/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	(Loose), damp, brown, sandy GRAVEL. (FILL)
S-2	0		1–3	(Loose), damp, brown to black, slightly gravelly, silty SAND with brick debris, scrap metal, and charcoal. (FILL)
S-4	0		3–6.5	1/4 foot of moist, brown PEAT. Wet, gray, silty CLAY with SAND lenses and mixed organics. (Natural)
S-6	0	CA	6.5–8.5	Wet, gray, slightly clayey SILT with SAND lenses.

Bottom of Test Pit at 8-1/2 Feet.
Completed 7/18/88.

Note: Slow groundwater seepage at 6-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log I11/HT01

Sample	H-Nu	Lab Tests
S-2	3	CA
S-4	1.5	
S-6	2	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	(Loose), dry, brown, sandy GRAVEL. (FILL)
1–3.5	(Loose), damp, black COAL, CINDER, ASH, BRICKS, and METAL fragments. (FILL)
3.5–7	(Very loose), moist, orange to white, fine SAND (Foundary Sand) with many fire bricks and signs of product in matrix. (FILL)
7–8.5	(Medium dense), wet, brown PEAT with silty clay. (Natural)
8.5–10	(Loose), wet, gray, silty SAND. (Natural)

Bottom of Test Pit at 10 Feet.
Completed 6/29/88.

Note: Groundwater seepage at bottom of pit.

Test Pit Log J4/HT01

Sample	H-Nu	Lab Tests
S-2	0	CA
S-4	0	
S-6	.5	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–0.6	(Loose), damp, brown, sandy GRAVEL.
0.6–2	(Loose), damp, brown, slightly gravelly SAND with charcoal, brick, and scrap metal.
2–5	(Loose), wet, gray, slightly CLAY with SAND lenses and mixed organics.
5–7	(Loose), wet, gray, sandy GRAVEL.

Bottom of Test Pit at 7 Feet.
Completed 7/18/88.

Note: Fast groundwater seepage at 5-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log J11/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-5	0	
S-7	0	CA

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1.5	(Loose), damp, brown, slightly sandy GRAVEL. (FILL)
1.5–3	(Dense), damp, black, sandy GRAVEL with brick debris, metal, and slag. (FILL)
3–3.8	Moist, brown PEAT. (Natural)
3.8–8	Wet, gray, slightly silty, fine SAND with SILT lenses and mixed organics.

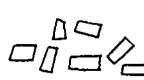
Bottom of Test Pit at 8 Feet.
Completed 7/14/88.

Note: Very slow groundwater seepage at 7-foot-depth.

Test Pit Log J12/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-4	5	
S-6.5	40	CA

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	(Loose), dry, tan to brown, sandy GRAVEL. (FILL)
1–3.5	(Medium stiff), damp, brown, slightly gravelly, silty, CLAY. (FILL)
3.5–8	(Medium dense), damp, brown to black, slightly gravelly, medium to coarse SAND with some clay, bricks, cinders, slag, and coal. (FILL)
8–9.5	Moist, brown PEAT with silty clay and logs (3-inch-diameter, 1 to 2-foot-length) on surface layer. (Natural)
9.5–10	(Medium dense), moist, gray, silty, medium SAND. (Natural)



Bottom of Test Pit at 10 Feet.
Completed 6/29/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log J13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–2	(Loose), dry, brown to gray, slightly silty, sandy GRAVEL. (FILL)
S-3	0		2–4	(Dense), damp, brown to gray, slightly sandy, clayey SILT. (FILL)
S-6	0	CA	4–7.5	(Dense), damp, gray, slightly sandy, slightly clayey SILT. (FILL) Wood.
S-8	0		7.5–9.5	(Loose), damp, brown PEAT. (Natural)
			9.5–11	(Loose), damp, gray, slightly silty SAND.

Bottom of Test Pit at 11 Feet.
Completed 7/5/88.

Test Pit Log K3/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
S-2	0		0–2.8	(Loose), damp, brown, slightly silty, gravelly SAND with brick debris, and charred wood. (FILL)
			2.8–3.2	Moist, brown PEAT.
S-4	0	CA	3.2–6	Moist, gray and brown mottled, clayey SILT with SAND lenses. (Natural)
			6–7	Wet, gray, clayey SILT with SAND lenses.
S-8	0			

Bottom of Test Pit at 7 Feet.
Completed 7/15/88.

Note: Very slow groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log K4/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-4	0	
S-7	0	CA

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), damp, brown, sandy GRAVEL.

(Dense), damp, brown to black, gravelly SAND with slag, some debris, and pieces of lumber. (FILL)

1/4 foot of damp, brown PEAT.

Moist, gray, silty SAND.

Moist, gray, slightly sandy, clayey SILT.

Wet, gray, silty, fine SAND.

Bottom of Test Pit at 8 Feet.
Completed 7/15/88.

Note: Slow groundwater seepage at bottom of pit.

Test Pit Log K11/HT01

Sample	H-Nu	Lab Tests
S-2	15	CA
S-4	0	
S-7	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), damp, gray, slightly sandy GRAVEL. (FILL)

Damp, black, slightly sandy GRAVEL.

(Dense), damp, black, gravelly SAND with scrap metal, and brick debris. (FILL)

Moist, brown PEAT.

Wet, gray, slightly silty SAND with SILT lenses and mixed organics.

Bottom of Test Pit at 7-1/2 Feet.
Completed 7/14/88.

Note: Slow groundwater seepage at 6-1/2-foot-depth.

Test Pit Log L3/HT01

Sample	H-Nu	Lab Tests
S-2	0	CA
S-4	0	
S-7	0	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), damp, brown, sandy GRAVEL. (FILL)

(Loose), damp, black, slightly gravelly SAND with scrap metal. (FILL)

(Dense), dry SLAG, COAL, and BRICK debris. (FILL)

1/4 foot of moist, brown PEAT.
Moist, gray, slightly sandy, clayey SILT with SAND lenses. (Natural)

Wet, gray, fine sandy SILT with SAND lenses.

Bottom of Test Pit at 7-1/2 Feet.
Completed 7/15/88.

Note: Very slow groundwater seepage at 7-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log L4/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-3.5	0	CA
S-7	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0 – 2.2	(Loose), damp, brown to black, slightly gravelly SAND with brick debris (charred) and scrap metal.
2.2 – 4.8	(Loose), wet, gray mottled, slightly silty SAND. (Natural)
4.8 – 6	Wet, gray, slightly sandy, clayey SILT.
6 – 7	Wet, gray, slightly silty, fine SAND.

Bottom of Test Pit at 7 Feet.
Completed 7/18/88.

Note: Slow groundwater seepage at bottom of pit.

Test Pit Log L12/HT01

Sample	H-Nu	Lab Tests
S-2	0	CA
S-6	0	
S-9	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0 – 1	(Very loose), dry, brown, slightly silty, slightly sandy GRAVEL.
1 – 3	(Loose), damp, brown to gray, slightly sandy, clayey SILT with some gravel.
3 – 7.5	(Loose), damp, gray, slightly sandy, clayey SILT. Wood
7.5 – 9	(Loose), damp, brown PEAT. (Natural)
9 – 10	(Loose to medium dense), damp, gray, slightly silty SAND (Natural)

Bottom of Test Pit at 10 Feet.
Completed 7/5/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log L13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-3	0		~2.5
S-5	0		~5
S-9	0	CA	~9.5

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1	(Loose), dry, brown, slightly silty, slightly sandy GRAVEL.
1–3	(Dense), damp, brown, slightly sandy, clayey SILT. (FILL)
3–3.5	Damp, gray, slightly silty SAND.
3.5–7	(Dense), damp, gray, sandy, clayey SILT. (FILL) Wood; Wood
7–8.5	Damp, brown PEAT. (Natural)
8.5–10	(Loose), damp, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 10 Feet.
Completed 7/5/88.

Test Pit Log M3/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0	CA	~2.5
S-4	0		~4
S-8	0		~7.5

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1.5	(Loose), damp, brown, sandy GRAVEL. (FILL)
1.5–3	Damp, black, slightly gravelly SAND with brick debris and scrap metal.
3–3.5	Damp, gray SLAG/DEBRIS .
3.5–4.5	Damp, gray, slightly sandy, clayey SILT.
4.5–5	Moist, gray, silty SAND. (Natural)
5–6	Moist, mottled gray, slightly sandy, clayey SILT.
6–8.5	Wet, gray, silty, fine SAND.

Bottom of Test Pit at 8-1/2 Feet.
Completed 7/15/88.

Note: Groundwater seepage at 8-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log M4/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-4	0	
S-8	0	CA

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), dry, brown to black, slightly gravelly SAND with brick debris and large amount of scrap metal. (FILL)

(Loose), moist, mottled gray, slightly silty SAND. (Natural)

(Loose), wet, gray, slightly sandy, clayey SILT.

(Loose), wet, gray, silty SAND.

Bottom of Test Pit at 8-1/2 Feet.
Completed 7/18/88.

Note: Very slow groundwater seepage at bottom of pit.

Test Pit Log M11/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-3	0	
S-7	0	CA

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Very loose), dry, brown, slightly sandy GRAVEL.

(Loose), damp, brown, gravelly SAND with large amount of slag and charcoal. (FILL)

(Loose), moist, brown PEAT. (Natural)

(Loose), wet, gray, silty SAND. (Natural)

(Loose), wet, gray, slightly clayey, sandy SILT.

(Medium dense), wet, gray, silty SAND.

Bottom of Test Pit at 7-1/2 Feet.
Completed 7/19/88.

Note: Slow groundwater seepage at bottom of pit.

Test Pit Log N4/HT01

Sample	H-Nu	Lab Tests
S-2	160	
S-5	100	CA
S-8	1	

Depth in Feet: 0–9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

(Loose), dry, gray, sandy GRAVEL. (FILL)

(Loose), damp, black, slightly gravelly SAND.

Damp, brown, slightly sandy, silty CLAY. (Natural)

Damp, brown to gray mottled, slightly silty SAND.

Wet, gray, slightly sandy, clayey SILT.

Bottom of Test Pit at 8 Feet.
Completed 7/18/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log N12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1	0		1–2
S-4	2	CA	3.5–4.5
S-8	.5		7–8

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1	(Loose), dry, brown, slightly silty, slightly sandy GRAVEL. (FILL)
1–1.8	Damp, gray, slightly sandy, clayey SILT. (FILL)
1.8–8	(Loose), damp, black BRICKS, ASH, CONCRETE, METAL, GLASS and WOOD PLANKS. (FILL) Wood
8–9	Moist, brown PEAT.

Bottom of Test Pit at 9 Feet.
Completed 7/5/88.

Note: Groundwater seepage with oily sheen at 7-foot-depth.

Test Pit Log N13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-3	.5	CA	2–3
S-6	.5		6–7
S-1	0		9.5–10.5

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet	Soil Description
0–1	Dry, brown, slightly silty, slightly sandy GRAVEL. (FILL)
1–3	(Dense), damp, gray and brown, slighlty sandy, clayey SILT. (FILL)
3–4.5	(Dense), damp, gray, sandy, clayey SILT. (FILL)
4.5–8	(Loose), moist, gray to black, slighlty silty SAND with organic material intermixed. (FILL) Wood
8–9	Moist, brown PEAT. (Natural)
9–10.5	(Loose), moist, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 10-1/2 Feet.
Completed 7/5/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

TEST PIT LOGS
HART CROWSER (1989)
FIGURES C-174 THROUGH C-177

Test Pit Log P11/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	8	CA	2
S-4	.5		3.5
S-7	0		6.5

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Description
0–2	Dry, brown, sandy GRAVEL with scrap metal and wood.
2–2.5	Moist and black with oily appearance.
2.5–3	Moist, brown PEAT.
3–5.5	Wet, gray, slightly clayey, sandy SILT with SAND lenses and mixed organics.
5.5–7	Wet, gray, slightly silty SAND.

Bottom of Test Pit at 7 Feet.
Completed 7/18/88.

Note: Rapid groundwater seepage at 6-1/2-foot-depth.

Test Pit Log P12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0		2
S-4	0		4.5
S-7	0	CA	6.5

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet

Depth in Feet	Description
0–1	(Loose), dry, brown, slightly sandy GRAVEL. (FILL)
1–3	(Loose), damp, gray to black, slightly silty, gravelly SAND. (FILL)
3–4	Moist, brown PEAT. (Natural)
4–5.5	(Dense), moist, gray, slightly sandy, clayey SILT. (Natural)
5.5–7	(Loose), wet, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 7 Feet.
Completed 7/6/88.

Note: Water seeping into trench at 7-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log P13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1	(Loose), dry, brown, slightly silty, sandy GRAVEL. (FILL)
S-2	0		2	(Loose), damp, black, slightly gravelly, silty SAND with ash, metal slag, metal. (FILL) Slag, Slag, Wood, Ash
S-5	2.5	CA	5	
			8	Damp, brown PEAT. (Natural)
S-1	0		9–10	(Loose), damp, gray, sandy GRAVEL. (Natural)
			10	Bottom of Test Pit at 10 Feet. Completed 7/6/88.

Test Pit Log Q5/HT01

Sample	H-Nu	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
			0–1.5	1/2 foot of ASPHALT/CONCRETE over dry, brown, gravelly, silty SAND. (FILL)
S-2	25		1.5	Damp, gray to green, slightly sandy, silty CLAY. sewer pipe (unused?)
S-4	1.5	CA	4	Silty CLAY with minor sand and some wood.
S-6	0		8	
			10	Bottom of Test Pit at 10 Feet. Completed 6/17/88. Note: Groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log R5/HT01

Sample	H-Nu	Lab Tests
S-2	4	
S-4	35	
S-7	30	CA

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	(Loose), damp, brown, sandy GRAVEL.
1–3	(Very loose), moist, brown to gray, gravelly SAND and intermixed clayey SILT with brick debris and concrete.
3–5.5	Thin layer of tar-like substance. (Medium dense), wet, gray, slightly sandy, clayey SILT.
5.5–7	(Loose), wet, gray, slightly sandy GRAVEL with oily substance.

Bottom of Test Pit at 7 Feet.
Completed 7/15/88.

Note: Fast groundwater seepage at 5-1/2-foot-depth.

Test Pit Log R12/HT01

Sample	H-Nu	Lab Tests
S-1	0	
S-3	0	CA
S-7	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0–1	(Loose), damp, brown, slightly sandy GRAVEL. (FILL)
1–2	(Loose), damp, black, slightly silty, gravelly SAND with ash and charcoal. (FILL)
2–3.5	Damp, brown PEAT with wood. (FILL?)
3.5–5	(Loose), damp, gray, slighlty sandy, clayey SILT. (Natural)
5–7	(Loose), damp, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 7 Feet.
Completed 7/5/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log R13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0		2
S-6	0	CA	6
S-10	0		10

Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
0	(Loose), dry, black to gray, slightly sandy GRAVEL. (FILL)
1	(Loose), dry, brown FILL.
2	(Loose), damp, black, slightly silty SAND with bricks, ash, wood pieces, wire, charcoal, and a paint bucket. (FILL)
7	COAL.
7	Damp, brown PEAT. (Natural)
8.5	(Loose), damp, brown, sandy GRAVEL. (Natural)
10	Bottom of Test Pit at 10 Feet. Completed 7/6/88.

Test Pit Log S7/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-2	0		2
S-4	0	CA	4
S-7	0		7

Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet)
0	(Loose), dry, brown, gravelly SAND. (FILL)
1	(Loose), moist, brown to black, gravelly SAND with mixed coal. (FILL)
3.5	Moist, brown PEAT.
4	(Loose), wet, gray, slightly sandy, clayey SILT. (Natural)
6	(Loose), wet, gray, slightly silty SAND.
8	Bottom of Test Pit at 8 Feet. Completed 7/19/88.

Note: Very slow groundwater seepage at bottom of pit.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

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Figure C-171

Test Pit Log T7/HT01

Sample	H-Nu	Lab Tests
S-2	0	
S-3	0	
S-7	0	CA

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0	(Very loose), dry, brown, gravelly SAND. (FILL)
1	(Loose), damp, brown to black, gravelly SAND with wood, brick pieces, and coal.
2	Moist, brown PEAT. / PEAT.
3	(Loose), wet, gray to brown, slightly sandy, clayey SILT
4	(Loose), wet, gray, slightly silty, medium to coarse SAND.
7	Bottom of Test Pit at 7 Feet. Completed 7/19/88.
9	Note: Slow groundwater seepage at bottom of pit.

Test Pit Log T13/HT01

Sample	H-Nu	Lab Tests
S-2	0	CA
S-4	0	
S-6	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0	Dry, brown, slightly sandy GRAVEL. (FILL)
1.5	CHARCOAL.
2	Dry, red, gravelly SAND with brick pieces. (FILL)
2.5	Dry, brown, slightly silty, gravelly SAND. (FILL)
3	Moist, brown PEAT. (FILL?)
4	(Dense), moist, gray, slightly sandy, clayey SILT. (Natural)
4.5	(Loose), moist, brown, slightly silty SAND. (Natural)
6.5	Bottom of Test Pit at 6-1/2 Feet. Completed 7/6/88.

Test Pit Log U7/HT01

Sample	H-Nu	Lab Tests
S-1	0	CA
S-4	0	
S-7	0	

Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet
0	(Loose), dry, brown, gravelly SAND with some burnt coals (FILL) Concrete footing / Concrete footing
2.5	Damp, brown PEAT.
3	(Loose), wet, brown to gray, slightly sandy, clayey SILT (Natural)
4	Wet, gray, slightly silty SAND. (Natural)
6	Wet, gray, slightly sandy, clayey SILT. (Natural)
7	Bottom of Test Pit at 7 Feet. Completed 7/19/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

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HART-CROWSER & associates, inc.
Figure C-172

Test Pit Log V12/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1.5	.2		1.5
S-3	0		3
S-6	0	CA	6

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet (approx.)	Soil Description
0–1	(Loose), dry, brown, slightly sandy GRAVEL. (FILL)
1–2	(Loose), damp, brown, slightly silty, gravelly SAND with metal pieces. (FILL)
2–2.5	Black ASH.
2.5–3	Moist, brown PEAT.
3–4	(Dense), moist, gray, slightly sandy, clayey SILT. (Natural)
4–6.5	(Loose), moist, gray, slightly silty SAND. (Natural)

Bottom of Test Pit at 6-1/2 Feet.
Completed 7/7/88.

Test Pit Log V13/HT01

Sample	H-Nu	Lab Tests	Depth in Feet
S-1	0		1
S-3	0		3
S-6	0	CA	6

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Depth in Feet (approx.)	Soil Description
0–2	GRAVEL surface over dry, brown with metal scrap, scrap, and white substance in soil.
2–2.5	PEAT.
2.5–3	Moist, gray, slightly silty SAND.
3–5	(Loose), moist, brown, slightly sandy GRAVEL. (Natural)
5–6	(Loose), wet, brown, slightly silty SAND with some wood. (Natural)
6–10	(Loose), wet, gray, slightly sandy GRAVEL. (Natural)

Bottom of Test Pit at 10 feet.
Completed 7/7/88.

Note: Groundwater seepage filled trench from 7-1/2-foot-depth.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log TP-1

Sample	Water Content in Percent	H-Nu in ppm
S-1	10	0.4
S-2	8	0.3
S-3	11	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet 36

Depth in Feet	Soil Description
0–4.5	(Very dense), moist, brown, slightly clayey, gravelly, silty SAND with some cobbles.
4.5–7	(Dense), moist to wet, brown, slightly silty, sandy GRAVEL.
7–8	(Dense), moist to wet, brown, slightly silty, gravelly SAND.
8	Bottom of Test Pit at 8 Feet. Completed 1/19/89.

Test Pit Log TP-2

Sample	Water Content in Percent	H-Nu in ppm
S-1	19	2.0
S-2	207	10
S-3	50	20
S-4	252	
S-5	25	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet 36

Depth in Feet	Soil Description
0–3.5	(Stiff), moist, brown, slightly sandy SILT with occasional cobbles.
3.5–6	(Soft), wet, dark brown PEAT with wood fragments.
6–9	(Soft), wet, gray-brown, fine sandy SILT and (loose), wet, gray, very silty SAND with moderate organics (fine roots).
9–10	(Soft), wet, dark brown PEAT.
10–10.5	(Medium dense), moist, gray, very silty, fine SAND.
10.5	Bottom of Test Pit at 10-1/2 Feet. Completed 1/19/89.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

HARTCROWSER
J-2330 1/89
Figure C-174

Test Pit Log TP-3

Sample	Water Content in Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet 36)
S-1	16		0–1.5	(Loose), wet, brown, gravelly, silty, fine to medium SAND with moderate organics. (FILL)
			1.5–6	(Soft), wet, dark brown PEAT. Rubber tire.
S-2	474			
S-3	43		6–7	(Soft), wet, gray SILT with moderate organics.
S-4	29		7–8	(Loose to medium dense), wet, gray, silty, fine SAND.
S-5	46		8–11	(Soft), wet, gray SILT with moderate organics.
			11	Bottom of Test Pit at 11 Feet. Completed 1/19/89.

Test Pit Log TP-4

Sample	Water Content in Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS (Ground Surface Elevation in Feet 36)
S-1	15		0–5.5	Interbedded (medium dense), moist, brown-gray, very silty, SAND and (medium stiff), moist, gray-brown, sandy SILT. (FILL)
S-2	101		5.5–7	(Soft), wet, brown, fine sandy SILT and (loose), wet, dark brownPEAT with wood fragments.
S-3	37		7–10	(Loose), wet, gray, slightly silty to silty SAND with slight to moderate organics.
			10	Bottom of Test Pit at 10 Feet. Completed 1/19/89.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

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J-2330 1/89
Figure C-175

Test Pit Log TP-5

Sample	Water Content in Percent	Lab Tests
S-1	6	
S-2	17	
S-3	147	
S-4	26	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet 37

Depth in Feet	SOIL DESCRIPTIONS
0–1	(Medium dense), moist, brown, sandy, fine GRAVEL. (FILL)
1–2	(Medium dense), moist, brown, silty, fine to medium SAND.
2–4	(Stiff), moist, gray SILT with moderate organics.
4–5.5	(Loose), moist to wet, gray, slightly silty, fine SAND.
5.5–7	(Soft), dark brown PEAT with (soft), moist to wet, gray, sandy SILT.
7–8.5	(Soft), wet, dark brown PEAT with (soft), gray SILT interbeds with organics.
8.5–9.5	(Medium dense), wet, gray, slightly silty, fine SAND grading to (medium dense), wet, gray, sandy GRAVEL.

Bottom of Test pit at 9-1/2 Feet.
Completed 1/19/89.

Test Pit Log TP-6

Sample	Water Content in Percent	Lab Tests
S-1	9	
S-2	23	
S-3	116	
S-4	10	

SOIL DESCRIPTIONS
Ground Surface Elevation in Feet 39

Depth in Feet	SOIL DESCRIPTIONS
0–1.5	(Medium dense), moist, brown, sandy GRAVEL with silt pockets.
1.5–6.5	(Medium stiff), moist, brown, slightly sandy SILT.
6.5–9	(Medium stiff), wet, brown SILT with (soft), wet, dark brown PEAT.
9–10	(Loose), wet, gray, sandy GRAVEL with some cobbles.

Bottom of Test Pit at 10 Feet.
Completed 1/19/89.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

Test Pit Log TP-7

Sample	Water Content in Percent	Lab Tests	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Eleavtion in Feet 39
			0–1	(Medium dense), moist, gray CRUSHED ROCK.
S-1	11		1–2.5	(Medium dense to dense), moist, brown-gray, silty, gravelly, fine to medium SAND (slightly organic).
			2.5–7	(Loose), moist to wet, gray, slightly silty, slightly gravelly, fine to medium SAND.
S-2	310		7–8.8	(Soft), wet, dark brown PEAT.
S-3	31		8.8–10	(Loose), wet, gray, very silty, fine SAND with slight to moderate organics.
				Bottom of Test Pit at 10 Feet. Completed 1/20/89.

Test Pit Log TP-8

Sample	Water Content in Percent	H-Nu in ppm	Depth in Feet	SOIL DESCRIPTIONS Ground Surface Elevation in Feet 39
S-1	9		0–2	(Medium dense), gray-brown, silty, gravelly SAND with slight organics.
S-2	16		2–4	(Stiff), moist, gray, slightly fine sandy SILT with slight organics.
S-3	11		4–7	(Loose), moist, black, silty, fine SAND.
			7–8	SAND with brick, brush, and wood fragments.
S-4	309		8–9	(Soft), wet, dark brown PEAT.
S-5	27		9–10	(Soft), wet, brown SILT with slight to moderate organics.
			10–10.5	(Loose), wet, gray, slightly silty, fine gravelly, coarse SAND with slight organics.
				Bottom of Test Pit at 10-1/2 Feet. Completed 1/20/89.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater conditions, if indicated, are at time of excavation. Conditions may vary with time.

SOIL BORING LOGS
LB-1 THROUGH LB-28
LANDAU ASSOCIATES (1986)

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LB-1

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev.* 27.3
0.0-0.2		Asphalt.
0.2-4.0	GM	Gray silty GRAVEL (very dense) (fill).
4.0-5.5	SP	Black fine SAND (loose) (fill).
5.5-6.0	PT	Brown PEAT with traces of silt (medium stiff).
6.0-6.5	SP	Black poorly graded fine SAND (loose) (fill).
6.5-8.5	PT	Brown PEAT (soft).
8.5-9.0	ML	Gray SILT with brown root fibers and trace of fine sand (soft).
		End of boring at 9.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count**	Description
223	0.0-1.5	50/3"	Gray very dense silty GRAVEL.
224	1.5-3.0	39	Gray to black silty GRAVEL.
225	4.5-6.0	9	Black poorly graded fine SAND and 4-inch peat layer.
226	6.0-7.5	4	Black poorly graded fine SAND over a 4-inch PEAT and SILT layer; grading to gray fine sand.
227	7.5-9.0	2	Brown PEAT and gray SILT with root fibers and trace of fine sand.

* Elevations based on City of Renton datum.
** Blows required to drive a 2.5-inch I.D. ring sampler 1 foot with a hammer weight of 300 pounds and a stroke of 30 inches.

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LB-2

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.2
0.0-6.5	SP	Black fine SAND with gravel and trace of metal; yellow and red mottles (very dense) (fill).
6.5-7.2	PT/ML	Alternating layers of brown PEAT and gray SILT (soft).
7.2-8.0	SP	Gray fine SAND (very loose).
8.0-8.75	ML	Gray SILT with brown root fibers (soft).
8.75-9.0	SP	Gray fine SAND (loose).
		End of boring at 9.0 feet.

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LB-2

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
228	0.0-1.5	56/3"	Black poorly graded fine SAND with gravel, trace of metal debris, and bright yellow and red mottles of sandy material.
233	2.0-3.0	17/4"	Boring 3 feet north of original boring LB-2. Black poorly graded SAND with mottles of bright yellow and red material and some white cemented material. HNU reads 0.
229	3.0-4.5	3	Black fine SAND. HNU reads 100 in sample. Face area over sample for bottles reads approximately 7. Face area at drill rig reads 4.
234	3.0-4.5	4	Boring 3 feet north of original LB-2. HNU reads 1.4. No sample obtained.
230	4.5-6.0	2	Black fine SAND. HNU reads 3 at sample.
231	6.0-7.5	3	Black fine SAND (saturated) over alternating 5-inch layers of brown PEAT and gray SILT; gray fine SAND in sample bit. HNU at sample reads 90-100 and reads 1-2 at face.
232	7.5-9.0	4	Gray fine SAND, and gray SILT with brown root fibers.

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LB-3

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.5
0.0-1.5	SW	Brown fine to coarse SAND (dense) (fill).
1.5-3.0	SP	Black SAND with gravel, ashes, nails, and chunks of wood (medium dense) (fill).
3.0-4.5	SP	Black fine SAND with gravel and metallic slag. Wood fibers (soft) (fill).
4.5-5.9	PT	Brown PEAT (very soft).
5.9-6.0	SM	Sandy SILT (very soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
235	0.0-1.5	32	Brown fine to coarse SAND.
236	1.5-3.0	13	Black fine SAND with gravel, 238 ashes, nails, and chunks of wood; HNU reads 0-1; Duplicate with sample # 238.
239	3.0-4.5	2	Black fine SAND with gravel and metallic slag.
237	4.5-6.0	1	Brown PEAT with trace of sandy silt in bit (natural material).

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LB-4

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.3
0.0-0.3		Asphalt.
0.3-7.5	GM	Gray silty sandy GRAVEL (medium dense) (fill).
7.5-10.0	SP	Gray fine SAND with some gravel and trace of peat (very loose) (saturated) (fill).
10.0-11.5	PT/ML	Alternating layers of PEAT and SILT (soft).
		End of boring at 11.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
216	0.0-1.5	23	Gray silty sandy GRAVEL.
217	1.5-3.0	16	Gray silty sandy GRAVEL with one large black mottle of ash.
218	3.0-4.5	45	Gray silty sandy GRAVEL.
219	4.5-6.0	41	Gray silty sandy GRAVEL with cemented grains.
220	6.0-7.0	8	Gray silty sandy GRAVEL with white cemented grains.
221*	7.5-9.0	4	Gray fine SAND with some gravel and trace of peat.
222*	9.0-10.5	2	Gray fine SAND with gravel and wood fiber debris from 9.0-9.75 feet. Alternating layers of peat and silt from 9.75 to 10.5 feet.

* Samples obtained from boring 4 feet east of original LB-4.

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LB-5

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 26.9
0.0-4.5	SP	Brown fine SAND with some gravel and rusty metal, ash, and traces of small metal flakes (medium dense) (fill).
4.5-6.0	PT	Brown fibrous PEAT (soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
213	0.0-1.5	34	Brown fine SAND with some gravel and one piece of rusty metal.
214	1.5-3.0	16	Brown fine SAND with some gravel, traces of black ash and small metallic flakes.
215	3.0-4.0	3	Black fine SAND, saturated with a slight odor.

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LB-6

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.3
0.0-4.75	SW	Brown and black fine to coarse SAND with ash and burn debris (medium dense) (fill).
4.75-5.2	PT	Brown PEAT (very soft).
5.2-5.75	ML	Gray SILT (very soft).
5.75-6.0	PT	Brown PEAT (very soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
240	0.0-1.5	34	Brown grading to black fine to coarse SAND. Ash and burn debris at approximately 1.5 feet.
241	1.5-3.0	6	Black well-graded SAND with ash, debris and a piece of fire brick.
242	3.0-4.5	7	Insufficient material to sample after six attempts.
243	4.5-6.0	--	Fine to coarse SAND fill with 3-inch PEAT layer and 6-inch gray SILT layer.

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LB-7

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 26.6
0.0-3.5	SW	Brown grading to black well-graded SAND with gravel (medium dense) (fill).
3.5-5.0	ML	Brownish gray SILT (soft).
5.0-6.0	SP	Gray fine SAND (very loose).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
199	0.0-1.5	37	Brown grading to black well-graded SAND with gravel.
200	1.5-3.0	12	Black well-graded SAND with gravel, chunks of wood, and mild petroleum odor.
201	3.0-4.5	3	Black well-graded SAND with gravel, (petroleum odor) grading to gray SILT.
---	4.5-6.0	4	Gray poorly graded fine SAND.

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LB-8

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.1
0.0-0.5	SW	Brown fine to coarse SAND with gravel (medium dense) (fill).
0.5-2.5	ML/SP	Black SILT and gray fine SAND with debris and brick fragments (loose) (fill).
2.5-3.25	SP	Gray fine SAND (loose) (fill).
3.25-3.75	GM	Gray silty GRAVEL (loose).
3.75-4.0	SP	Gray fine SAND (loose).
4.0-4.25	GM	Gray silty GRAVEL (loose).
4.25-4.5	PT	Brown PEAT (medium stiff).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
196	0.0-1.5	15	Brown well-graded SAND with gravel, black silt, and gray poorly graded fine sand.
197	1.5-3.0	9	Black SILT with debris, chunk of brick and gray poorly graded fine sand.
198	3.0-4.5	7	Layers of gray silty GRAVEL and gray poorly graded fine SAND with peat in sample bit.

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LB-9

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 38.6
0.0-1.5	GW	Brown well-graded GRAVEL (medium dense) (fill).
1.5-2.5	SW	Brown well-graded SAND with gravel (medium dense) (fill).
2.5-4.5	SM	Gray silty SAND with trace of peat and wood debris (medium dense) (fill).
4.5-9.0	CL	Gray and brown CLAY (stiff) (fill).
9.0-11.0	SC	Brown sandy CLAY with trace of wood debris (soft) (fill).
11.0-12.0	PT	Brown fibrous PEAT with 2-inch layer of gray fine SAND (soft).
		End of boring at 12.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
248	0.0-1.5	39	Brown well-graded GRAVEL.
249	1.5-3.0	30	Brown well-graded SAND with gravel over gray silty sand with trace of peat.
250	3.0-4.5	18	Gray silty SAND with some gravel and a chunk of charred wood.
251	4.5-6.0	14	Gray and brown stiff CLAY.
---	6.0-7.5	4	Concrete fragment in bit. Insufficient material to sample.
252	7.5-9.0	2/18"	Gray brown clay with trace of wood debris.
253	9.0-10.5	3	Brown sandy CLAY with trace of wood debris.
254	10.5-12.0	2	Brown PEAT with 2-inch layer of gray fine sand.

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LB-10

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.4
0.0-0.5		Gravel and cobble surfacing.
0.5-3.0	SP	Brown fine SAND with some gravel (loose) (fill).
3.0-5.0	SP	Gray fine SAND with root fibers (very loose) (fill).
5.0-5.5	ML	Gray SILT with roots (soft).
5.5-6.0	SP	Gray fine SAND (very loose).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
244	0.0-1.5	10	Brown fine SAND with some gravel.
245	1.5-3.0	5	Brown grading to black very fine SAND with some gravel and few rust mottles.
246	3.0-4.5	3	Gray fine SAND with root fibers and some brown sand in waste barrel.
247	4.5-6.0	4	Gray soft SILT over fine sand.

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LB-11

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.0
0.0-2.0	SW	Brown grading to black well-graded SAND with some gravel (loose) (fill).
2.0-3.0	ML	Brownish-gray SILT (soft).
3.0-4.5	SP	Gray poorly graded fine SAND with few large rust colored mottles (medium dense).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
194	0.0-1.5	10	Brown to black well-graded SAND with gravel.
195	1.5-3.0	4	Black well-graded SAND over brownish gray silt; saturated just above the silt contact.
---	3.0-4.5	16	Gray poorly graded fine SAND with few large rust-colored mottles.

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LB-12

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.1
0.0-0.5	GW	Grayish-brown well-graded GRAVEL (medium dense) (fill).
0.5-2.5	SW	Black well-graded SAND (medium dense) (fill).
2.5-4.5	ML	Gray SILT with trace of very fine sand (very soft).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
191	0.0-1.5	34	Grayish-brown well-graded GRAVEL and black well-graded sand with strong odor.
192	1.5-3.0	4	Black well-graded SAND with a very strong odor and trace of silt in bit.
193	3.0-4.5	2/18"	Gray SILT with trace of fine sand. Sample obtained in bo ing 2 feet southwest of original LB-12.

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LB-13

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.1
0.0-0.2		Asphalt.
0.2-3.5	SP	Dark brown medium SAND with gravel and brick fragments (dense) (fill).
3.5-6.75	SP	Gray fine SAND (medium dense).
6.75-7.5	ML	Brown SILT (soft).
		End of boring at 7.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
202	0.0-1.5	54	Dark brown medium SAND with gravel and 2-inch layer of brick fragments.
203	1.5-3.0	14	Brown medium SAND with brick fragments and some gravel.
204	3.0-4.5	2	Brown medium SAND with brick fragments and burn products at contact with gray fine sand.
---	4.5-6.0	27	Gray fine SAND.
205	6.0-7.5		Gray fine SAND with brown silt chemical odor detected.

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LB-14

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 19.7
0.0-3.0	SP	Brown gravelly medium SAND (medium dense) (fill).
3.0-6.0	SP	Gray silty fine SAND (loose).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
206	0.0-1.5	33	Brown gravelly medium SAND.
207	1.5-3.0	19	Brown gravelly medium SAND.
208	3.0-4.5	11	Brownish-black cinder layer above gray silty fine SAND.
---	4.5-6.0	2	Gray silty fine SAND.

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LB-15

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.0
0.0-0.2		Gravel surfacing.
0.2-1.0	SW	Brown well-graded SAND (very loose) (fill).
1.0-2.0		Burn debris and ash (very soft) (fill).
2.0-4.5	SP	Brown fine SAND with rust colored mottles (loose).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
189	0.0-1.5	2	GRAVEL and well-graded SAND with burn debris and ash.
190	1.5-3.0	3	Burn debris and some mottled brown and rust fine SAND.
---	3.0-4.5	8	Brown to gray fine SAND.

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LB-16

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.9
0.0-1.5	SW	Brown well-graded SAND with black and colored mottles (loose) (fill).
1.5-3.2	PT	Brown fibrous PEAT (soft).
3.2-4.5	ML	Gray SILT with root fibers (very soft).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
255	0.0-1.5	13	Brown well-graded SAND with black and rust colored mottles.
256	1.5-3.0	3	Brown fibrous PEAT.
---	3.0-4.5	1/18"	Gray SILT with root fibers.

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LB-17

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 33.5
0.0-0.2		Asphalt.
0.2-1.5	SP	Gray fine SAND with gravel (dense) (fill).
1.5-4.0		Black ash debris and cream-colored silt-type material (stiff) (fill).
4.0-5.0	SP	Gray medium SAND (loose).
5.0-5.5	PT	Brown fibrous PEAT (very soft).
5.5-6.0	ML	Gray SILT (very soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
257	0.0-1.5	53	Gray poorly graded fine SAND with gravel and slight petroleum odor immediately under asphalt.
258	1.5-3.0	11	Black ash debris with 1-inch layer of colored silt-type material.
259	3.0-4.5	5	Black ash debris and gray medium SAND.
260	4.5-6.0	2/18"	Brown fibrous PEAT and gray SILT.

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LB-18

Sample Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 31.2
0.0-1.0	GW	Brown well-graded GRAVEL (medium dense) (fill).
1.0-2.0	SP	Black fine SAND (medium dense) (fill).
2.0-3.5	PT	Brown fibrous PEAT (soft).
3.5-4.2	ML	Brown SILT with root fibers (very soft).
4.2-4.5	SP	Gray fine SAND (very soft).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
266	0.0-1.5	17	Brown well-graded GRAVEL and black fine SAND.
267	1.5-3.0	2	Black poorly graded fine SAND (saturated) with petroleum odor and brown fibrous PEAT. Duplicate with sample # 268.
268	1.5-3.0		Duplicate with sample # 267.
---	3.0-4.5	2/18"	Brown fibrous PEAT, brown grading to gray SILT with root fibers and gray fine SAND.

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LB-19

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.7
0.0-0.5		Concrete.
0.5-2.0	SP	Brown fine SAND with black and red colored mottles (very loose) (fill).
2.0-4.0	PT	Brown fibrous PEAT (very soft).
4.0-5.0	ML	Gray SILT with root fibers (soft).
		End of boring at 5.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
269	0.5-2.0	1/12"	Brown poorly graded fine SAND with black and red mottles.
---	2.0-3.5	1	Brown fibrous PEAT. Insufficient material to sample.
270	3.5-5.0	2	Brown PEAT and gray SILT with root fibers.

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LB-20

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.2
0.0-0.1		Asphalt.
0.1-3.5	SW	Blackish-brown well-graded SAND with burn debris (loose) (fill).
3.5-4.5	ML	Gray-brown SILT (very soft).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
186	0.0-1.5	5	Blackish-brown well-graded SAND with burn debris.
187	1.5-3.0	3	Black well-graded SAND with some silt and burn debris.
188	3.0-4.5	1/18"	Black well-graded SAND with some fines and gray-brown SILT.

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LB-21

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.2
0.0-0.5		Concrete.
0.5-1.5	SW	Brown well-graded SAND with occasional gravel (very loose) (fill).
1.5-3.0	PT	Brown PEAT (very soft).
3.0-5.0	SP	Gray fine SAND with roots (very loose).
5.0-6.5	ML	Gray SILT with roots (very soft).
		End of boring at 6.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
273	0.5-2.0	1/12"	Brown well-graded SAND with occasional gravel and brown PEAT.
---	2.0-2.5	2	Brown well-graded SAND, brown PEAT and gray SILT with 2-inch burn cinder. Insufficient material to sample.
274	3.5-5.0	3	Gray poorly graded fine SAND with roots.
275	5.0-6.5	1/18"	Gray SILT with roots.

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LB-22

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 32.0
0.0-0.2		Asphalt.
0.2-3.5	GW	Brown well-graded GRAVEL with trace of asphalt (loose) (fill).
3.5-4.5	SM	Brown-gray silty SAND (very loose).
		End of boring at 4.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
183	0.0-1.5	10	Brown well-graded GRAVEL with trace of asphalt.
184	1.5-3.0	10	Brown well-graded GRAVEL with traces of asphalt.
185	3.0-4.5	2/13"	Brown-gray silty SAND with rust colored mottles. Only natural material placed in sample jars.

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LB-23

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.6
0.0-0.5		Concrete.
0.5-1.5		Black burn debris (fill).
1.5-2.25	ML	Brownish gray SILT (soft).
2.25-2.75	PT	Brown fibrous PEAT (soft).
2.75-3.2	ML	Brownish-gray SILT (soft).
3.2-3.5	PT	Brown PEAT (soft).
		End of boring at 3.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
271	0.5-2.0	3	Black burn debris and brownish-gray SILT.
272	2.0-3.5	2	Alternating layers of brown fibrous PEAT and brownish-gray SILT.

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LB-24

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 33.2
0.0-0.2		Asphalt.
0.2-6.5	SP	Brown fine SAND with rusty metal debris (medium dense) (fill).
6.5-8.0	SP	Gray fine SAND with trace of root (loose).
8.0-8.5	ML	Gray SILT (soft).
8.5-9.0	SP	Gray fine SAND (very loose).
		End of boring at 9.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
261	0.0-1.5	15✓	Brown fine SAND with rusty metal debris.
262	1.5-3.0	4	Brown fine SAND with rusty metal debris.
---	3.0-4.5	7	Brown poorly graded fine SAND with metal debris. Insufficient material to sample.
263	4.5-6.0	14	Brown fine SAND with trace of metal debris.
264	6.0-7.5	8✓	Brown to gray poorly graded fine SAND with trace of roots in gray sand.
265	7.5-9.0	3	Gray fine SAND with 4-inch layer of SILT and trace of peat.

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LB-25

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.5
0.0-3.5	SP/SM	Dark brown silty medium SAND with some gravel, foundry cinders, wood chips, and other waste (loose) (fill).
3.5-4.5	SP	Gray fine SAND (very loose).
4.5-6.0	ML	Gray SILT (soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
209	0.0-1.5	5	Dark brown silty medium SAND with some gravel, foundry slag, and burn products.
210	1.5-3.0	2	Dark brown silty medium SAND with some gravel, burn material, and wood fragments; slight odor.
211	3.0-4.0	2	Dark brown silty medium SAND and gray fine sand.
212	4.5-6.0	3	Gray fine SAND grading to gray silt.

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LB-26

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 27.8
0.0-3.5	SW	Black well-graded SAND with brick debris (loose) (fill).
3.5-6.0	ML	Brown to gray SILT with trace of PEAT (soft).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
276	0.0-1.5	11	Black well-graded SAND with brick debris. HNU reads 2 to 3.
277	1.5-3.0	5	Black well-graded SAND and burn debris. HNU reads 3 to 5. Duplicate with sample # 278.
278	1.5-3.0		Duplicate with sample # 277.
279	3.0-4.5	4	Black well-graded SAND with burn debris and brown to gray SILT with trace of peat.
280	4.5-6.0	2	Gray SILT with some fine sand and roots.

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LB-27

Sample Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 26.7
0.0-1.75	SW	Brown to black well-graded SAND with gravel, trace of silt, and debris (very dense) (fill).
1.75-2.75	PT	PEAT and wood debris (soft).
2.75-3.0	ML	Gray SILT (very soft).
3.0-3.5	SW	Black fine to coarse SAND and debris (very loose). Debris could be carried down from above.
3.5-4.5	ML	Gray SILT with trace of fine sand (soft).
4.5-6.0	SP	Gray fine SAND (medium dense).
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
281	0.0-1.5	76	Brown to black well-graded SAND with gravel, trace of silt and debris.
282	1.5-3.0	2	Black well-graded SAND with debris, peat, and wood debris; gray silt in bit.
283	3.0-4.5	2/18"	Black well-graded SAND, debris, gray SILT, and trace of sand.
284	4.5-6.0	18	Gray poorly graded fine SAND.

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LB-28

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 27.6
0.0-3.5	SW	Brown to black well-graded SAND with gravel and ash debris (medium dense) (fill).
3.5-4.5	ML	Brown SILT (soft).
4.5-6.0	SP	Gray fine SAND.
		End of boring at 6.0 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
285	0.0-1.5	27	Brown to black well-graded SAND with gravel.
286	1.5-3.0	12	Black well-graded SAND with gravel and trace of red fine sand-like material (very moist).
287	3.0-4.5	2	Black well-graded SAND, ash debris, and brown silt with petroleum odor. HNU reads 3. Saturated above the silt layer. Duplicate with sample # 288.
288	3.0-4.5		Duplicate with sample # 287.
289	4.5-6.9	--	Gray poorly graded fine SAND.

APPENDIX D
WELL DATA

CONTENTS

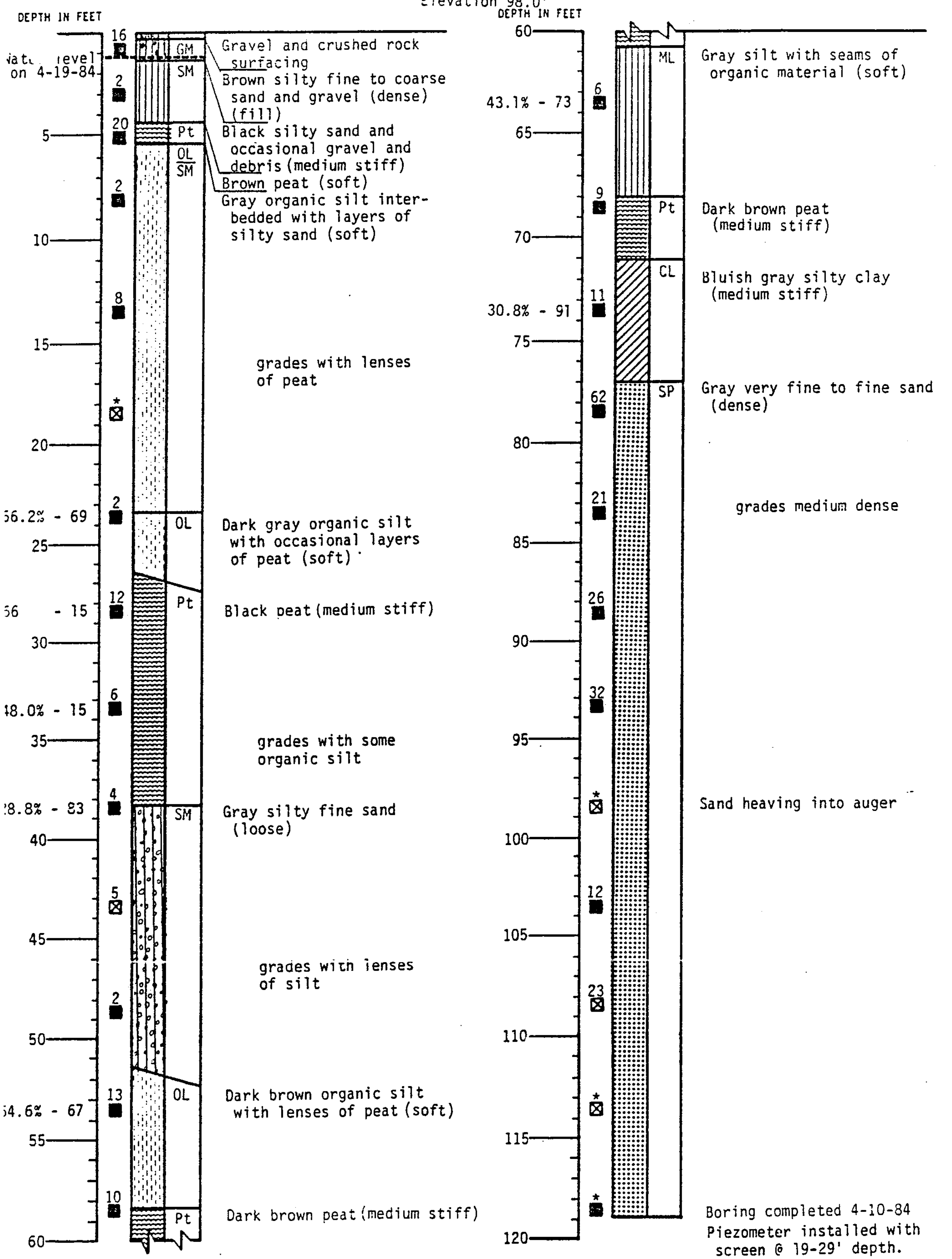
Page

APPENDIX D
WELL DATA

WELLS DM-2, DM-3, AND DM-5
DAMES & MOORE (1984)

Boring 2

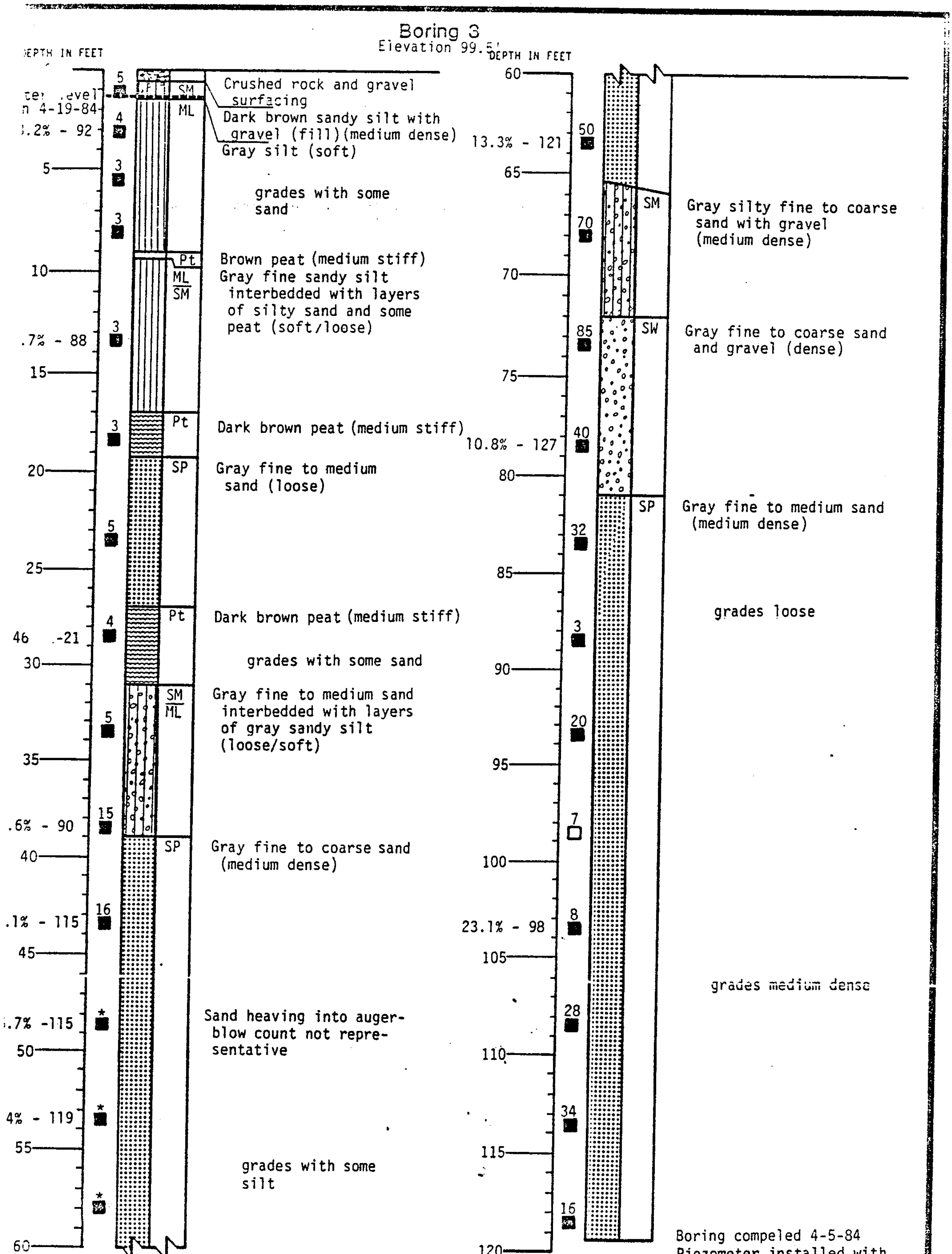
Elevation 98.0'



LOG OF BORINGS

Dames & Moore

No. 3391-027

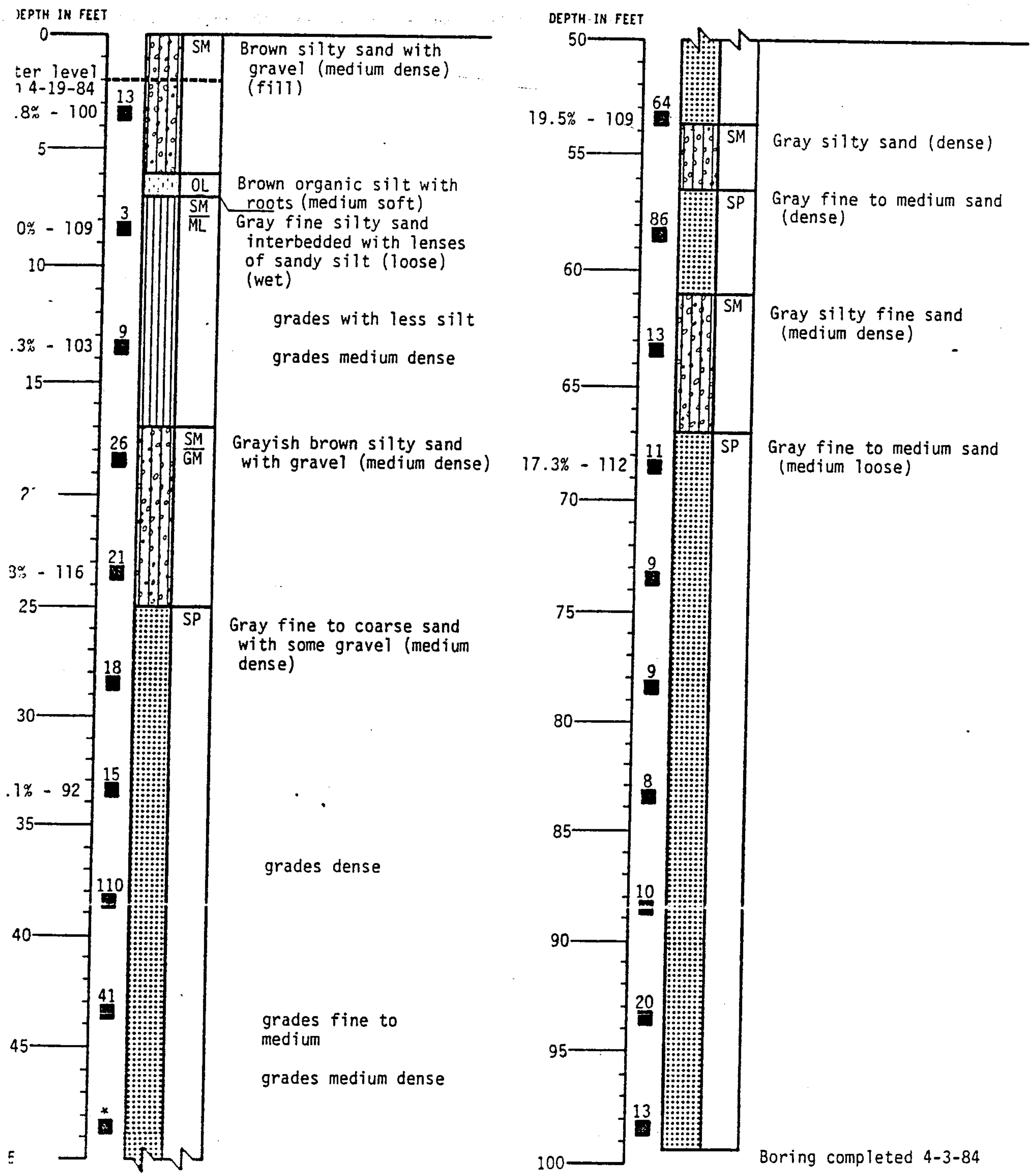


LOG OF BORINGS

Dames & Moore

No. 3391-027

Boring 5
Elevation 109.6'



Boring completed 4-3-84

Piezometer installed with screen at 60-70' depth

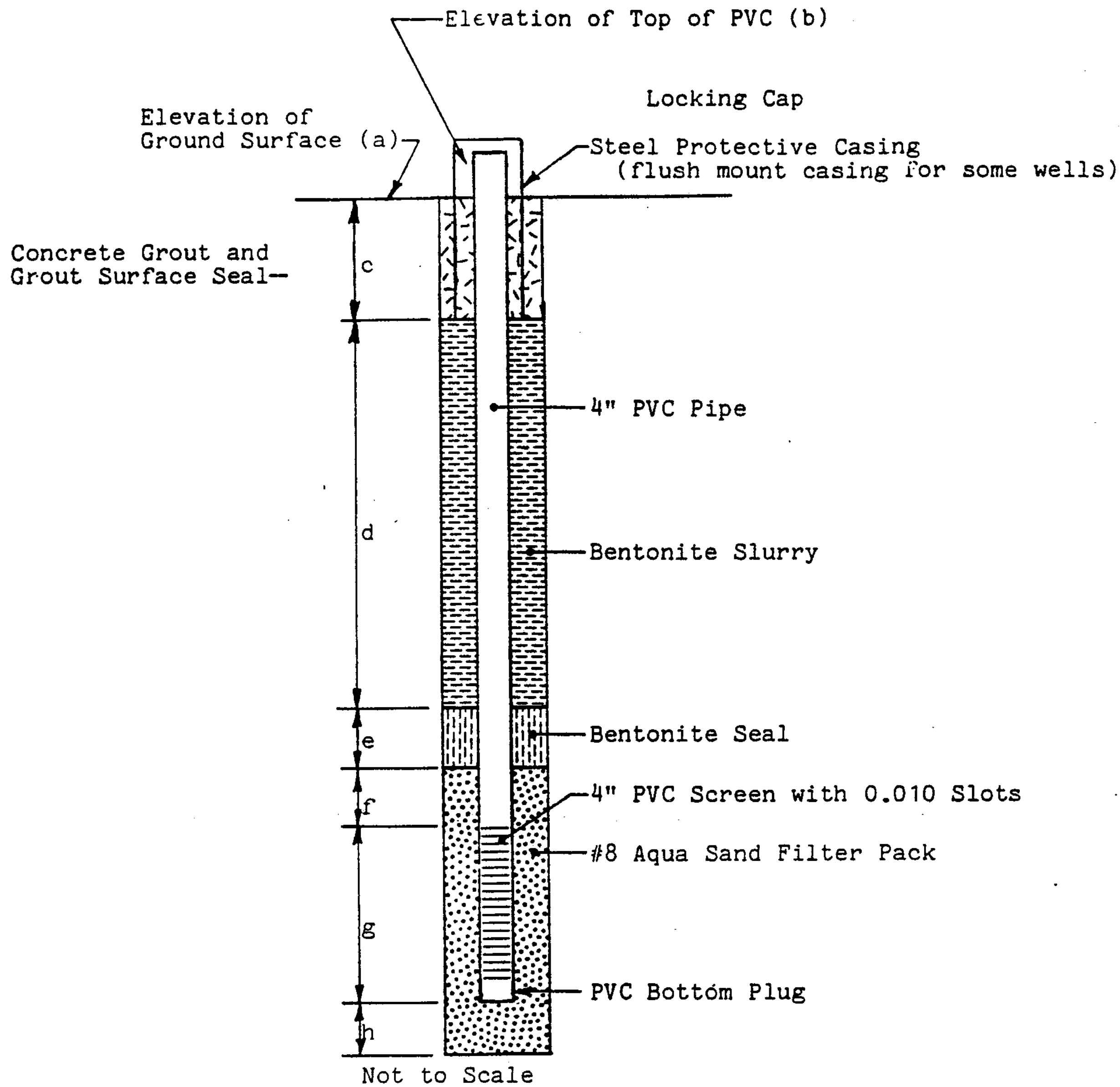
LOG OF BORINGS

Dames & Moore

o. 3391-027

WELLS LW1-S THROUGH LW15-S
AND LW5-VS AND LW11-VS
LANDAU ASSOCIATES (1986)

DRAFT



NOTE: Refer to Table for Dimensions

LANDAU ASSOCIATES, INC.	TYPICAL SHALLOW MONITORING WELL CONSTRUCTION DETAILS

Figure

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LW1-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 26.4* ft.
0-2.5	SM	Dark brown silty SAND with gravel (dense) (fill).
2.5-6.3	SP	Black grading to gray fine SAND (medium dense).
6.3-7.5	PT/ML	Brown fibrous PEAT with alternating layers of brown-gray SILT (very soft).
		End of boring at 7.5 feet, 7/8/86

Sample Detail

Sample#	Depth (feet)	Blow Count**	Description
157	0-1.5	34	Dark brown silty SAND with gravel.
158	1.5-3.0	36	Dark brown silty SAND with gravel and black to gray poorly graded fine SAND.
159	3.0-4.5	13	Gray poorly graded fine SAND with approximately 3-inches of carried down fill at top of sample.
160	4.5-5.5	3	Gray poorly graded fine SAND.
161	6.0-7.5	2/18"	Brown fibrous PEAT with alternating layers of silt.

* Elevations based on City of Renton datum.

** Blows required to drive a 2.5-inch ID ring sampler 1 foot with a hammer weight of 300 pounds and a stroke of 30 inches.

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LW2-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 27.9 ft.
0-3.5	SP	Brown fine SAND with some gravel (medium dense) (fill).
3.5-4.5	SP	Fine SAND grading to medium SAND (very loose).
4.5-5.5	PT	Brown PEAT with plant fibers (very soft).
5.5-14.0	SM	Brown to gray silty to fine SAND (very loose).
		End of boring at 14.0 feet, 6/27/86

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
114	0-1.5	16	Brown fine SAND with some gravel.
115	1.5-2.5	22	Brown fine SAND with some gravel and traces of old brick.
116	3-4.5	1	Fine SAND grading to medium SAND and PEAT.
117	4.5-6.0	2/18"	Brown PEAT with plant fibers and brown to gray silty fine SAND.
---	12.5-13.0	1/18"	Gray silty fine SAND.

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LW3-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.6 ft.
0-4.5	GW	Brown sandy GRAVEL (very dense) (fill) grades to black with traces of gray silt at 3.0 ft. (loose).
4.5-5.5	PT	Brown fibrous PEAT (soft).
5.5-9.0	ML	Gray silt (soft).
9.0-12.0	SP	Gray to fine SAND (very loose).
		End of boring at 12 feet 6/30/86

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
118	0-1.5	65	Brown sandy GRAVEL.
119	1.5-3.0	8	Brown to black sandy GRAVEL with traces of gray silt.
120	3.0-4.5	3	Black sandy GRAVEL.
121	4.5-6.0	4/18"	Brown PEAT and gray silt.
---	10.5-11.5	2	Gray fine SAND.

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LW4-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 37.9 ft.
0-4.5	ML	Brown fine sandy SILT with gravel (stiff) (fill).
4.5-7.0	ML	Gray-green SILT with occasional fine to coarse gravel and wood debris and pieces of metal (very soft) (fill).
7.0-7.5	PT	Dark brown fibrous PEAT (soft).
7.5-14.0	SP/ML	Alternating layers of slightly silty fine to medium SAND, brown peaty SILT, and silty fine SAND (loose/soft).
		End of boring at 14.0 feet. Ground water encountered at 5.45 feet during drilling 6/27/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
108	0-1.5	34	Brown fine sandy SILT with gravel.
109	1.5-3.0	24	Mottled gray-brown fine sandy SILT with 1-inch layer of burnt wood and ash.
110	3.0-4.5	14	Mottled blue-gray and brown fine sandy SILT with occasional fine gravel.
111	4.5-6.0	9	Gray-green SILT with occasional fine to coarse gravel and wood debris with a piece of metal.
112	6.0-7.0	1/18"	Gray SILT with occasional fine to coarse gravel and wood debris and dark brown fibrous PEAT.
113	7.5-9.0	3	Alternating layer of slightly silty fine to medium SAND, brown peaty SILT and silty fine SAND.
---	12.5-14.0	10	Gray medium SAND.

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LW5-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.0 ft.
0-0.3		Asphalt.
0.3-3.5	SW	Black fine to coarse SAND (loose) (fill).
3.5-4.0	ML	Gray SILT (sharp contact) (stiff).
4.0-8.0	SP	Gray fine SAND (loose).
8.0-9.5	GP	Gray fine GRAVEL (loose to medium dense).
9.5-12.5	PT	Brown PEAT (very soft).
12.5-13.0	ML	Gray SILT (very soft).
13.0-14.5	SP	Gray fine SAND (very loose).
		End of boring at 14.5 feet, 7/2/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
144	0-1.0	9	Black fine to coarse SAND.
(1) 145 146	1.5-3.0	3	Black well-graded SAND.
(1) 147 148	3.0-4.5	6	Black well-graded SAND, gray SILT and fine SAND.
---	7.5-8.5	10	Gray fine GRAVEL.
---	12.5-13.5	1/18"	Gray SILT and fine SAND.

(1) Duplicate sample split from two samplers, one driven and one pushed. Soil was homogenized and sample bottles filled.

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LW5-VS

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 28.0 ft.
0-2.0	SP	Black fine SAND with some charred material (loose) (fill).
2.0-2.5	PT	Brown PEAT (very soft).
2.5-4.5	SP	Gray fine SAND (very loose).
4.5-5.0	ML	Gray SILT with peat fibers (soft).
5.0-7.5	SP	Gray fine SAND (loose).
		End of boring at 7.5 feet, 7/3/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
149	0-1.0	12	Black fine SAND with some charred material.
150	1.5-3.0	3	Black fine SAND fill over 4-inch peat layer, 0.5 foot gray fine sand. Metallic flakes throughout the sample.
151	3.0-4.5	2	Black fine SAND fill with gray fine sand. Metallic flakes observed. (fill may be carry down.)
152	4.5-6.0	5	Gray SILT with peat over fine SAND with very few metallic flakes.

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LW6-S

Soil Profile

Depth (feet)	USC Symbol	LW6-S Ground Surface Elev. 27.6 ft.
0-3.0	GW	Brown grading to black well-graded sandy GRAVEL (very dense) (fill).
3.0-5.0	ML	Gray SILT with some peat fibers (soft) (fill).
5.0-10.5	SP	Gray fine SAND (very loose).
10.5-11.5	SM	Gray silty fine SAND (very soft).
		End of boring at 11.5 feet, 6/30/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
122	0-1.5	68	Brown grading to black well-graded sandy GRAVEL.
123 (1) 126	1.5-3.0	5	Black sandy GRAVEL with red sand grains.
124	3.0-4.5	4	Gray SILT with some black sandy gravel.
125	4.5-6.0	4	Gray poorly graded fine SAND.
---	10.0-11.5	2	Gray silty fine SAND.

(1) Duplicate Sample Collected 4 feet S.W. of well location.

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LW7-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 31.7 ft.
0-6.5	GW	Brown fine and coarse GRAVEL (medium dense) (fill).
6.5-10-5	SP	Gray fine SAND with traces of silt (loose).
		End of boring at 10.5 feet, 6/30/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
127	0-1.5	21	Black well-graded GRAVEL.
128	1.5-3.0	30	Brown well-graded GRAVEL fill.
129	3.0-4.5	12	Brown well-graded GRAVEL fill.
130	4.5-6.0	8	Brown well-graded GRAVEL (wet).
131	6.0-7.5	8	Gray poorly graded fine SAND with black oily substance in bottom, 4 inches of fill just above the contact.

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LW8-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 31.1 ft.
0-2.0	SW	Brown sandy GRAVEL with traces of ash cinder (loose) (fill).
2.0-4.5	SM	Gray silty fine SAND with rust colored mottles and traces of peat (very loose) (fill).
4.5-10.0	ML	Gray silt with few rust mottles (soft). Thin layer of fine sand and traces of peat.
		End of boring at 10.0 feet, 7/1/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
136	0-1.5	8	Brown sandy GRAVEL with traces of ash cinder.
137	1.5-3.0	2	Gray silty fine SAND with rust colored mottles.
138	3.0-4.5	3	Silty SAND with rust and black mottles.
139	4.5-6.0	3	Gray soft SILT with few rust mottles.
---	8.5-10	1/18"	Gray SILT with a thin layer of fine sand and traces of peat.

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LW9-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.0 ft.
0-1.5	SP	Brown poorly graded fine SAND with some charred debris and gravel (medium dense) (fill).
1.5-4.5	SW	Fine to coarse SAND with some silt and gravel (loose) (fill).
4.5-10.0	ML	Brown SILT with some sand grading to gray silt with some debris at contact.
10.0-14.5	SM/ML	Silty fine to medium SAND (very loose).
		End of boring at 14.5 feet, 7/3/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
153 (1)	0-1.5	12	Brown poorly graded fine SAND.
154	1.5-2.5	6	Brown mottled SAND with gravel and some black debris (possibly cinders).
---	2.5-4.5		No sample recovered.
155	4.5-6.0	4	Brown SILT with some sand grading into gray silt.
---	7.5-9.0	1/18"	Gray SILT with fine sand.
---	12.5-13.5	2	Gray SILT with fine to medium sand.

(1) First sample from hole 2-feet north of final LW9-S.

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LW10-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.9 ft.
0-0.3		Asphalt pavement.
0.3-2.5	*	Black charred debris with some white and reddish particles (fill).
2.5-3.5	PT	Brown PEAT with some silt (soft).
3.5-8.5	SP	Gray fine SAND with root fibers (medium dense).
		End of boring at 8.5 feet, 7/9/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
172	0-1.5	5	Black charred debris with some white and reddish particles, possibly (burn debris).
173	1.5-3.0	4	Black charred burn debris and PEAT with some silt.
174	3.0-4.5	12	Gray poorly graded fine SAND with root fibers.
175	4.5-6.0	24	Gray poorly graded fine SAND.

* Blow Count not recorded

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LW11-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.1 ft.
0-2.0	GW	Black well-graded GRAVEL (loose) (fill).
2.0-4.5	ML	Black SILT with some gravel and large pieces of wood (medium stiff) (fill).
4.5-9.5	ML	Gray silt with roots (very soft).
9.5-10.5	SM	Gray silty fine SAND (very loose).
		End of boring at 10.5 feet, 7/8/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
162	0-1.5	9	Black oily well graded GRAVEL. HNU meter reads 10-15 at sample level and 1-5 at face level.
163	1.5-3.0	14	Black oily SILT with large pieces of wood.
164	3.0-4.0	3	Black oily sandy SILT.
165	4.5-6.0	1/18"	Gray SILT with roots; black oil in all root openings.
166	6.0-7.5	2/18"	Gray SILT with oil in all root openings.
167	7.5-8.5	4	Gray SILT with roots and oil in all root openings.
168	9.0-10.0	3	Gray SILT with roots and oil in all root openings grading to gray silty fine SAND; with oil.

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LW11-VS

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.2 ft.
0-0.5		Concrete.
0.5-2.5	GW	Black oily well-graded GRAVEL grading to gray fine to coarse GRAVEL (medium dense) (fill).
2.5-5.5	ML	Brownish-black SILT with some peat (very soft).
		End of boring at 5.5 feet.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
169	0.5-2.0	11	Black oily well-graded GRAVEL.
170	2.0-3.5	2	Black oily well-graded GRAVEL and brownish-black SILT with some peat. Approximate 3 inches thick layer of thick oily substance above the silt contact.
171	3.5-5.0	*	Brownish gray silt with root openings; saturated with oil.

* Blow Count not recorded.

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LW12-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.9 ft.
0-0.5		Concrete.
0.5-1.5	GW	Brown well-graded GRAVEL (loose) (fill).
1.5-2.0	ML	Brown-reddish SILT with few black mottles and traces of sand (very loose) (fill?).
2.0-4.0	SM/ML	Gray silty SAND and sandy SILT (very loose) (fill?).
4.0-10.5	ML	Gray SILT with traces of fine SAND (soft).
10.5-15.5	ML/SP	Alternating layers of gray SILT and gray fine SAND with trace layers of peat (medium stiff).
		End of boring at 15.5 feet, 7/9/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
176	1-2.5	4	Brown well-graded gravel fill, and brown-reddish silt with few black mottles.
177	2.5-4.0	2/18"	Gray silty SAND and sandy SILT mixture with petroleum odor. Sample reads 10-15 on HNU.
178	4.0-5.5	4	Gray SILT with trace of fine sand. Sample reads 10-15 on HNU.
179	5.5-7.0	4	Gray SILT with some fine sand. Sample reads 15-20 on HNU.
180	12.5-14.0	10	Alternating layers of gray SILT, gray poorly graded fine SAND and trace layers of PEAT. Sample reads 3 to 5 on HNU.

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LW13-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.8 ft.
0-2.0	GW	Black well-graded GRAVEL with traces of red brick and wood (loose) (fill).
2.0-3.5	PT	Brown fibrous PEAT (very soft).
3.5-4.0	ML	Brown SILT with traces of peat fibers and debris.
4.0-4.5	SP	Gray fine SAND (very soft).
4.5-5.5	ML	Gray SILT with peat (very soft)(very loose).
5.5-10.0	SP	Gray fine SAND (very loose) 2-inch layer of SILT at 8.0 ft.
		End of boring at 10 feet, 7/2/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
140	0-1.5	8	Black well-graded gravel fill with traces of brick and charred wood.
141	1.5-2.5	2	Black well-graded sandy GRAVEL fill with traces of brick and charred debris mixed with peat from lower half of sample.
142	3-4.5	2/18"	Brown fibrous PEAT, brown SILT with traces of peat, and gray poorly-graded fine SAND.
143	4.5-6.0	5	SILT with peat over poorly-graded fine SAND.

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LW14-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 32.0 ft.
0-0.3		Asphalt.
0.3-1.0	SW	Brown fine SAND with few chunks of asphalt (loose) (fill).
1.0-3.5	SM	Brown silty SAND with rust colored mottles (loose) (fill).
3.5-6.5	SP	Brownish gray fine SAND with rust colored mottles (very loose).
6.5-12.5	SM/ML/SP	Gray alternating layers of silty SAND, gray SILT with traces of peat, and gray fine SAND (very loose).
12.5-15.5	SP	Gray coarse SAND with some fine gravel (medium dense).
		End of boring at 15.5 feet, 7/10/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
181	0-1.5	6	Brown well-graded fine SAND with traces of asphalt and brown silty SAND with many rust colored mottles.
182	1.5-3.0	5	Brown-gray silty SAND with many rust colored mottles.
---	3.0-4.5	4	Brown-gray fine SAND.
---	7.5-9.0	3	Gray alternating layers of silty SAND, gray SILT with traces of peat and gray fine SAND.
---	12.5-13.5	21	Gray coarse SAND with some fine gravel.

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LW15-S

Soil Profile

Depth (feet)	USC Symbol	Ground Surface Elev. 30.1 ft.
0-2.0	GW	Brown well-graded GRAVEL (medium dense) (fill).
2.0-5.5	SP	Gray to dark gray fine SAND (medium dense). Grades to medium SAND at 4.5 ft. (loose) (fill).
5.5-6.5	PT	Brown silty PEAT grading to brown fibrous PEAT (medium stiff).
6.5-9.5	SP	Gray fine to medium SAND (loose).
9.5-10.0	ML	Gray SILT with medium SAND (soft).
		End of boring at 10 feet, 7/1/86.

Sample Detail

Sample#	Depth (feet)	Blow Count	Description
132	0-1.5	32	Brown well-graded GRAVEL.
133	1.5-3.0	15	Gray to dark gray fine SAND.
134	3.0-4.0	4	Gray fine SAND with some gravel.
135	4.5-6.0	10	Gray medium SAND, brown silty PEAT and brown fibrous PEAT.
---	6.0-7.5	14	Gray fine to medium SAND.
---	8.5-10.0	5	Gray SILT with medium SAND.

Hart Crowser
J-1639-09

WELLS LW1-D THROUGH LW3-D
AND LW5-D THROUGH LW13-D
LANDAU ASSOCIATES (1986)

NOTE: No LW-4D was installed

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DEEP WELL SYMBOLS

Key:

Blows required to drive a 2.5-inch ring sampler 1 foot with a hammer weighing 300 pounds and a stroke of 24 inches.

9 ■ Indicates depth at which undisturbed ring sample was extracted.

☒ Indicates depth at which disturbed or partial ring sample was extracted.

Blows required to drive Split Spoon Sampler 2 foot with a hammer weight of 140 pounds and a stroke of 30 inches.

26 ◪ Indicates S.P.T sample.

10 ▨ Indicates partial sample recovery.

3 □ Indicates sampling attempt with no recovery.

P Indicates sampler pushed into soil with hydraulics

* Elevations based on City of Renton Datum
* Water added to LW2-D,3-D,5-D,6-D,7-D,8-D,11-D, and 12-D.

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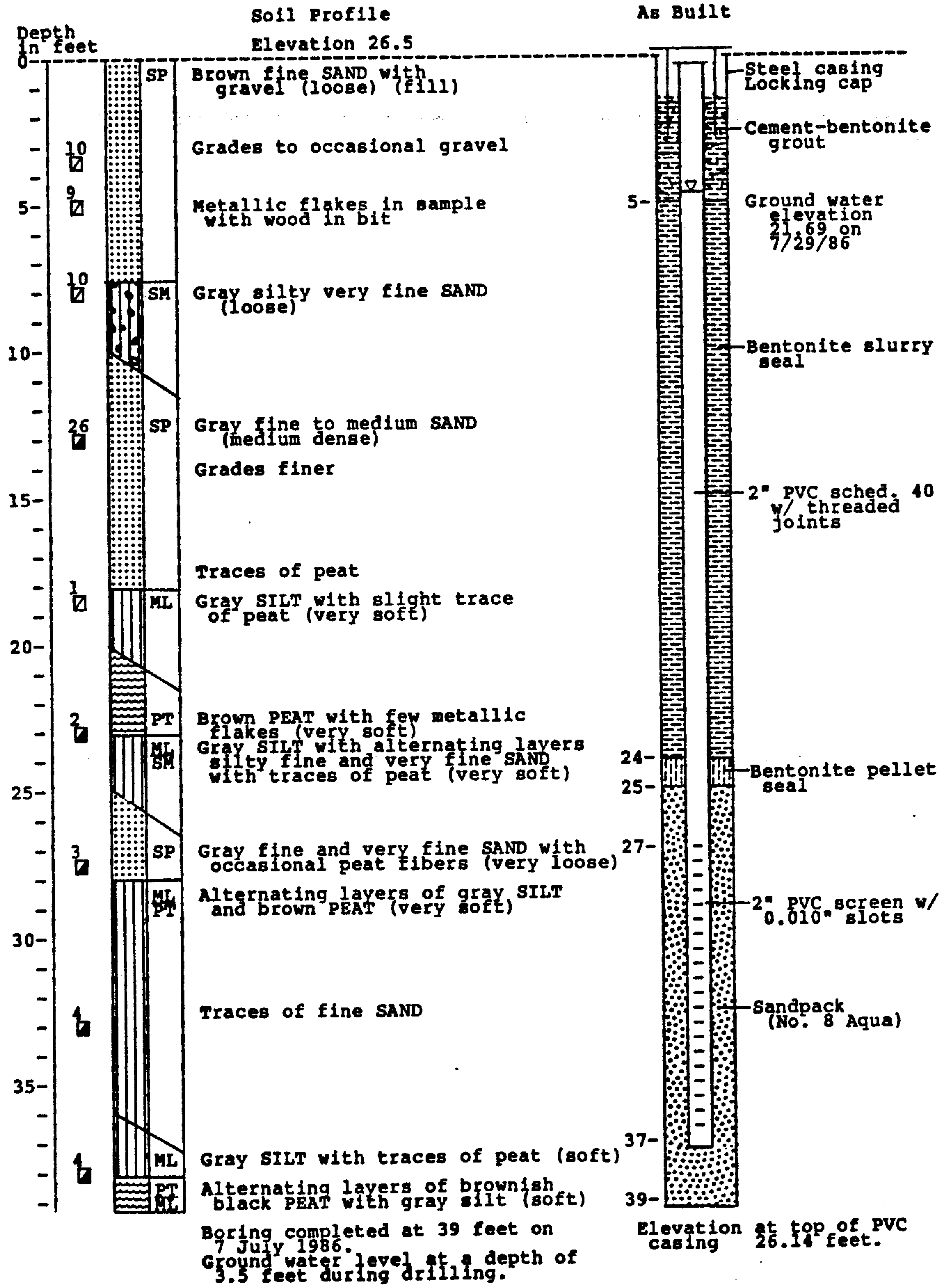
WELL LW1-D



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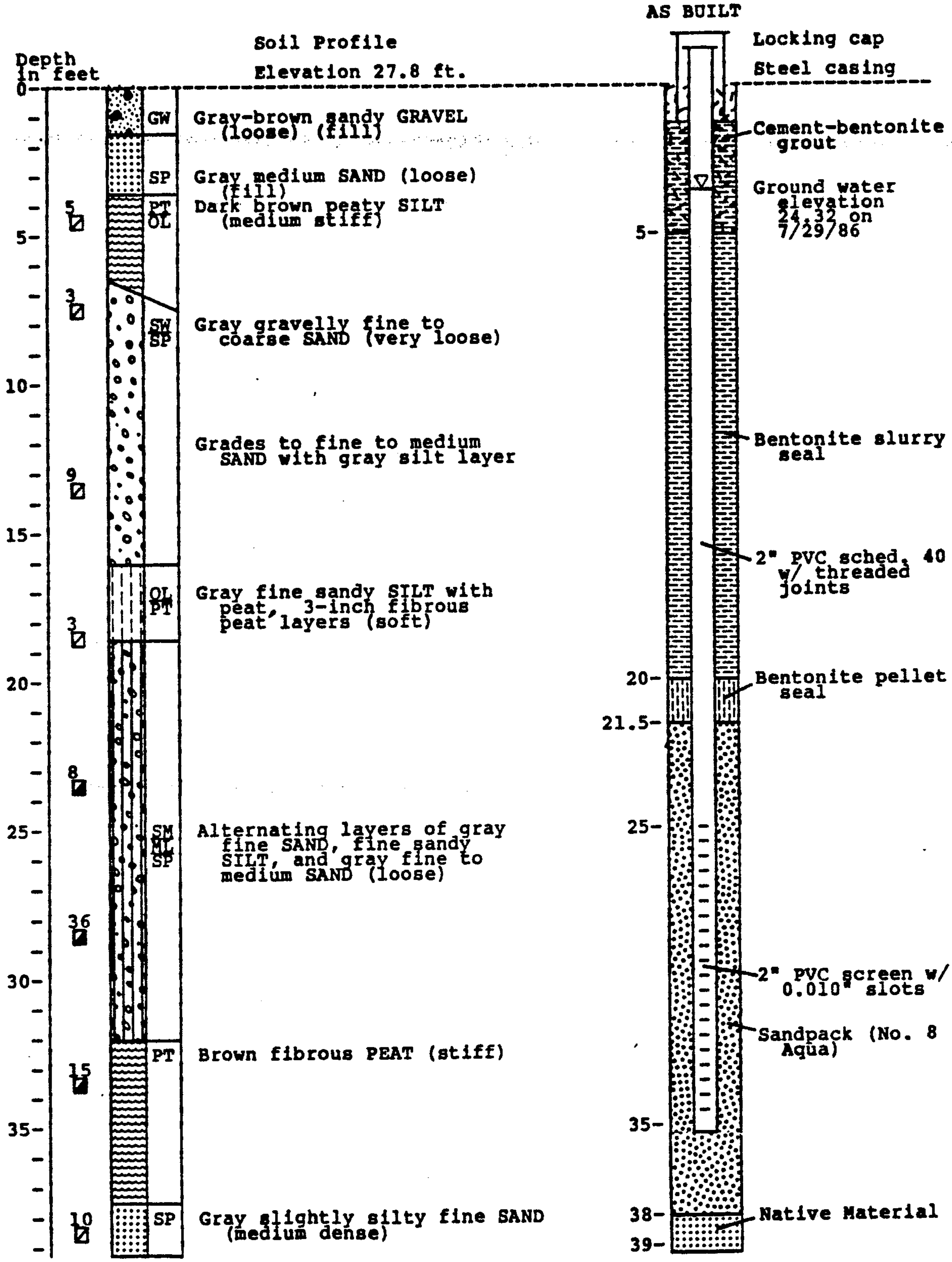
WELL LW 2-D



Boring completed at 39', 5/15/86
Ground water level at a depth of 2.8 feet during drilling.

Elevation at top of PVC casing - 30.17 feet.

LANDAU ASSOCIATES, INC.

Figure

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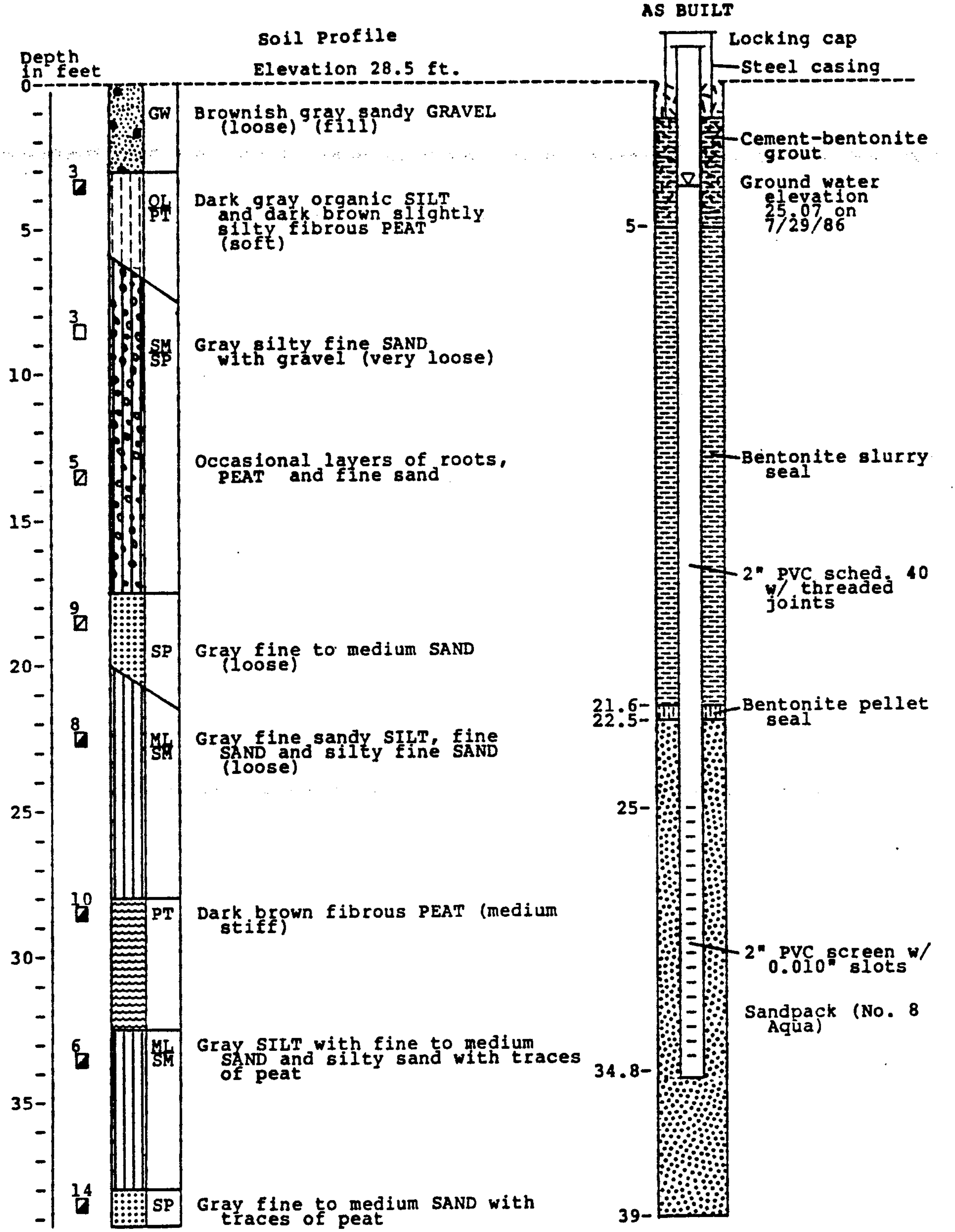
WELL LW 3-D



Boring completed at 39', 5/12/86
Ground water level at a depth of 4.0 feet during drilling.

Elevation at top of PVC casing 31.27 ft.

LANDAU ASSOCIATES, INC.

Figure

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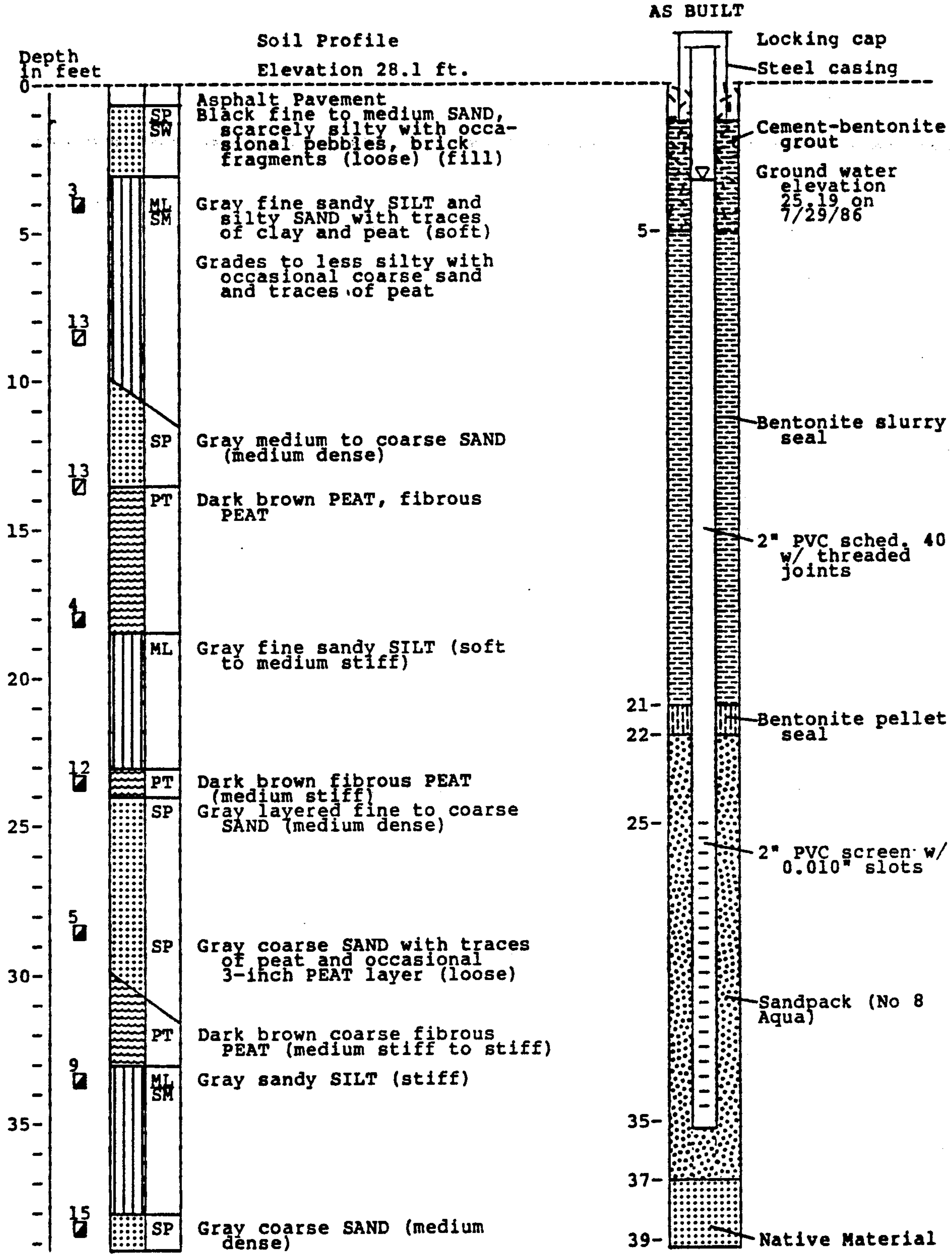
WELL LW 5-D



Boring completed at 39', 5/19/86
Ground water level at a depth of 2.8 feet during drilling.

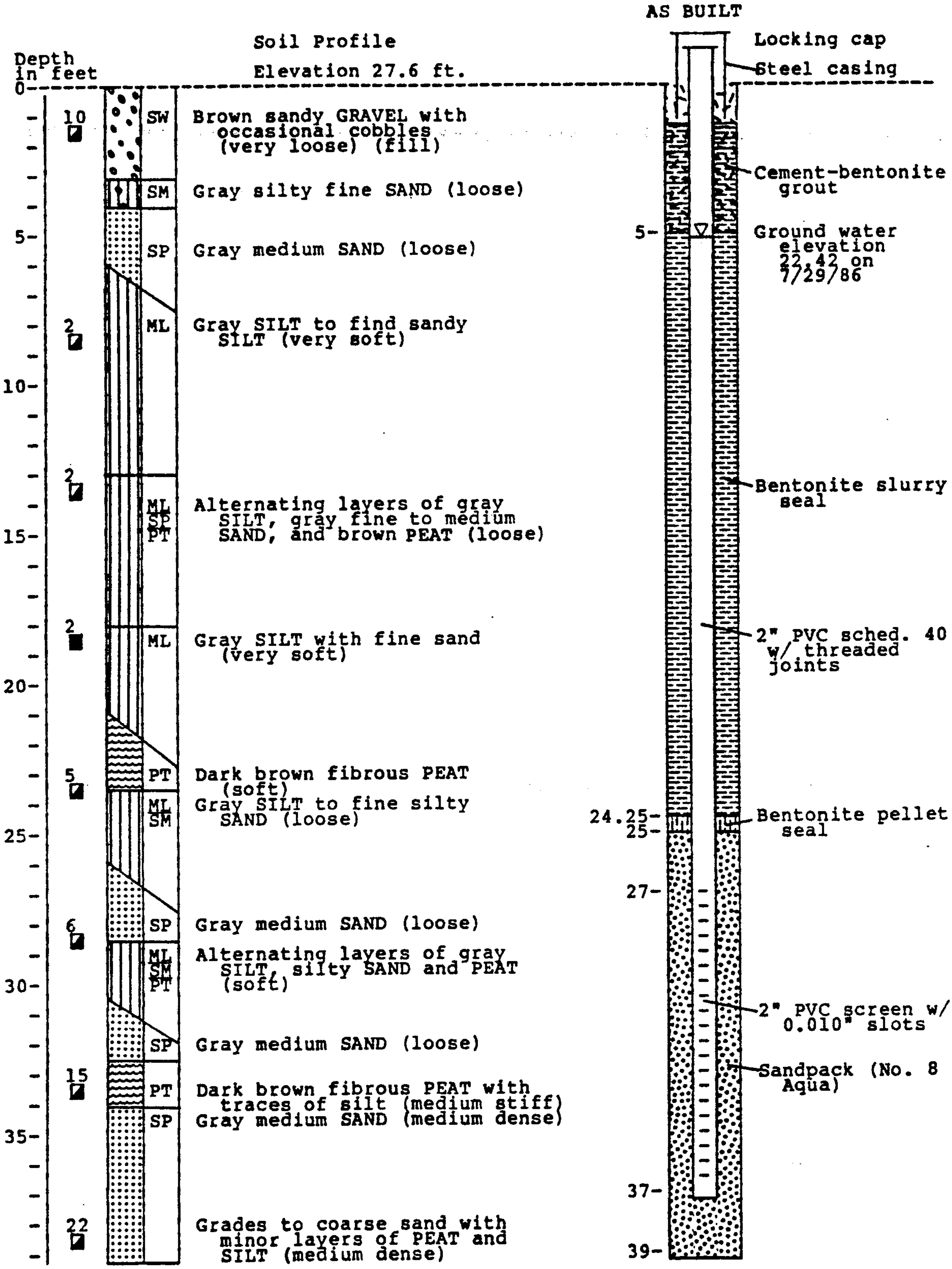
Elevation at top of PVC casing - 30.45 ft.

LANDAU ASSOCIATES, INC.

Figure

DRAFT

WELL LW 6-D



Boring completed at 39', 5/20/86
Ground water not measured during drilling.

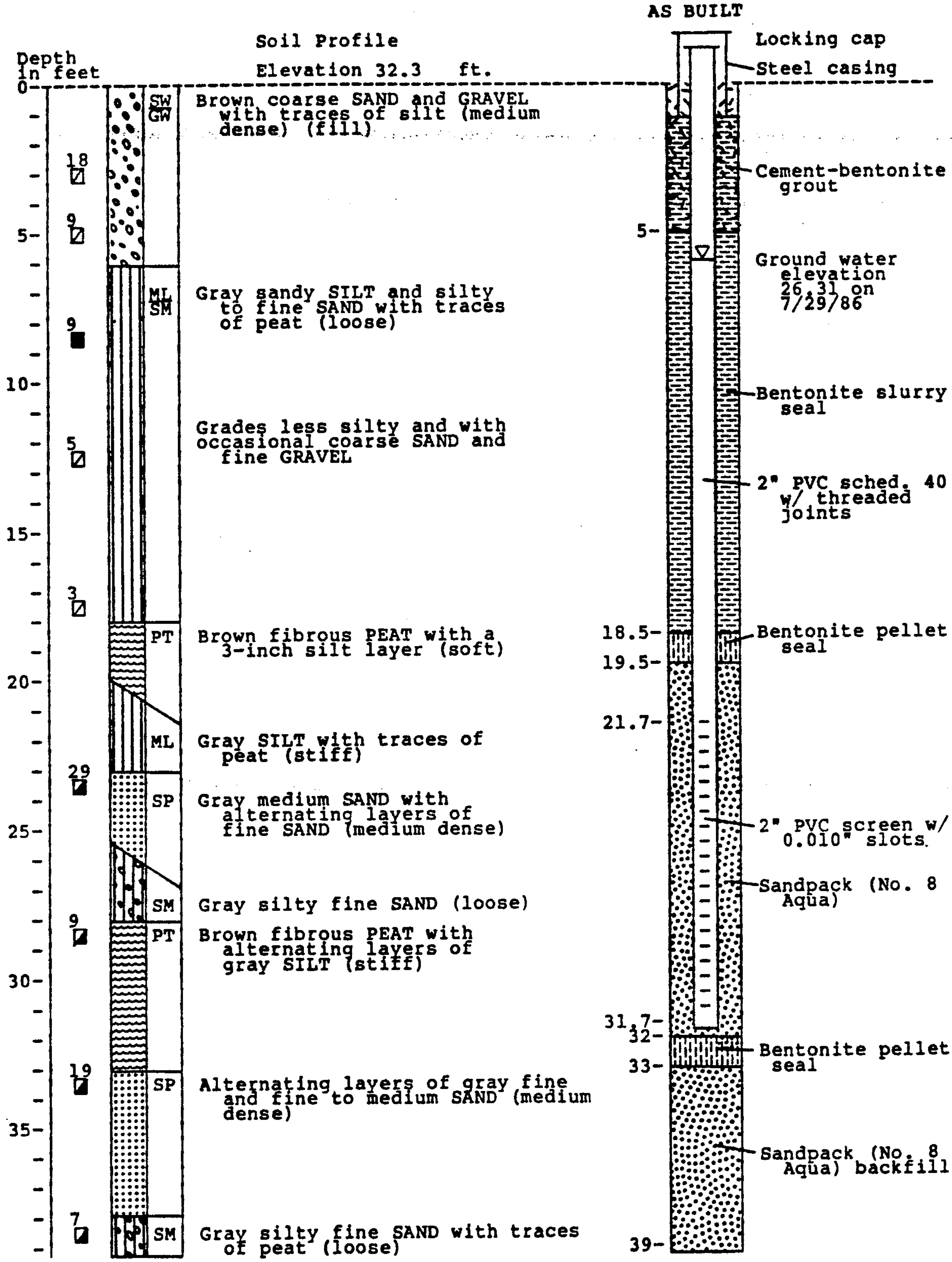
Elevation at top of PVC casing - 29.87 ft.

LANDAU ASSOCIATES, INC.

Figure

DRAFT

WELL LW 7-D



Boring completed at 39', 5/21/86
Ground water level at a depth of 1.2 feet during drilling.

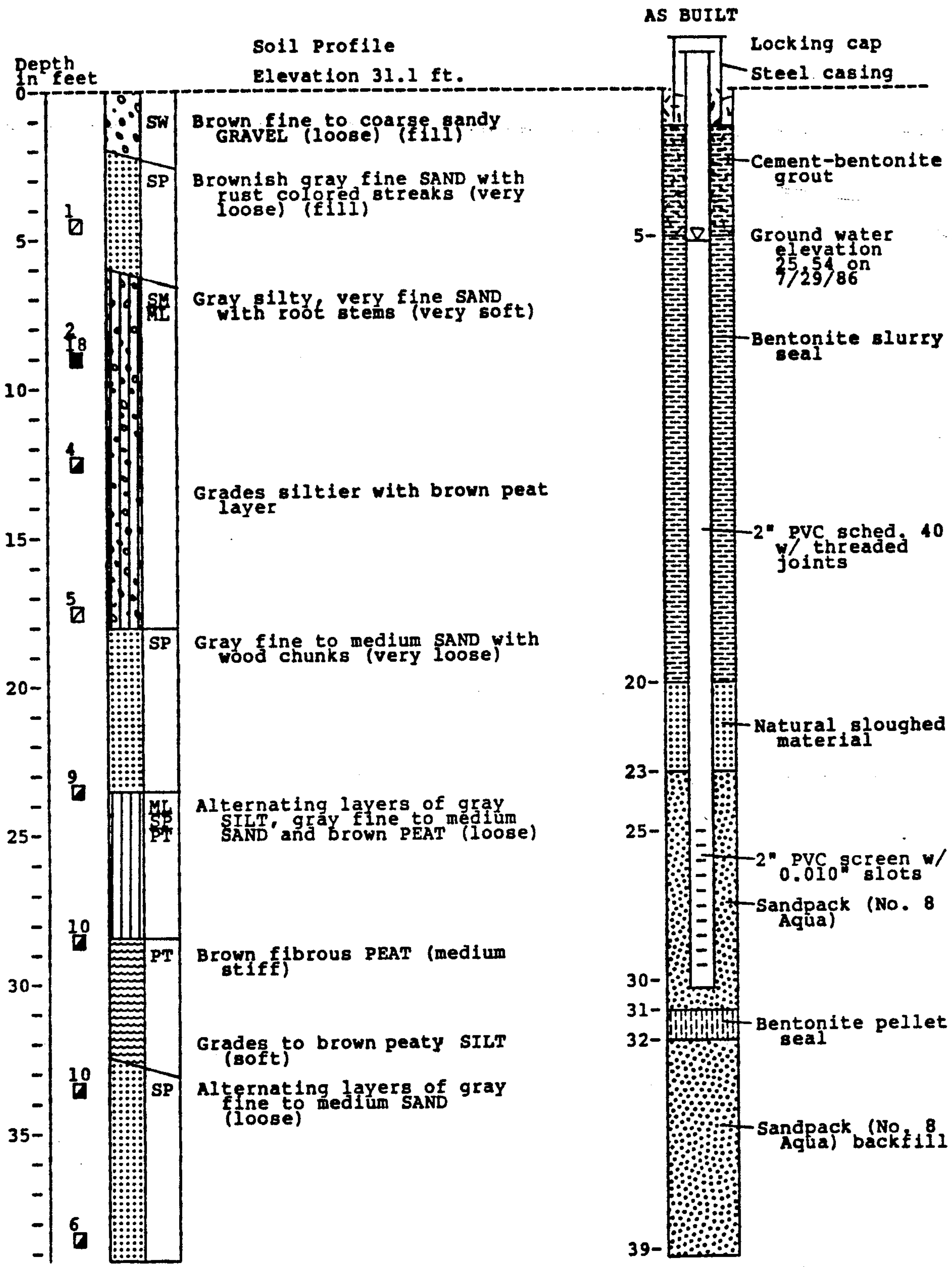
Elevation at top of PVC casing - 33.86 ft.

LANDAU ASSOCIATES, INC.

Figure

DRAFT

WELL LW 8-D



Boring completed at 39', 5/22/86
Ground water level at a depth of 4.5 feet during drilling.

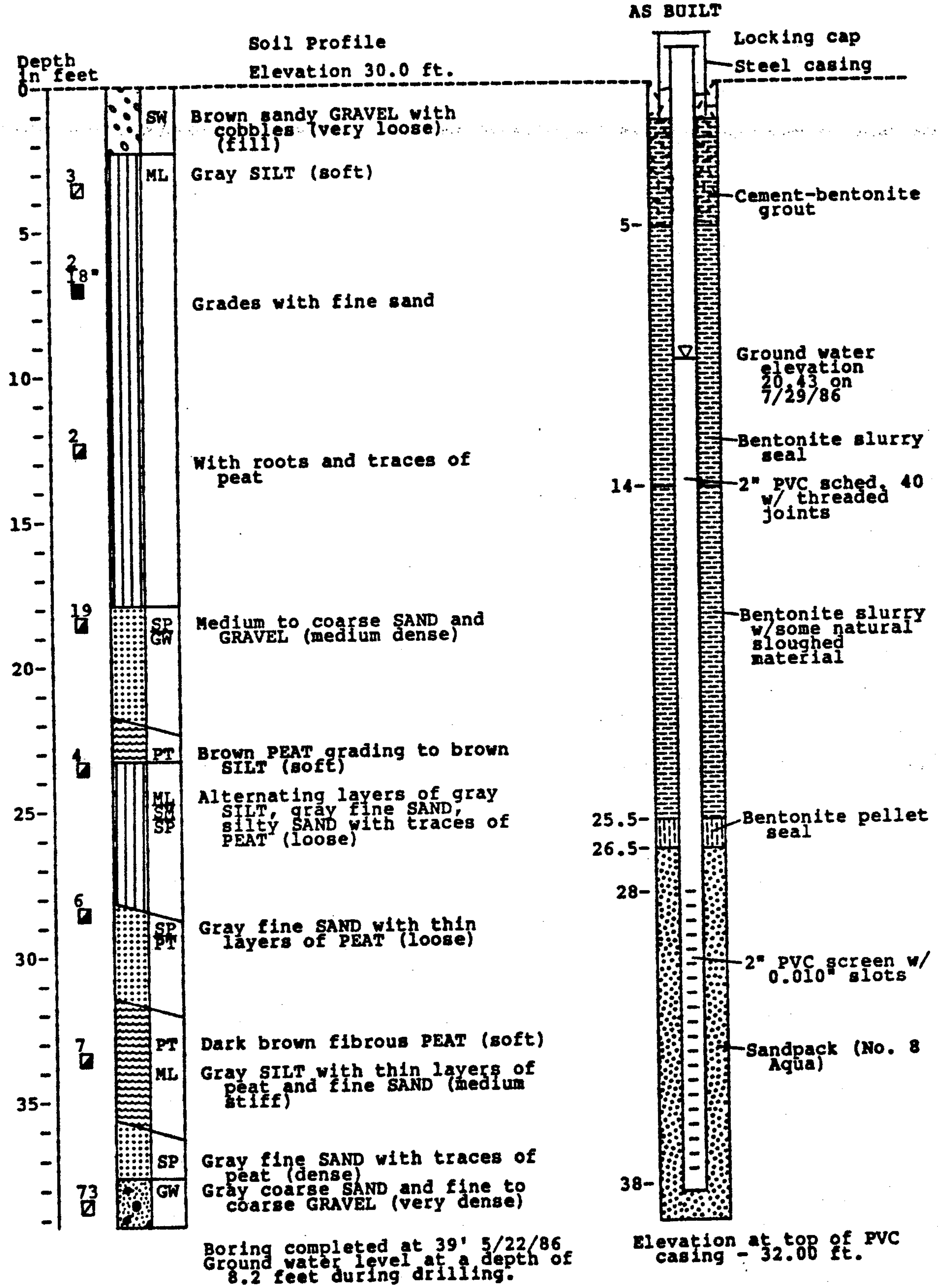
Elevation at top of PVC casing - 33.27 ft.

LANDAU ASSOCIATES, INC.

Figure

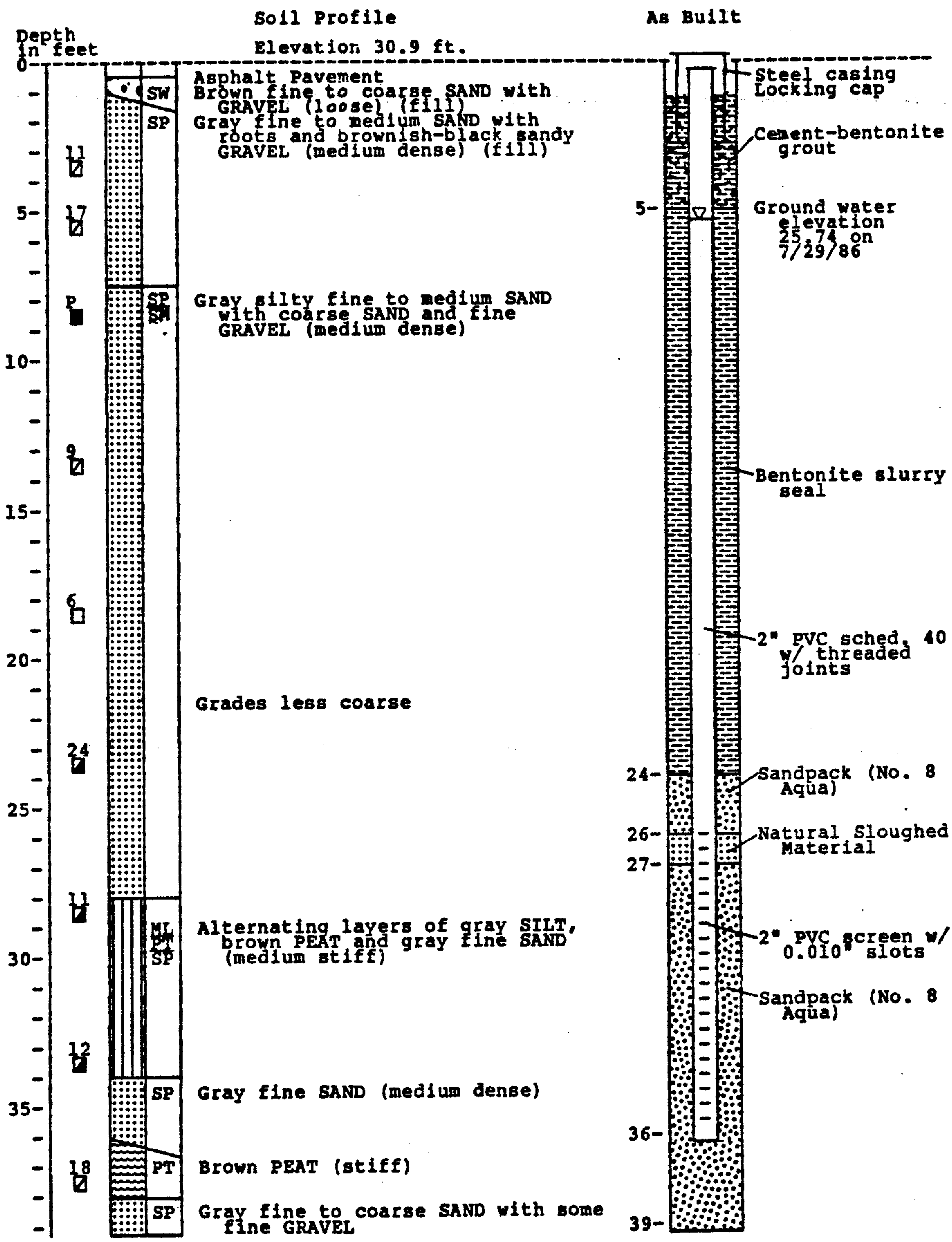
DRAFT

WELL LW 9-D



DRAFT

WELL LW 10-D

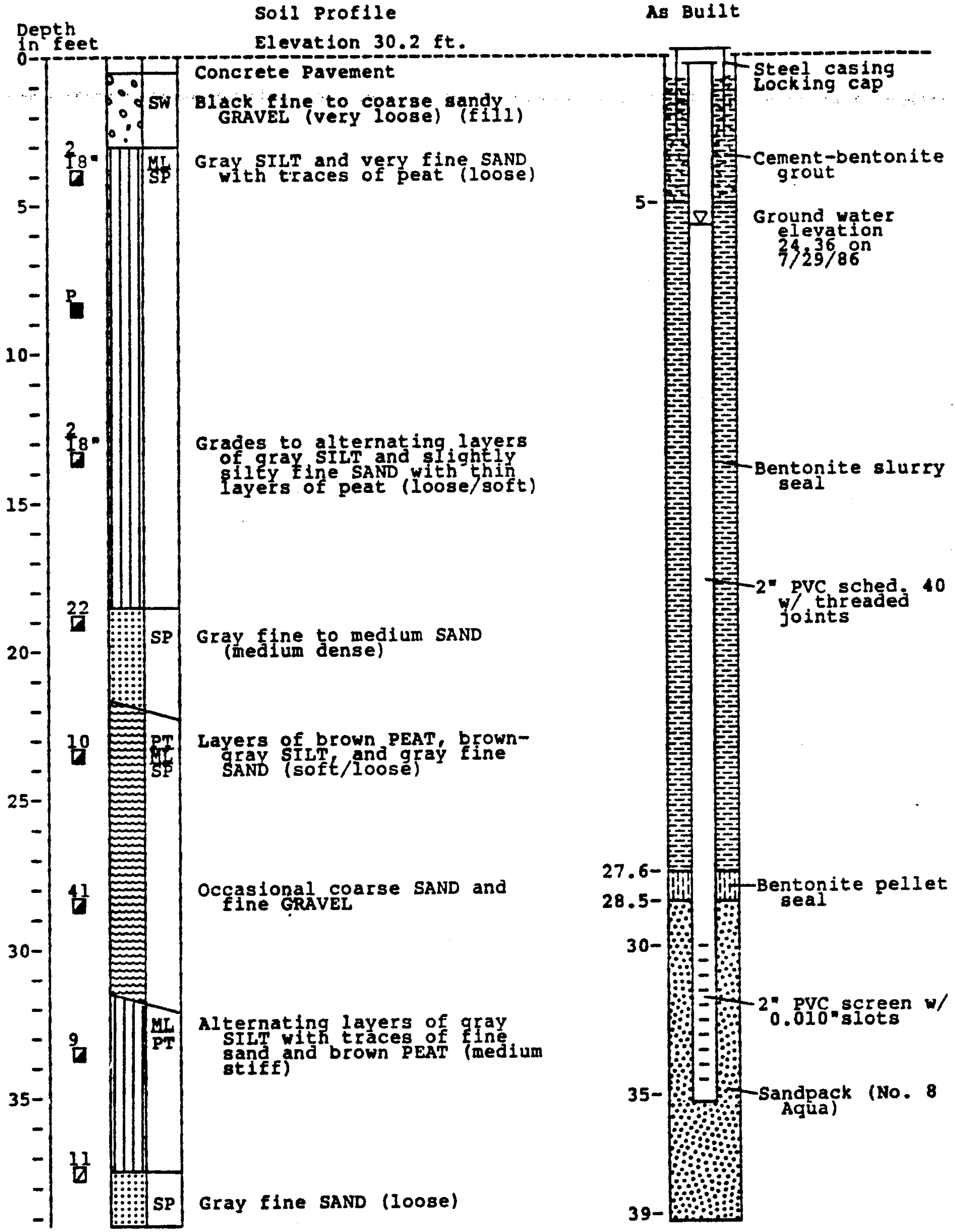


Boring completed at 39', 5/28/86
Ground water not measured during drilling.

Elevation at top of PVC casing - 30.59 ft.

DRAFT

WELL LW 11-D



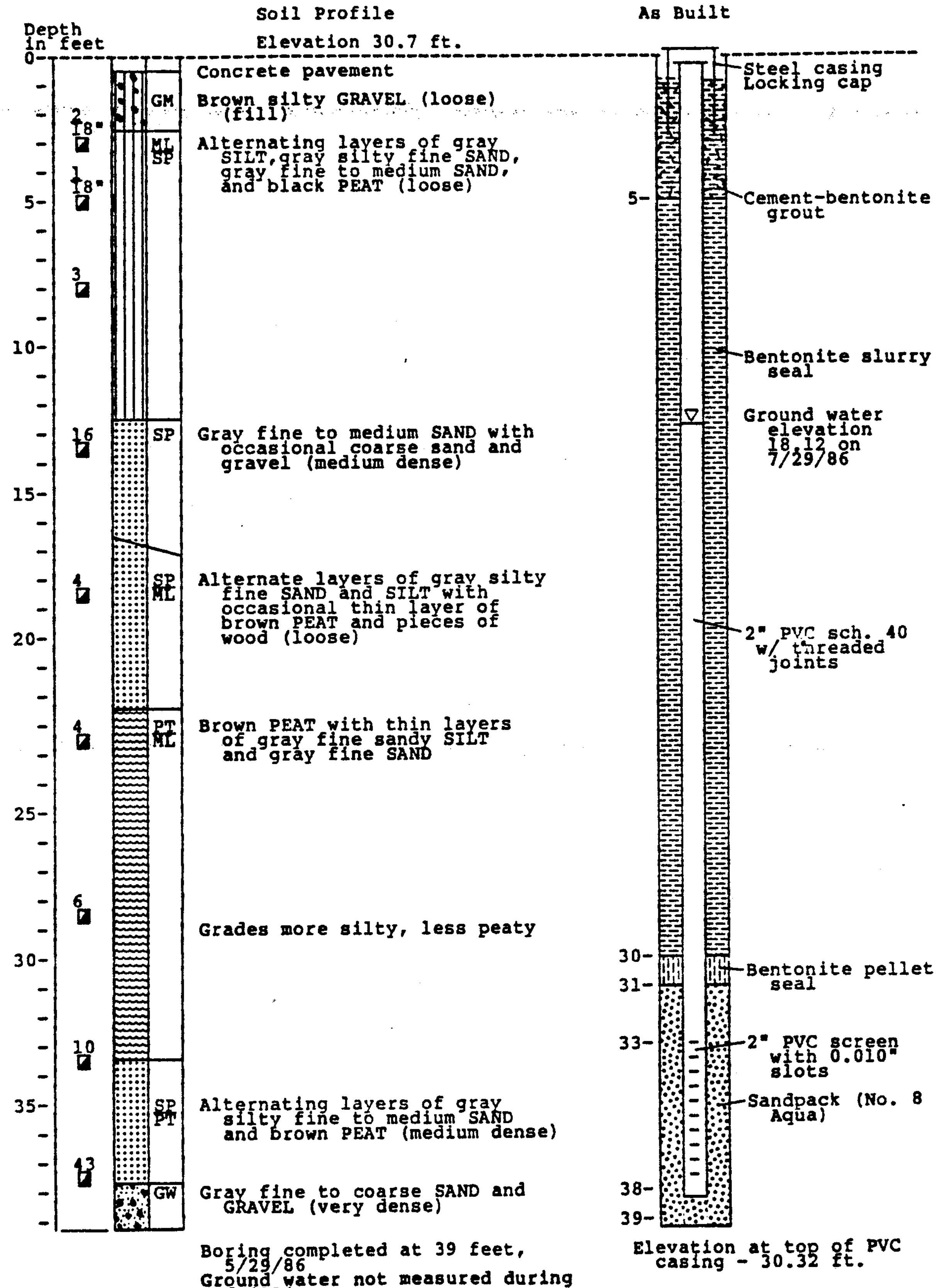
Boring completed at 39', 5/27/86
Ground water not measured during drilling.

Elevation at top of PVC casing - 29.98 ft.

LANDAU ASSOCIATES, INC.

DRAFT

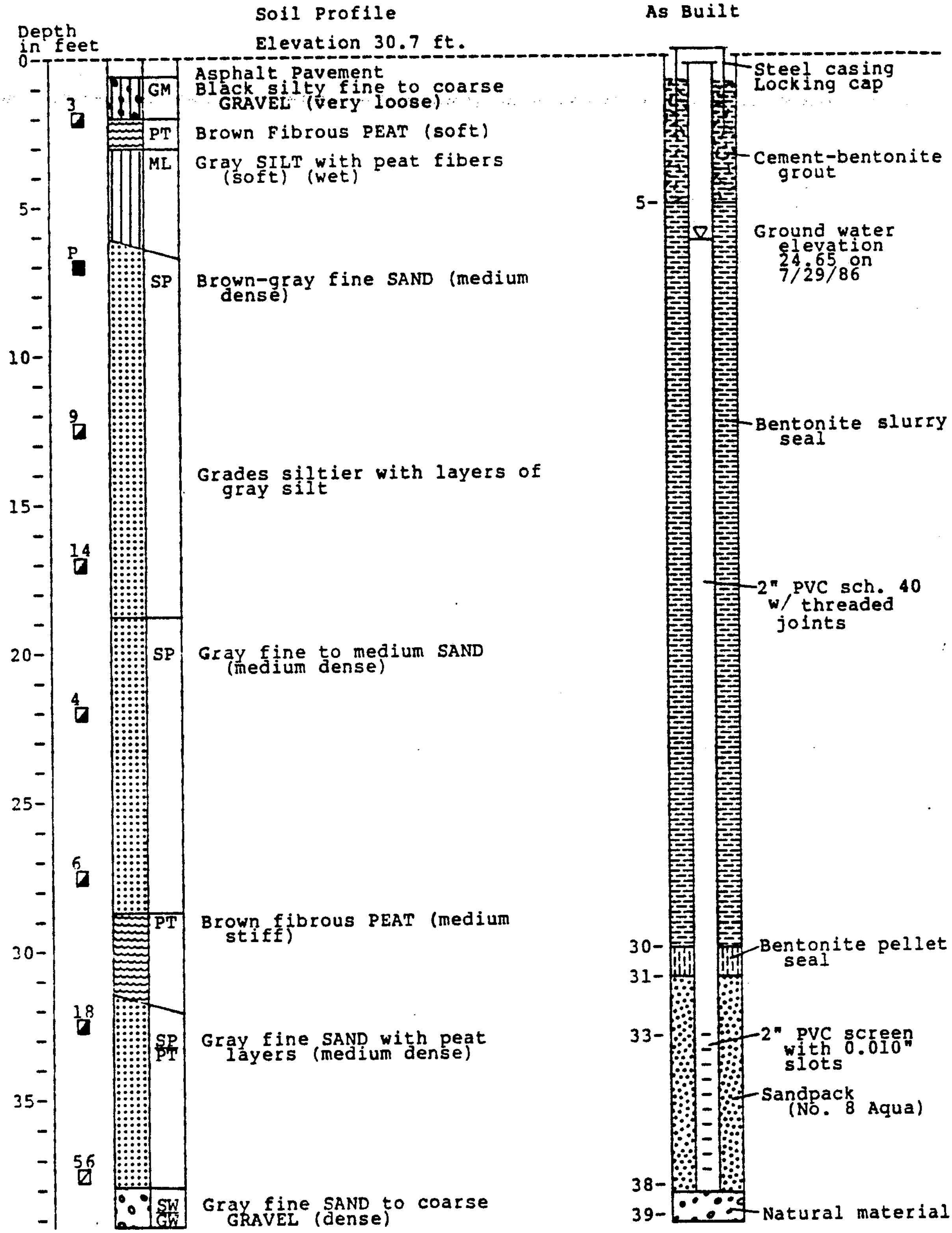
WELL LW 12-D



LANDAU ASSOCIATES, INC.

DRAFT

WELL LW 13-D



Boring Completed at 39' 5/29/86
Ground water level at a depth of 3.5 feet during drilling.

Elevation at top of PVC casing, 30.29 ft.

LANDAU ASSOCIATES, INC.

PIEZOMETERS HC-1I THROUGH HC-6I
HART CROWSER (1987)

Boring Log and Construction Data for Well HC-1I

Geologic Log

Depth in Feet

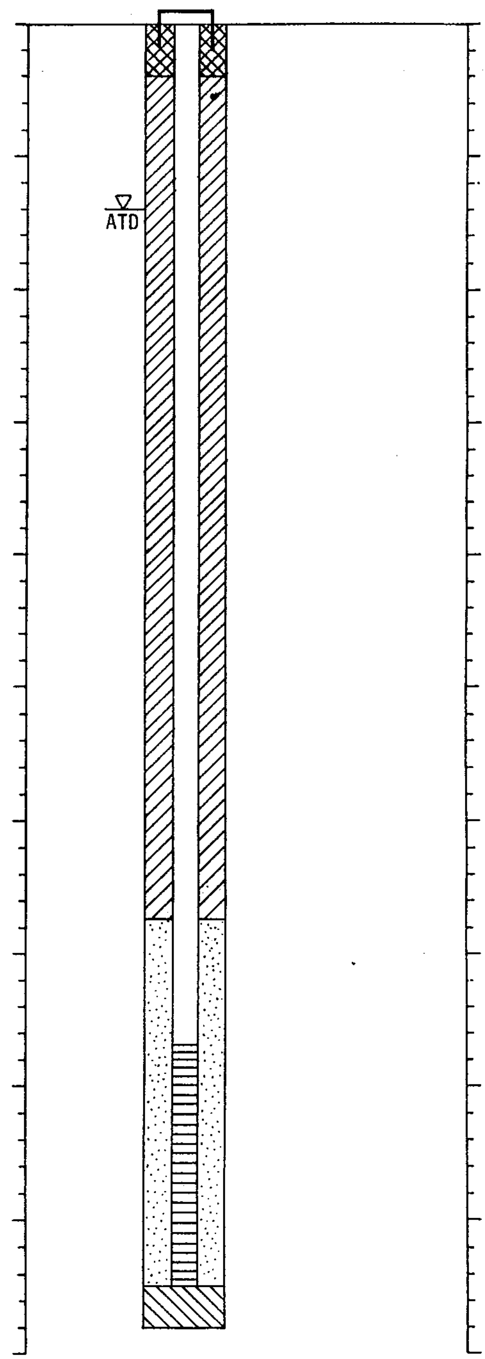
Ground Surface Top of Flush Mount Lid Elevation in Feet 32.02

Depth (Feet)	Description
0	Medium stiff, moist, light brown, slightly fine sandy, clayey SILT.
	Loose, moist, light brown, fine SAND.
5	Very dense, wet, reddish brown, very sandy GRAVEL.
10	Medium dense to dense, wet, gray, fine to medium SAND with zones of slightly gravelly SAND with some wood and fine organics.
15	
20	
	Stiff to very stiff, wet, gray, fine sandy SILT and medium dense, wet, fine SAND.
25	
	- Some thin laminated fine organics.
30	Stiff, wet, gray to light brown, silty CLAY and stiff, wet, brown, fibrous PEAT.
	Loose to medium dense, wet, gray, fine SAND and fine sandy SILT with occasional organics.
35	Very dense, wet, gray, gravelly SAND to sandy GRAVEL.
40	
45	
50	Bottom of Boring at 49.0 Feet. Completed 4/10/87.

Sample	N
S-1 A/B	7
S-2	54
S-3	21
S-4 A/B	38
S-5 A/B	22
S-6	14
S-7 A/B	10
S-8	73/11"
S-9	50/6"
S-10	99

Well Design

Top Casing Elevation in Feet 31.67



J-1639-04 April 1987

HART-CROWSER & associates, inc.

Boring Log and Construction Data for Well HC-2I

Geologic Log

Depth in Feet

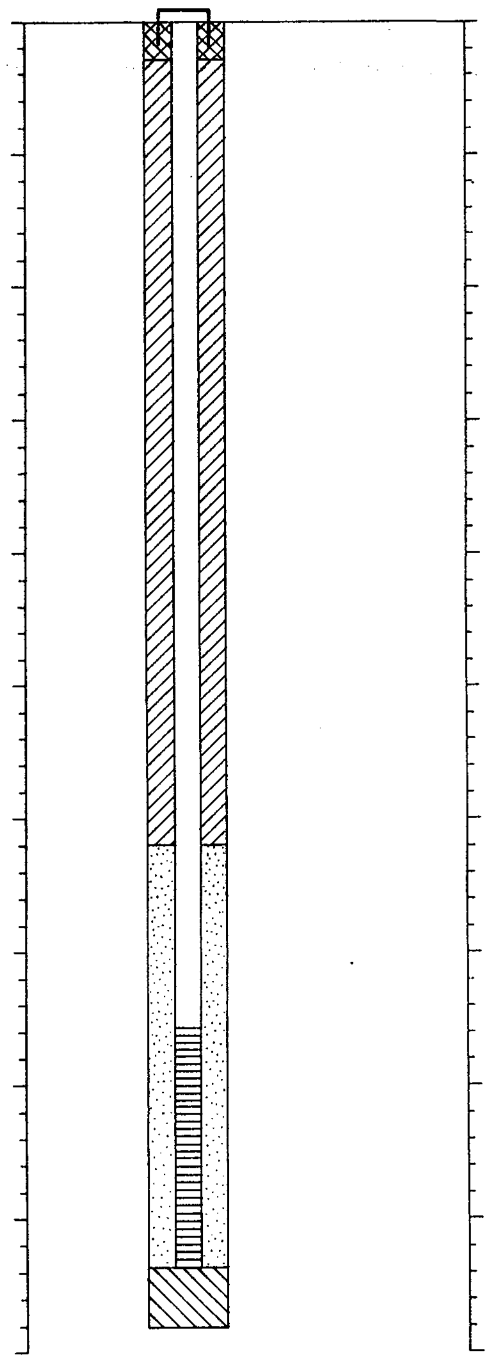
Ground Surface Top of Flush Mount Lid Elevation in Feet 35.53

Depth in Feet	Description
0	Loose to medium dense, reddish brown to gray, silty to slightly silty, fine SAND.
10	Very soft to soft, wet, light brown to gray, silty CLAY with zone of organics (wood).
15	Medium dense, wet, gray, slightly silty, fine SAND.
20	Stiff, wet, brown PEAT with some wood.
25	
30	Stiff, wet, brown PEAT and medium dense, wet, gray, fine SAND.
	Dense, wet, gray, sandy GRAVEL.
35	Very dense, wet, gray, slightly fine gravelly SAND.
40	Very dense, wet, gray, fine SAND.
45	Very dense, wet, light brown, very sandy GRAVEL with slightly gravelly, fine to medium SAND.
50	Bottom of Boring at 49.0 Feet. Completed 4/15/87.

Sample	N
S-1	9
S-2	14
S-3	2
S-4	17
S-5	12
S-6 A/B	15
S-7	42
S-8	70
S-9 A/B	50/6"
S-10 A/B	70

Well Design

Top Casing Elevation in Feet 35.05



J-1639-04 April 1987

HART-CROWSER & associates, inc.

Boring Log and Construction Data for Well HC-3I

Geologic Log

Depth in Feet

Ground Surface Top of Flush Mount Lid Elevation in Feet 35.44

Very loose to loose, wet, light reddish brown, silty, fine SAND and soft, to medium stiff, wet, light reddish brown, slightly fine sandy SILT.

Medium dense, moist to wet, light brown, very sandy to medium to coarse sandy GRAVEL.

- Fine to medium SAND with wood.

- Gravelly with trace organics.

Very dense to medium dense, wet, gray, silty, fine SAND.

- Some wood.
- Trace gravel.

Medium dense to very dense, wet, gray, slightly silty to clean, fine SAND.

- Trace wood.

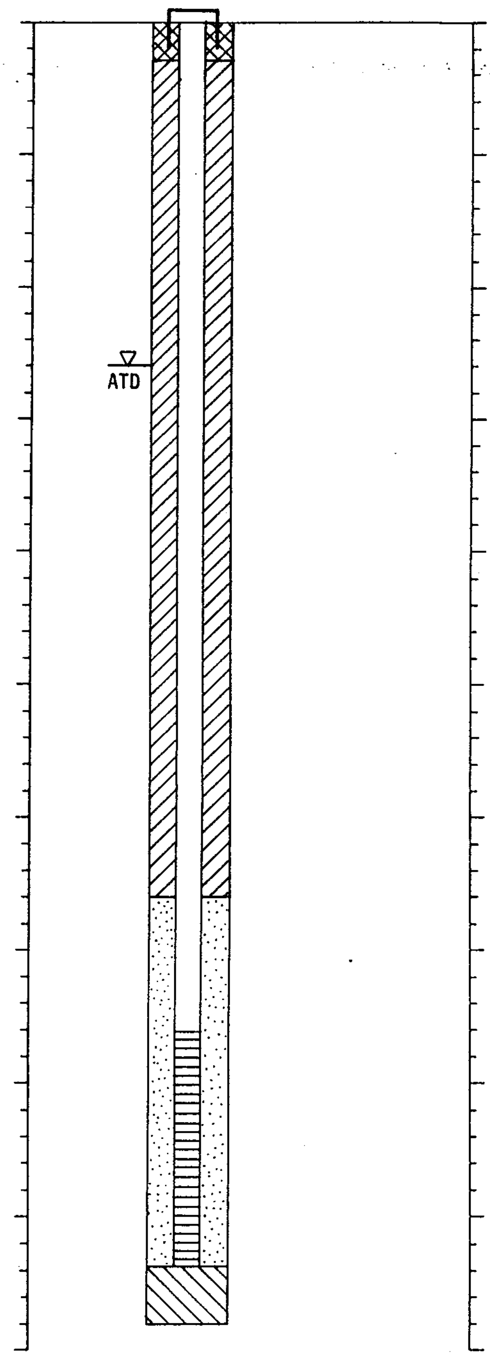
Very dense, wet, gray, gravelly SAND.

Bottom of Boring at 49.0 Feet.
Completed 4/14/87.

Sample	N
S-1	4
S-2	19
S-3	24
S-4 A/B	34
S-5	35
S-6	68/11"
S-7 A/B	10
S-8	54
S-9 A/B	40
S-10	72

Well Design

Top Casing Elevation in Feet 35.04



J-1639-04 April 1987
HART-CROWSER & associates, inc.

Boring Log and Construction Data for Well HC-4I

Geologic Log

Depth in Feet

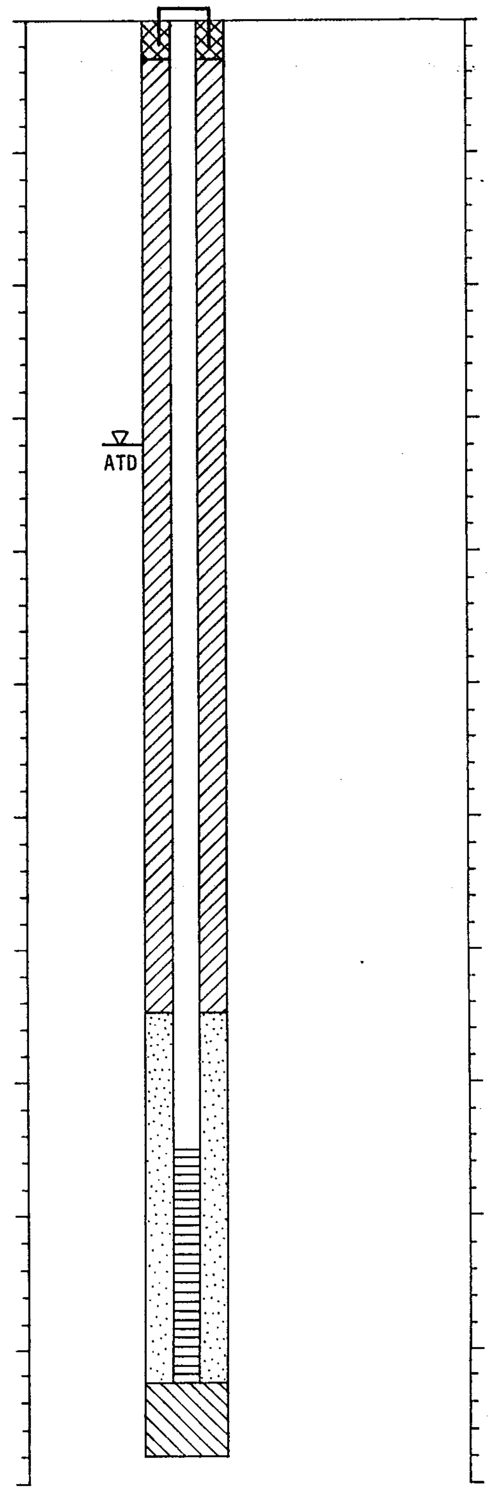
Ground Surface Top of Flush Mount Lid Elevation in Feet 34.99

Depth in Feet	Description
0	Medium dense, moist, light brown, very gravelly SAND.
5	Dense to very dense, moist to wet, light brown to reddish brown, very sandy GRAVEL to sandy GRAVEL.
20	Gravelly SAND.
	Dense, wet, gray, silty, fine SAND.
	Dense, wet, gray, slightly gravelly, fine SAND.
	No gravel.
	Dense to very dense, wet, gray to reddish brown, slightly silty, gravelly SAND with zones of silty, gravelly SAND and trace organics.
	Trace silty.
	Very dense, wet, reddish brown, fine SAND.
	Very dense wet, reddish brown, medium to coarse, sandy GRAVEL.
55	Bottom of Boring at 54.0 Feet. Completed 4/14/87.

Sample	N
S-1	28
S-2	50
S-3	42
S-4	40
S-5	78
S-6	42
S-7 A B	36
S-8	39
S-9 A B	32
S-10	82
S-11 A B	84

Well Design

Top Casing Elevation in Feet 34.61



J-1639-04 April 1987

HART-CROWSER & associates inc.

Boring Log and Construction Data for Well HC-5I

Geologic Log

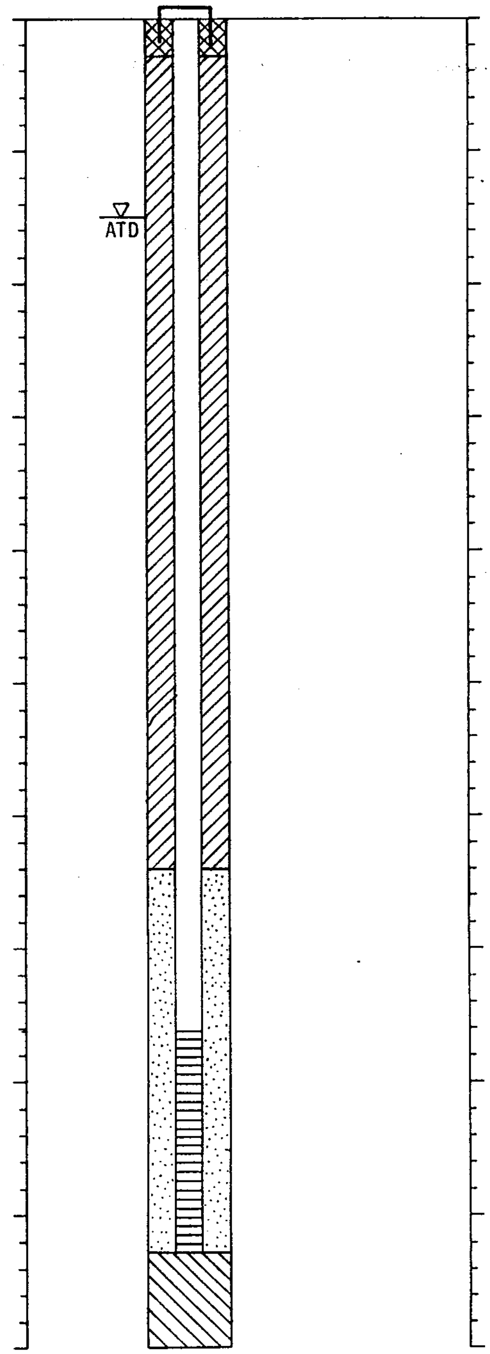
Ground Surface Top of Flush Mount Lid Elevation in Feet 30.61

Depth in Feet	Description	Sample	N
0	Soft, wet, light reddish brown, clayey SILT.	S-1 A/B	3
5	Very loose, wet, light reddish brown to gray, silty, fine SAND.		
	Medium dense, wet, gray, fine SAND.	S-2	15
10	Trace to slightly silty.		
	Medium stiff to stiff, wet, gray, clayey SILT with few fine organics.	S-3 A/B/C	8
15	Loose, wet, gray, slightly gravelly, silty, fine to medium SAND with trace fine organics.		
	Very dense, wet, gray, fine SAND.	S-4 A/B	58
20	Very dense to dense, wet, light brown to reddish brown, sandy GRAVEL.	S-5	73
25		S-6	76
30	Medium to coarse sandy.	S-7	38
35		S-8	61
40	Medium dense to dense, wet, light brown, fine SAND.	S-9 A/B	30
45	Medium dense to dense, wet, light brown, very fine sandy GRAVEL.		
	Medium dense, wet, light brown, fine SAND.	S-10	18
50			

Bottom of Boring at 50.0 Feet.
Completed 4/15/87.

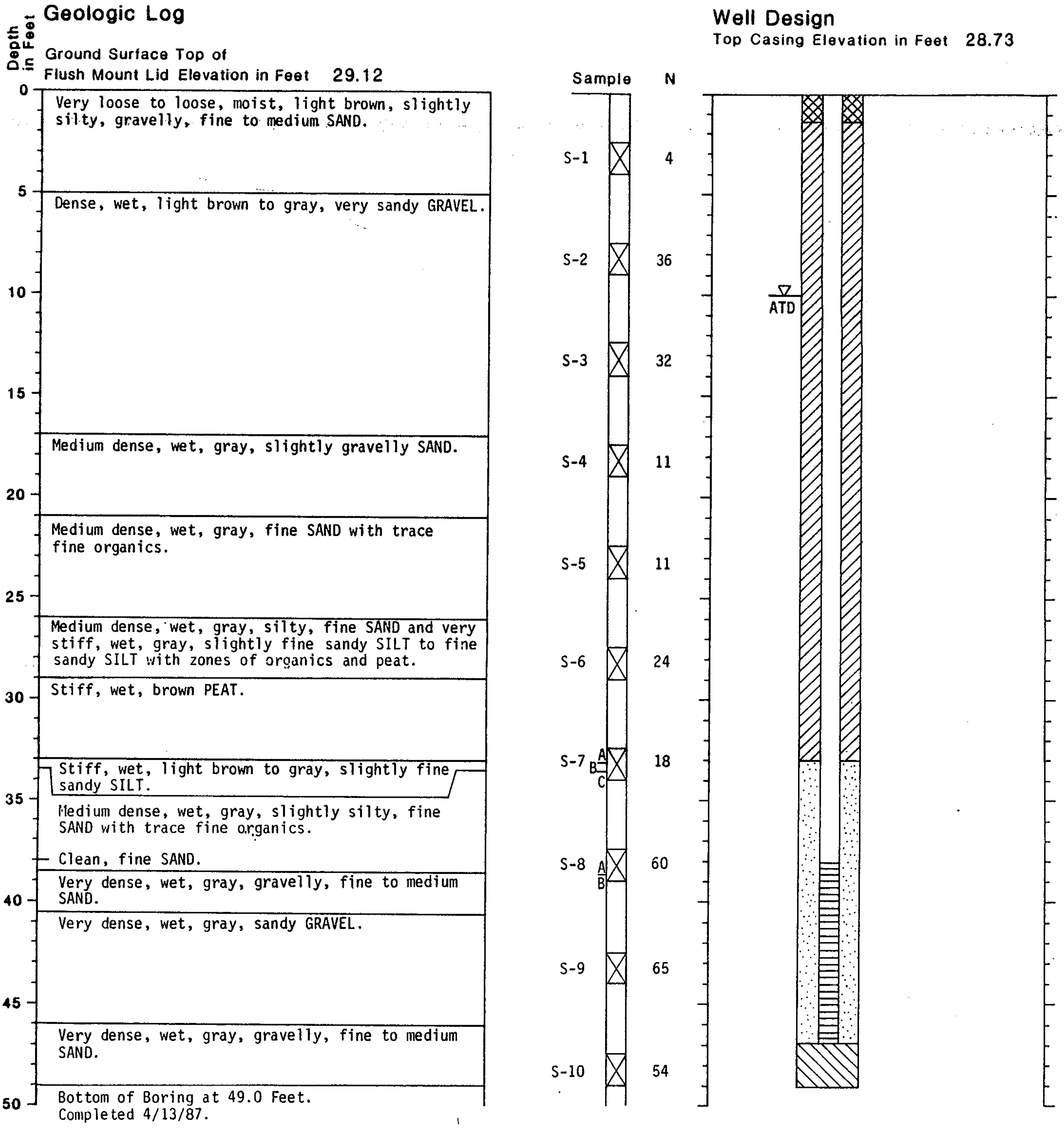
Well Design

Top Casing Elevation in Feet 30.28



J-1639-04 April 1987
HART-CROWSER & associates, inc.

Boring Log and Construction Data for Well HC-6I

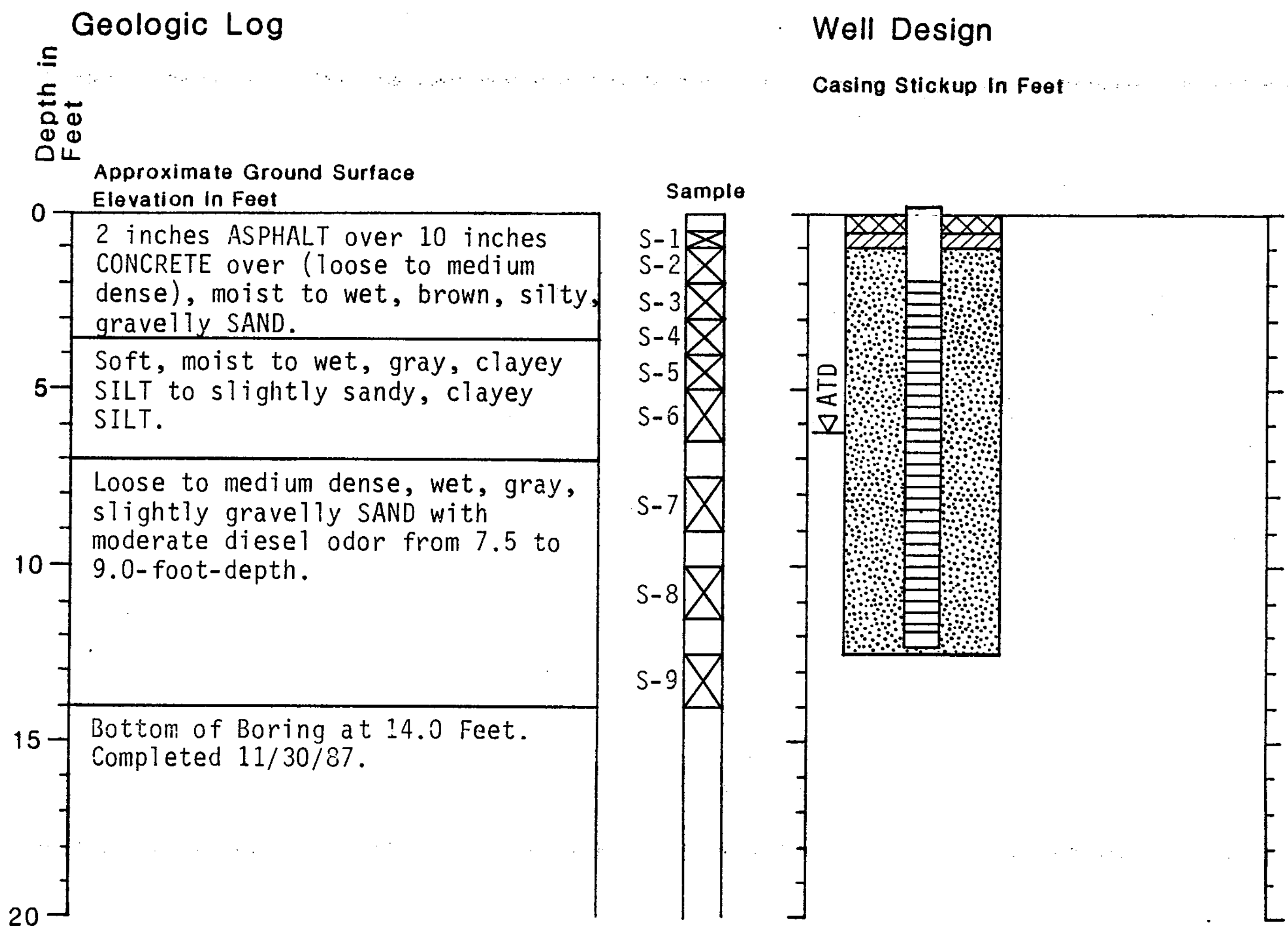


J-1639-04 April 1987

HART-CROWSER & associates, inc.

WELLS 11-OW1 THROUGH 11-OW3
HART CROWSER (1987)

Boring Log and Construction Data for 11-OW1



Water Level

Concrete Surface Seal

Volclay Grout Backfill

Aqua No. 8 Sand Pack

2-inch Φ PVC Riser Pipe

2-inch Φ PVC Screen (0.020 Slot Size)

NOTES:

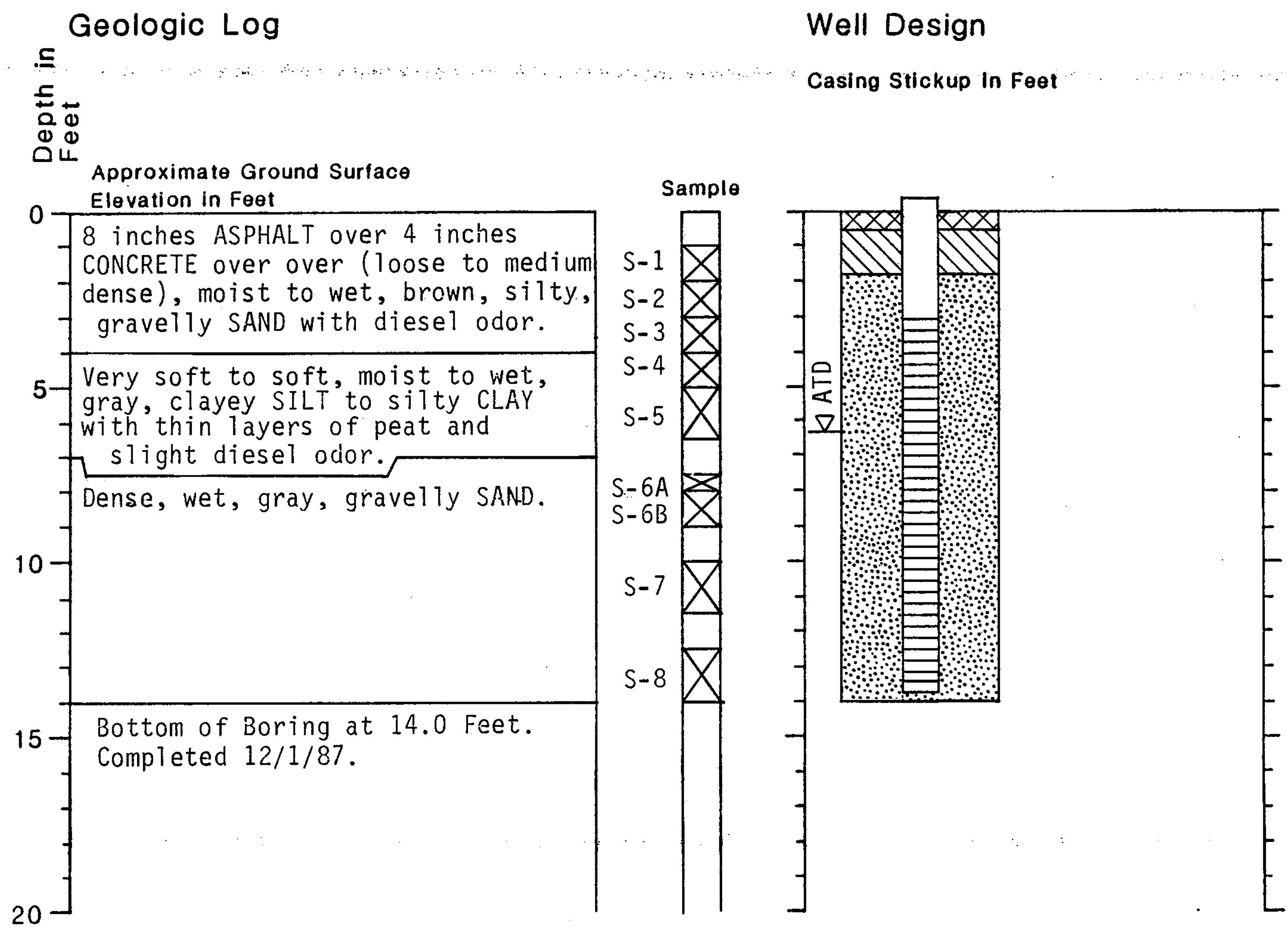
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with the time of year. ATD: At Time of Drilling

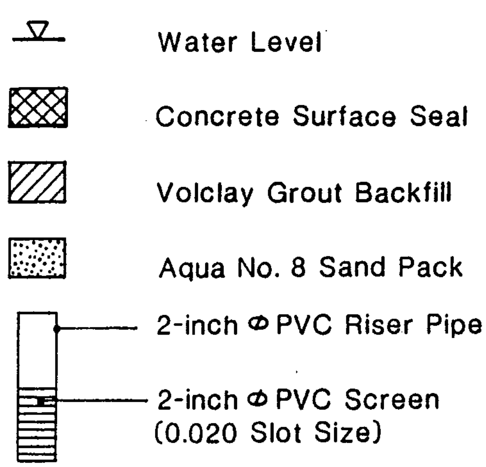
HARTCROWSER

J-1639-05 12/87

Figure

Boring Log and Construction Data for 11-OW2





NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with the time of year. ATD: At Time of Drilling

Boring Log and Construction Data for 11-OW3

Geologic Log

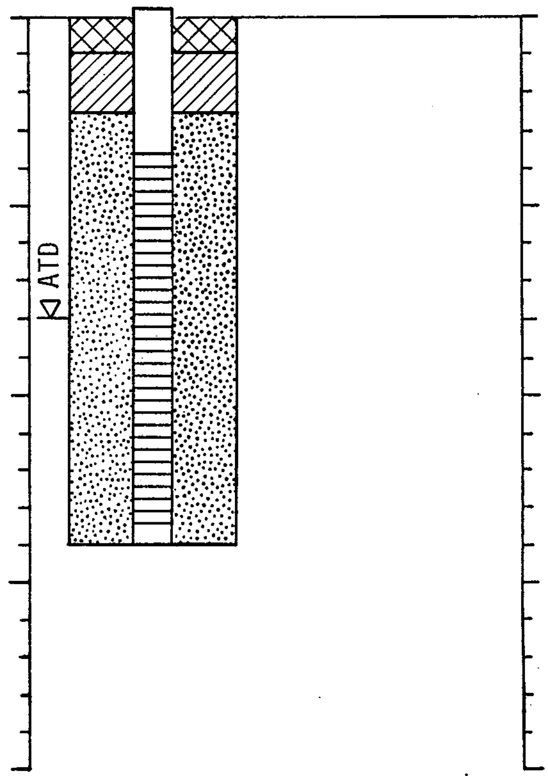
Depth in Feet

Approximate Ground Surface Elevation in Feet

Depth in Feet	Description	Sample
0	6 inches ASPHALT over (loose), wet, brown, gravelly SAND.	S-1, S-2
	Very soft, moist to wet, gray, clayey SILT to clayey, sandy SILT with moderate diesel odor from 2.0 to 4.0-foot-depth and thin layers of peat.	S-3, S-4, S-5, S-6
5	Loose, wet, gray, slightly clayey, silty SAND.	S-7
10	Medium dense to dense, wet, gray, gravelly SAND.	S-8, S-9
15	Bottom of Boring at 14.0 Feet. Compelted 12/1/87.	
20		

Well Design

Casing Stickup in Feet



- Water Level
- Concrete Surface Seal
- Volclay Grout Backfill
- Aqua No. 8 Sand Pack
- 2-inch ⌀ PVC Riser Pipe
- 2-inch ⌀ PVC Screen (0.020 Slot Size)

NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with the time of year. ATD: At Time of Drilling

HARTCROWSER

J-1639-05 12/87

Figure

WELLS OW-4S/D AND OW-5S/D,
MW-2DR, AND
OSP-1S/D THROUGH OSP-7S/D
HART CROWSER (1988)

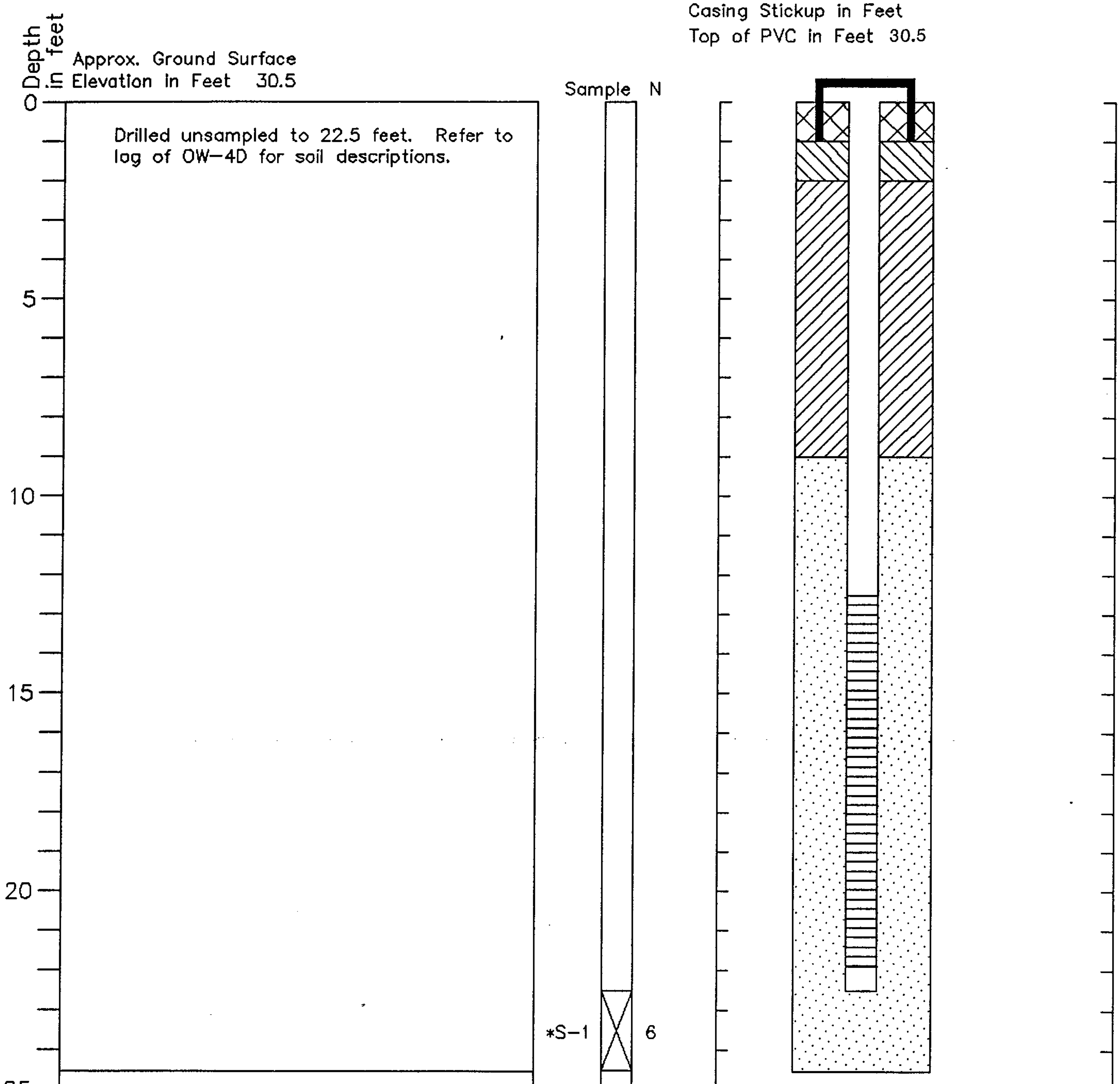
No Well OSP-3S was installed

Boring Log and Construction Data for Monitoring Well OW-4S

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 30.5



Bottom of Boring at 24.5 Feet.
Completed 8/29/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 8/88
Figure

Boring Log and Construction Data for Monitoring Well OW-4D

Geologic Log

Depth in feet

Approx. Ground Surface Elevation in Feet 30.5

Loose, damp, black, silty, fine to medium SAND with coal, slag, and ash material. (FILL)

Very soft to soft, wet, gray, slightly fine sandy to clayey SILT with petroleum-like odor.

Medium desne to dense, wet, gray, slightly silty to clean, gravelly SAND to very gravelly SAND with interbedded fine SAND.
Petroleum-like odor and sheen in samples S-4 and S-5.

Stiff to very stiff, wet, brown PEAT and light brown, slightly fine sandy SILT to SILT.

Very dense, wet, gray, fine SAND to slighlty gravelly, fine SAND.

Hard, wet, gray SILT and brown PEAT.

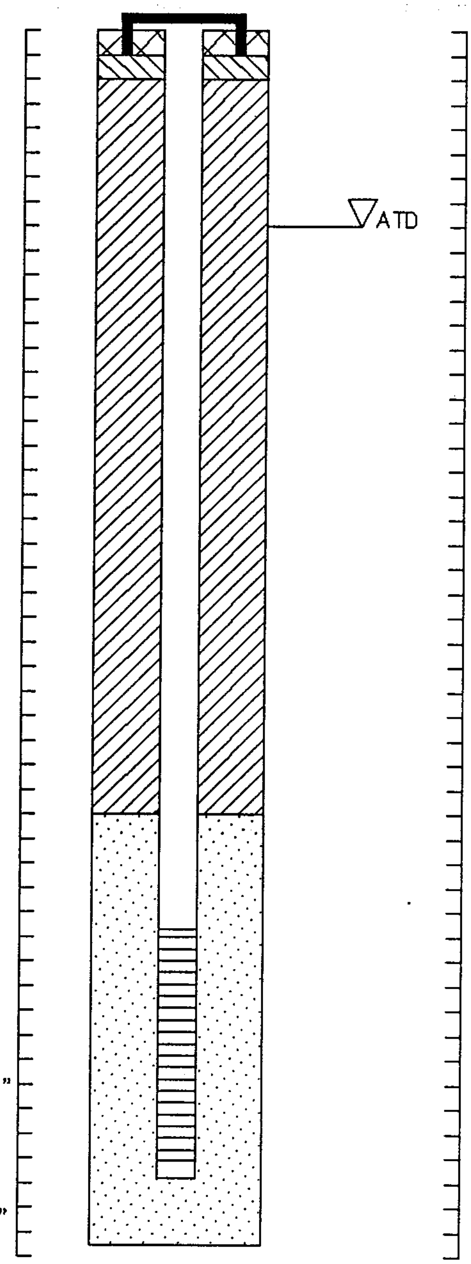
Very dense, wet, gray, slightly silty, gravelly SAND.

Bottom of Boring at 49.5 Feet.
Completed 8/26/88.

Sample	N
S-1	10
S-2	3
S-3	2
S-4	28
S-5	20
S-6	21
S-7	32
S-8	45
S-9	60
S-10	11
S-11 A/B	52
S-12	17
S-13	50/5"
S-14	73/10"
S-15 A/B	80/11"

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 30.5



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 8/88
Figure

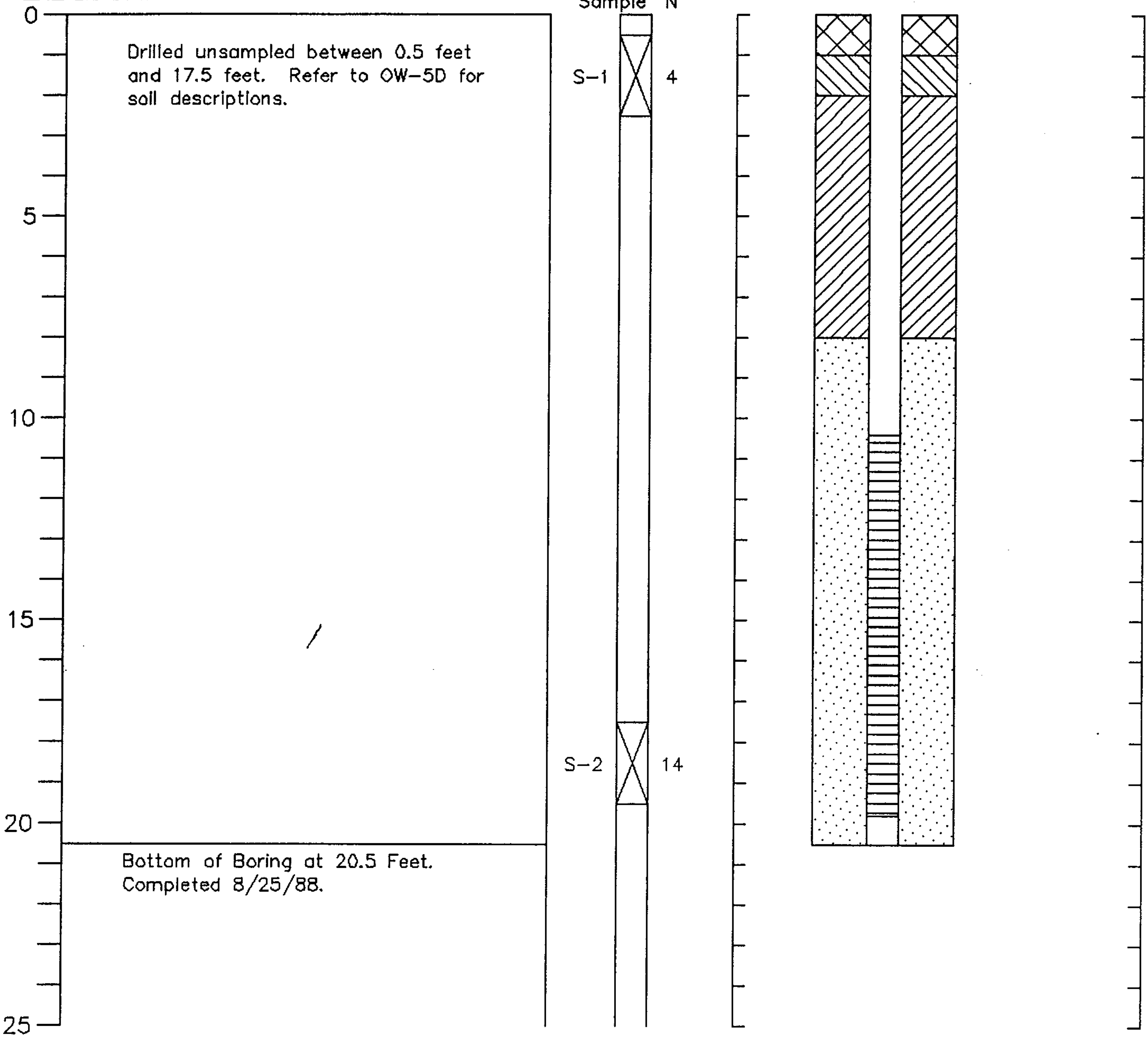
Boring Log and Construction Data for Monitoring Well OW-5S

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet

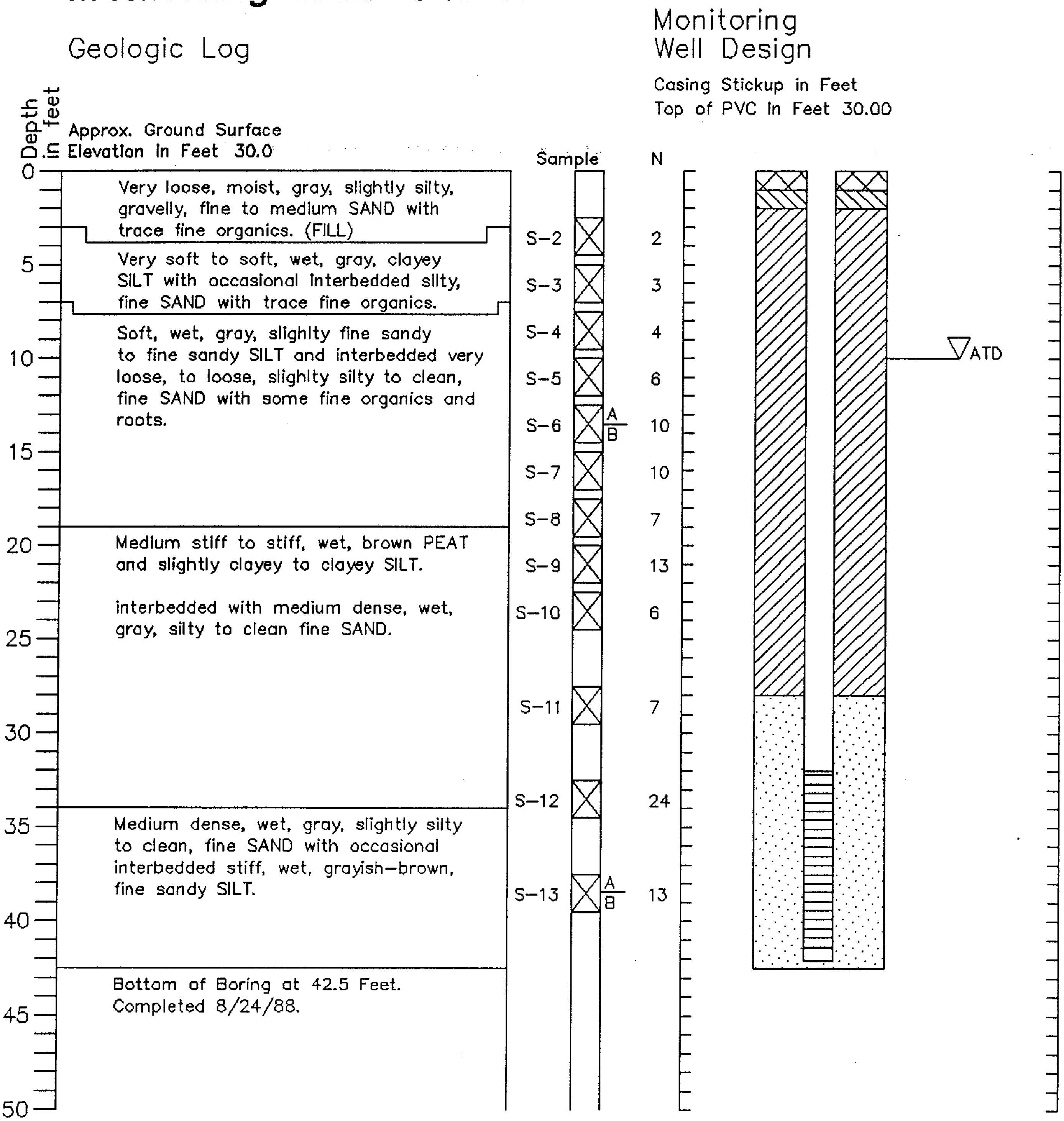
Depth in feet
Approx. Ground Surface Elevation in Feet



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 8/88
Figure

Boring Log and Construction Data for Monitoring Well OW-5D



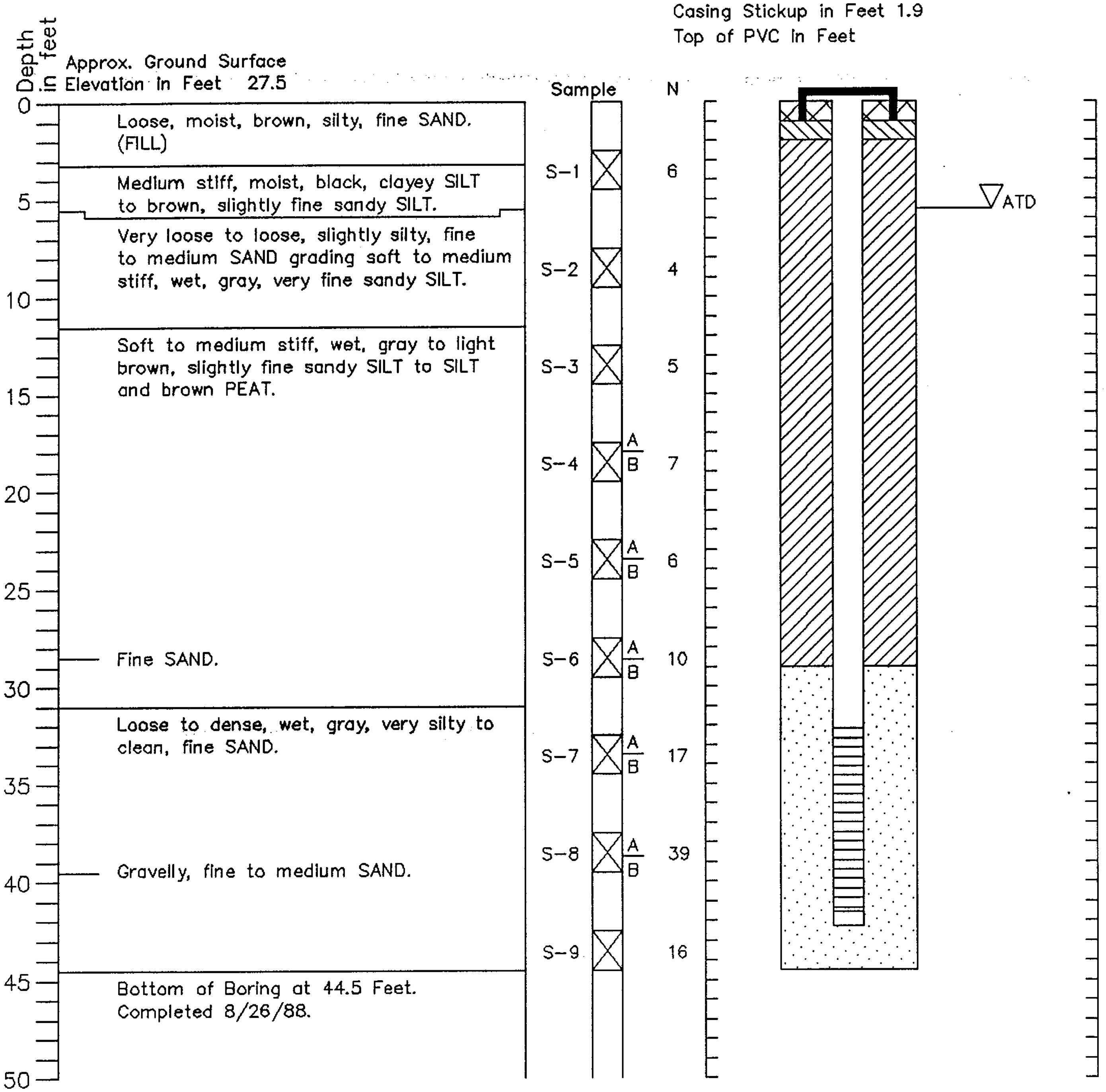
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 8/88
Figure

Boring Log and Construction Data for Monitoring Well MW-2DR

Geologic Log

Monitoring Well Design



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-1639-09 8/88

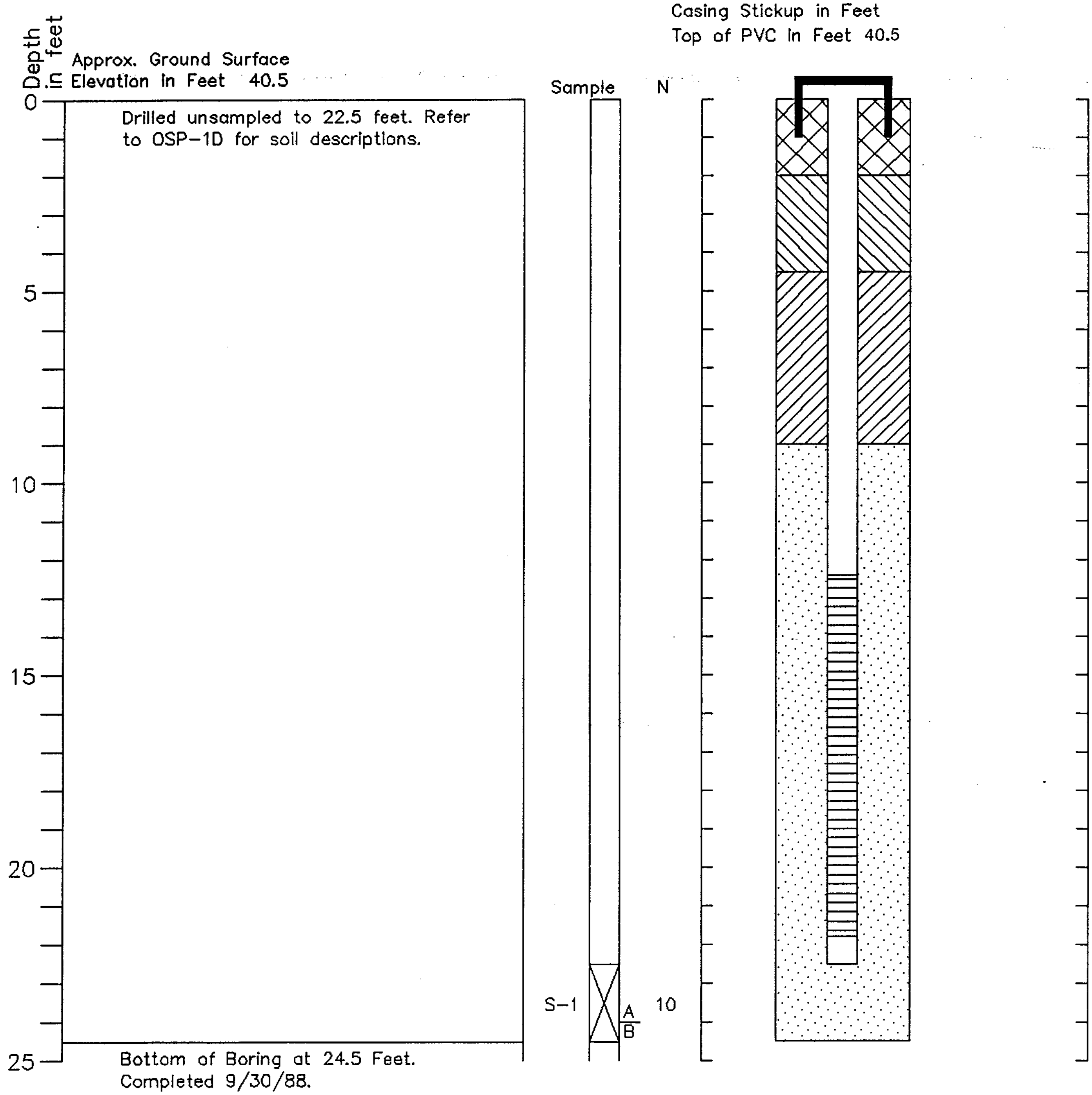
Figure

Boring Log and Construction Data for Monitoring Well OSP-1S

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 40.5



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 8/88

Figure

Boring Log and Construction Data for Monitoring Well OSP-1D

Geologic Log

Depth in feet

Approx. Ground Surface Elevation in Feet 40.5

- Medium dense, moist to damp, light brown to brown, silty, fine SAND with some wood, slag, and ashes. (FILL)
- Very stiff, moist, gray, fine sandy SILT with wood.
- Medium stiff, moist, brown PEAT and slightly fine sandy SILT.
- Loose, moist, light brown to gray, slightly silty, fine SAND grading to fine to coarse SAND with wood.
- Medium dense, wet, gray, slighlty silty, very sandy GRAVEL.
- Stiff, wet, brown PEAT and medium dense, wet, light brown to gray, very silty, fine SAND.
- Loose to medium dense, wet, gray, slightly silty, fine SAND grading to slightly gravelly SAND with some wood.
- Very stiff, wet, brown PEAT with some wood and light brown, clayey SILT.
- Medium dense to very dense, wet, gray to light brown, silty, fine SAND to fine SAND.

  Slightly gravelly

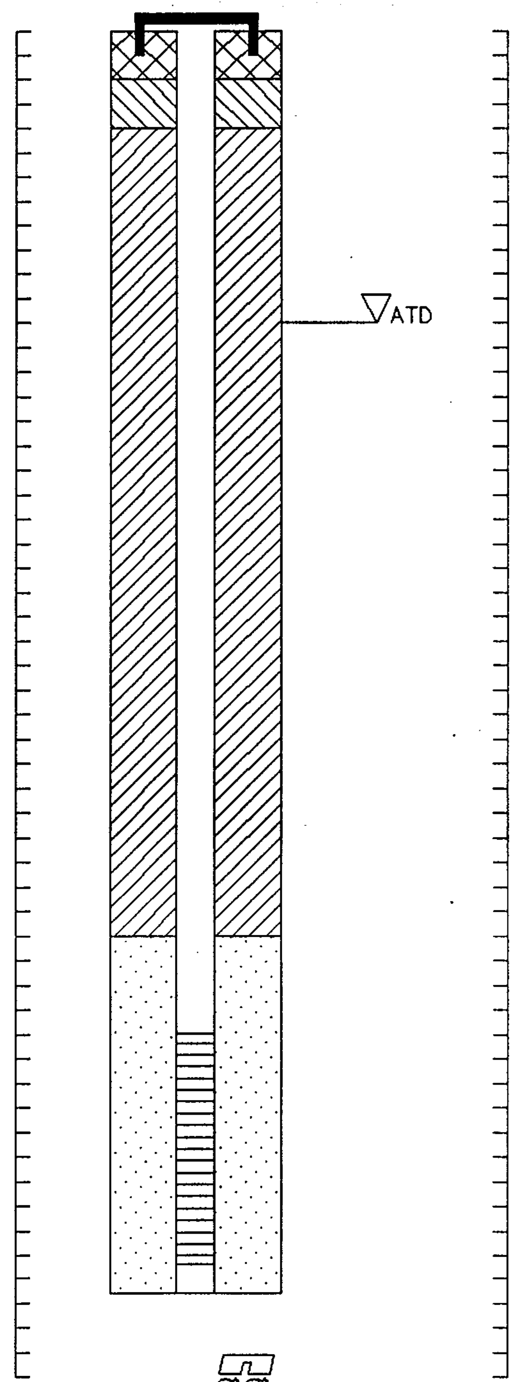
Bottom of Boring at 51.5 Feet.
Completed 8/29/88.

Sample	N
S-1	24
S-2	7
S-3	14
S-4	29
S-5	35
S-6	18
S-7	25
S-8	28
S-9	48
S-10	30
S-11	80

Monitoring Well Design

Casing Stickup in Feet

Top of PVC in Feet 40.50



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

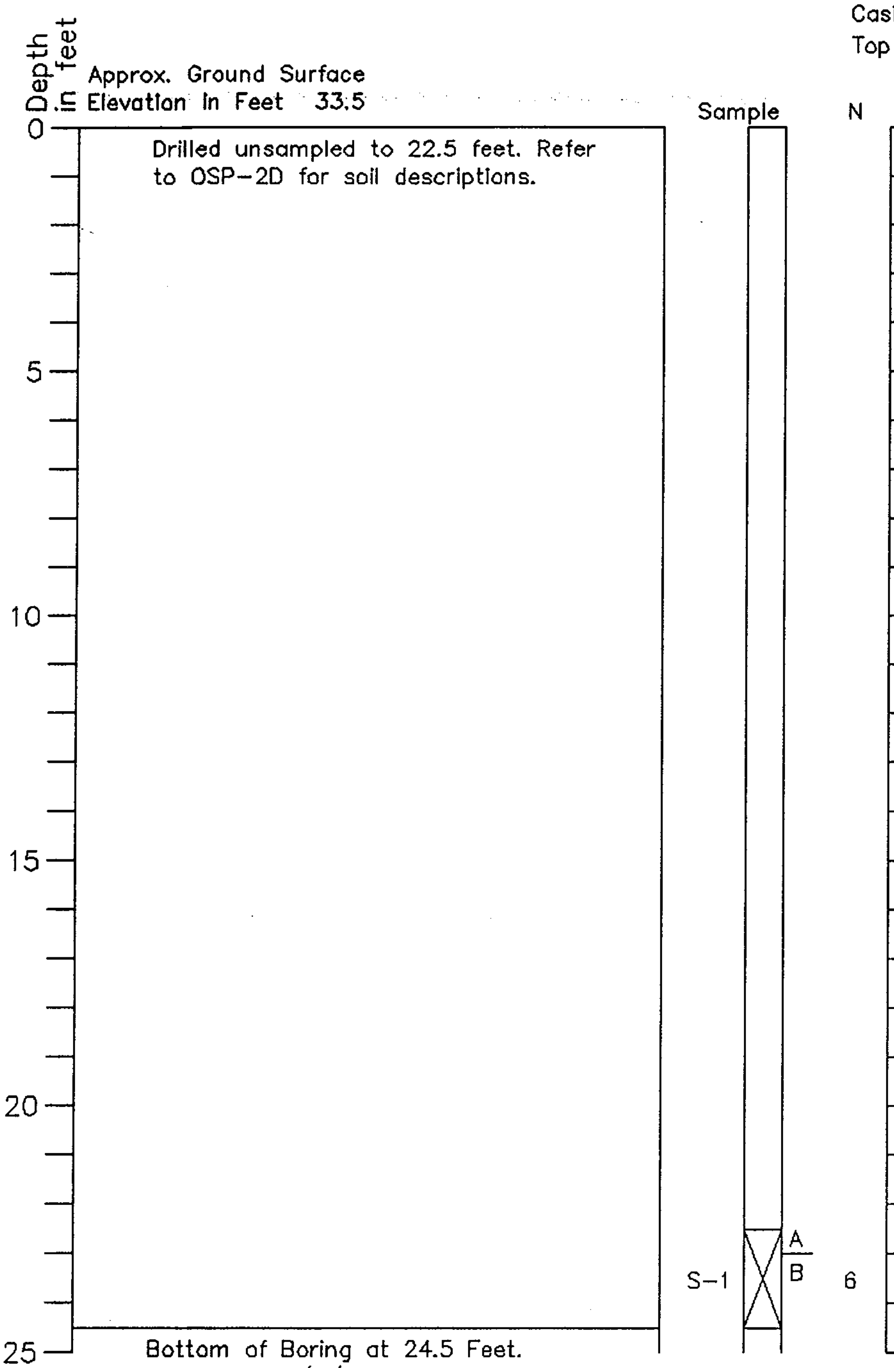
J-1639-09 8/88

Figure

Boring Log and Construction Data for Monitoring Well OSP-2S

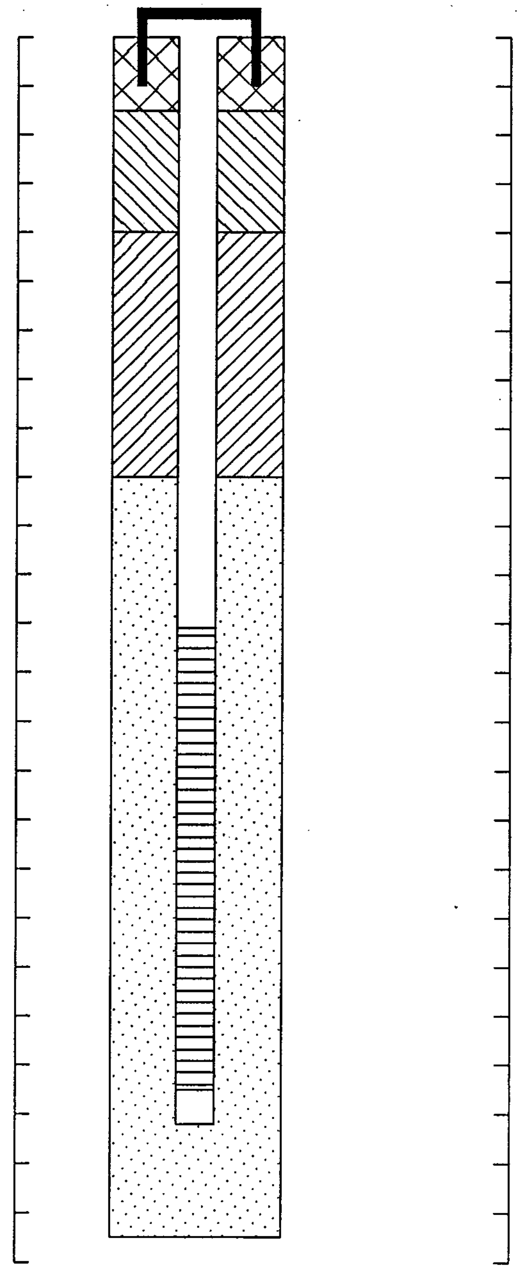
Geologic Log

Approx. Ground Surface Elevation in Feet 33.5



Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 33.5



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

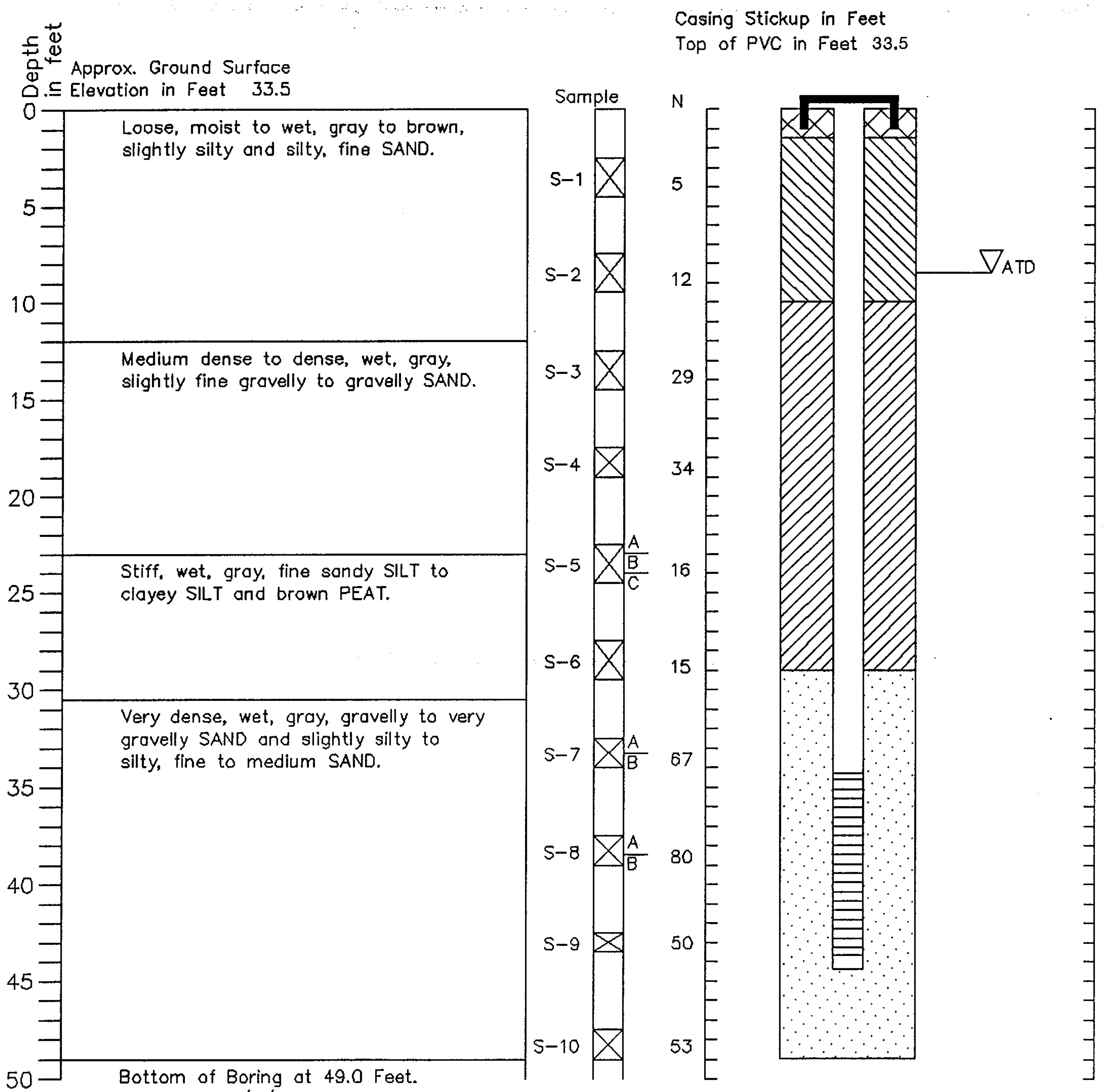
HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-2D

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 33.5



Bottom of Boring at 49.0 Feet.
Completed 9/2/88.

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88

Figure

Boring Log and Construction Data for Monitoring Well OSP-3D

Geologic Log

Depth in feet

Approx. Ground Surface Elevation in Feet 34.5

Loose, moist, light brown, silty, fine SAND with interbedded slightly silty, fine SAND and trace fine roots.

Very dense, moist, brown, slightly silty, gravelly, fine to medium SAND.

Loose to medium dense, wet, gray, slightly silty to silty, fine SAND.

Medium stiff, wet, gray, SILT with thin interbedded organics.

Very loose, wet, gray, fine gravelly SAND to slightly gravelly, fine SAND.

Soft to stiff, wet, gray, fine sandy SILT and SILT with thin interbedded fine organics.

Grading to medium dense, slightly silty to silty, fine SAND.

Medium dense to very dense, fine SAND with interbedded slightly gravelly to gravelly, fine to medium SAND.

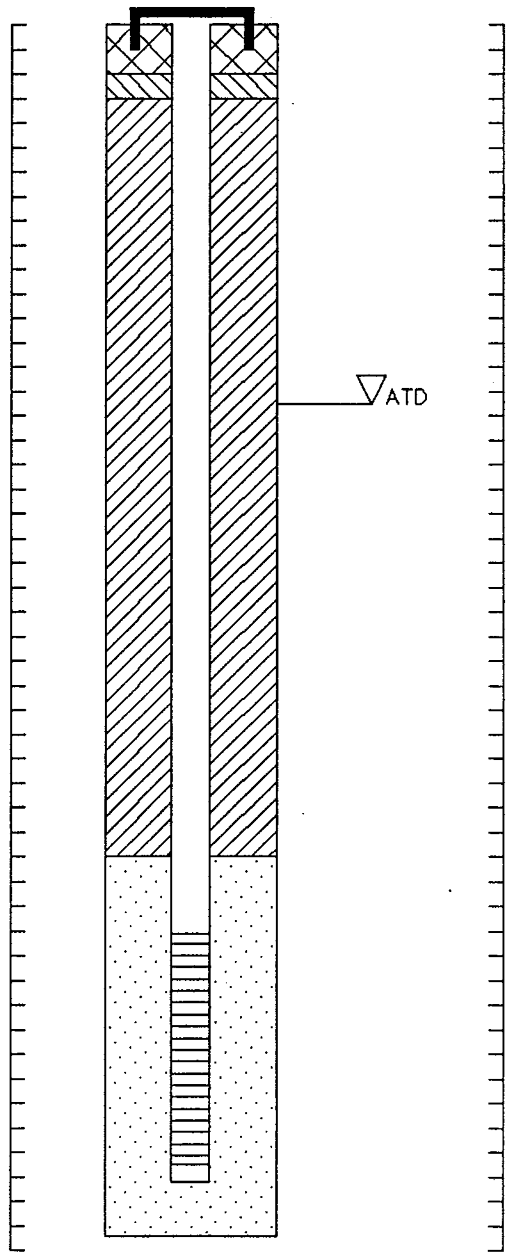
Very stiff, wet, gray, fine sandy SILT.

Bottom of Boring at 49.5 Feet.
Completed 8/30/88.

Sample	Subsamples	N
S-1		4
S-2		78
S-3		50/6"
S-4	A, B	7
S-5		15
S-6	A, B, C	6
S-7	A, B	24
S-8		29
S-9	A, B	59
S-10		74

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 34.5



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-1639-09 8/88

Figure

Boring Log and Construction Data for Monitoring Well OSP-4S

Geologic Log

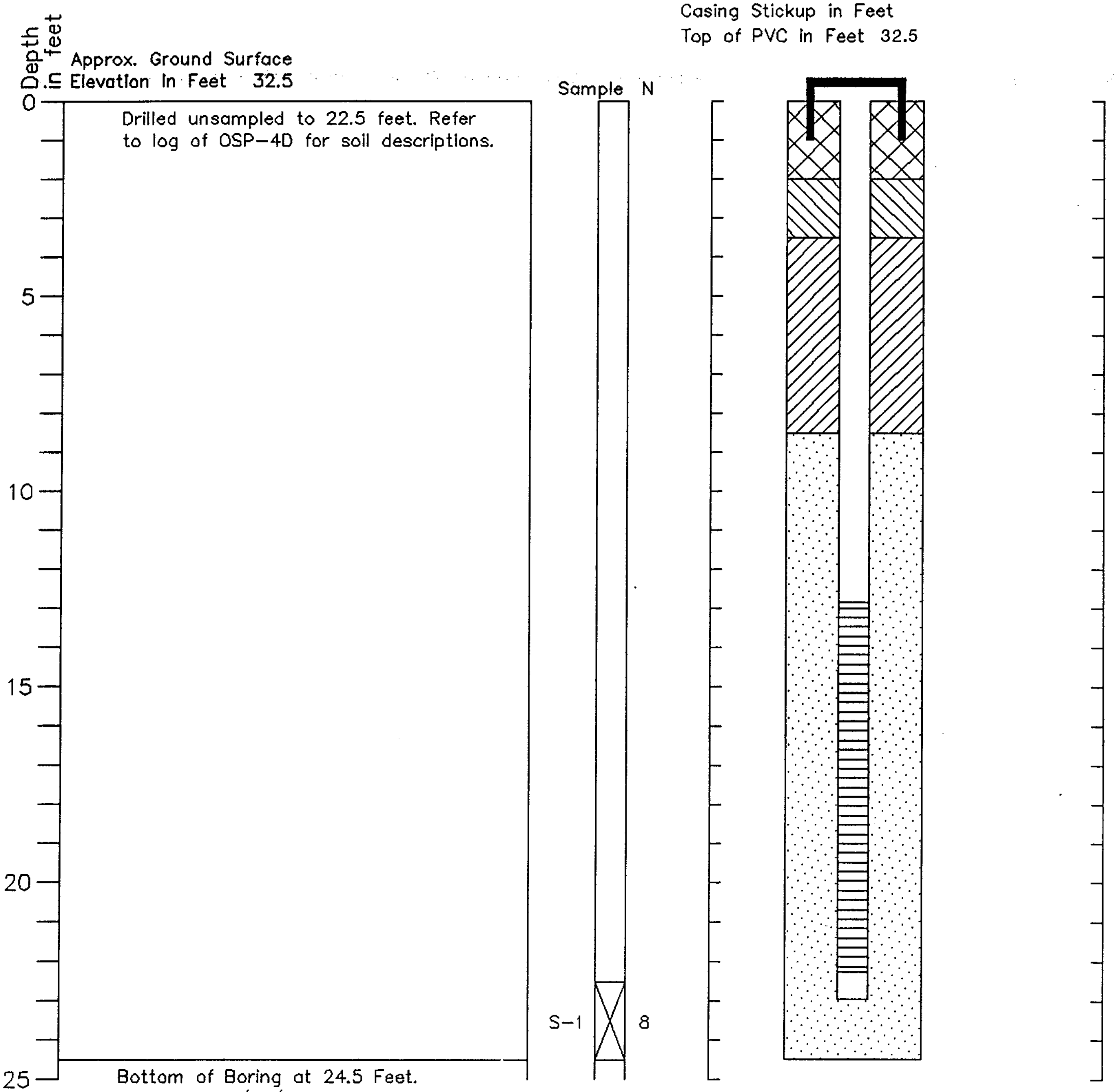
Approx. Ground Surface Elevation In Feet 32.5

Drilled unsampled to 22.5 feet. Refer to log of OSP-4D for soil descriptions.

Bottom of Boring at 24.5 Feet. Completed 9/10/88.

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 32.5



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-4D

Geologic Log

Approx. Ground Surface Elevation in Feet 33.0

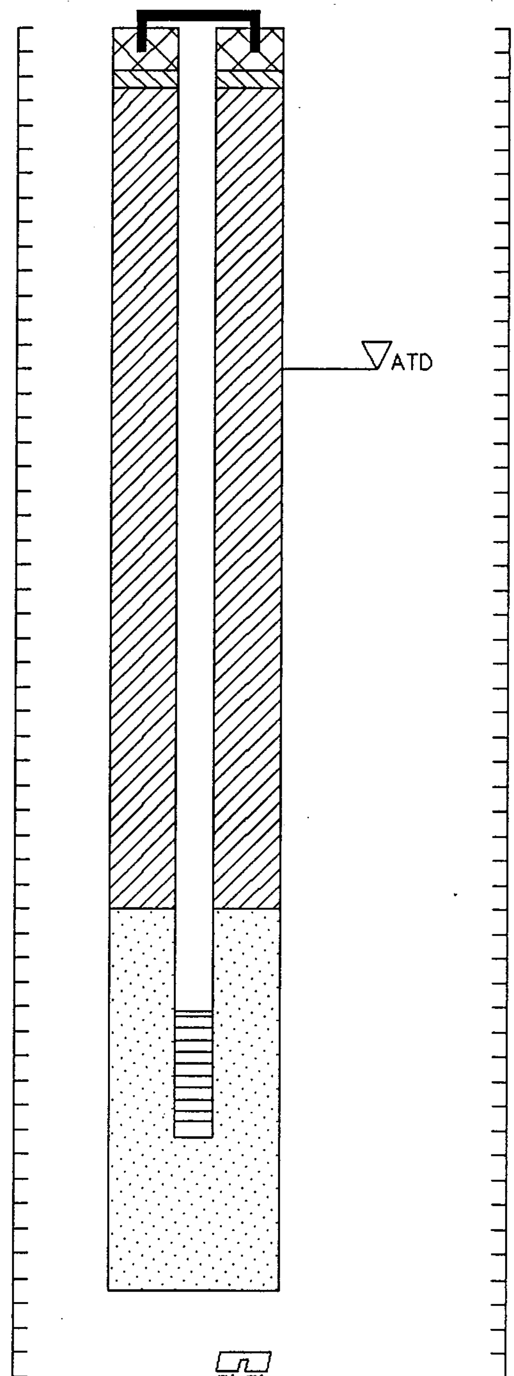
Soil Description
Very soft to soft, moist, light brown and reddish brown SILT.
Medium dense, moist, reddish brown, slightly silty, fine SAND.
Medium dense, moist, reddish brown, slightly silty, gravelly SAND grading slightly silty, very gravelly SAND.
Loose to medium dense, wet, gray, silty to very silty, fine SAND and medium stiff to stiff, wet, gray, fine sandy SILT to SILT and PEAT.
Medium dense to dense, wet, gray, slightly silty, fine SAND with fine sandy SILT and PEAT with wood.
Medium dense to dense, wet, gray, slightly silty, sandy GRAVEL to slightly silty, slightly gravelly to gravelly SAND.
Bottom of Boring at 51.5 Feet. Completed 9/8/88.

Sample	N
S-1	3
S-2	14
S-3	36
S-4 (A/B)	10
S-5	7
S-6	11
S-7 (A/B)	30
S-8 (A/B)	54
S-9	36
S-10	38
S-11	61

Depth in feet: 0–55

Monitoring Well Design

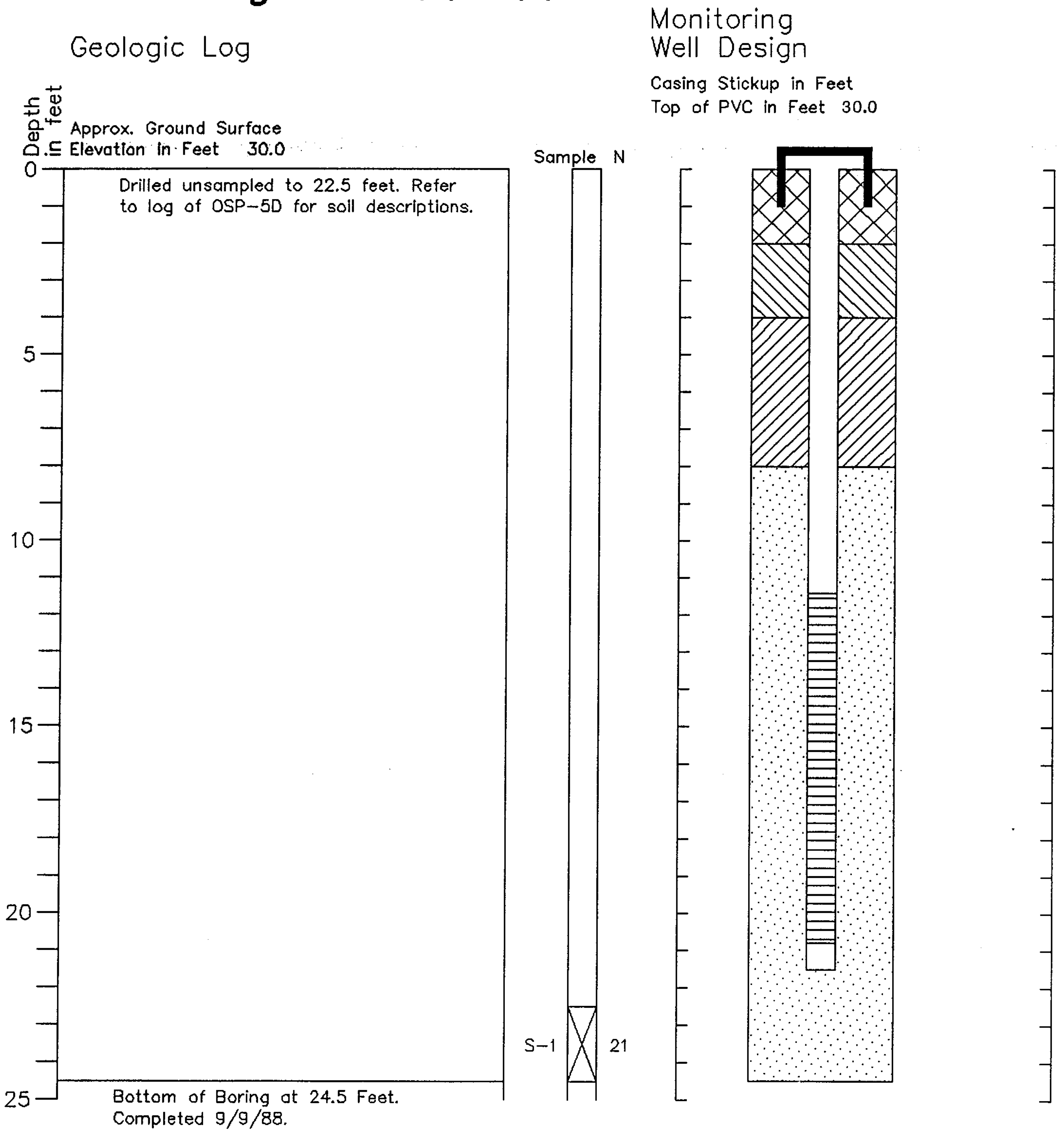
Casing Stickup in Feet
Top of PVC in Feet 33.00



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-5S



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-5D

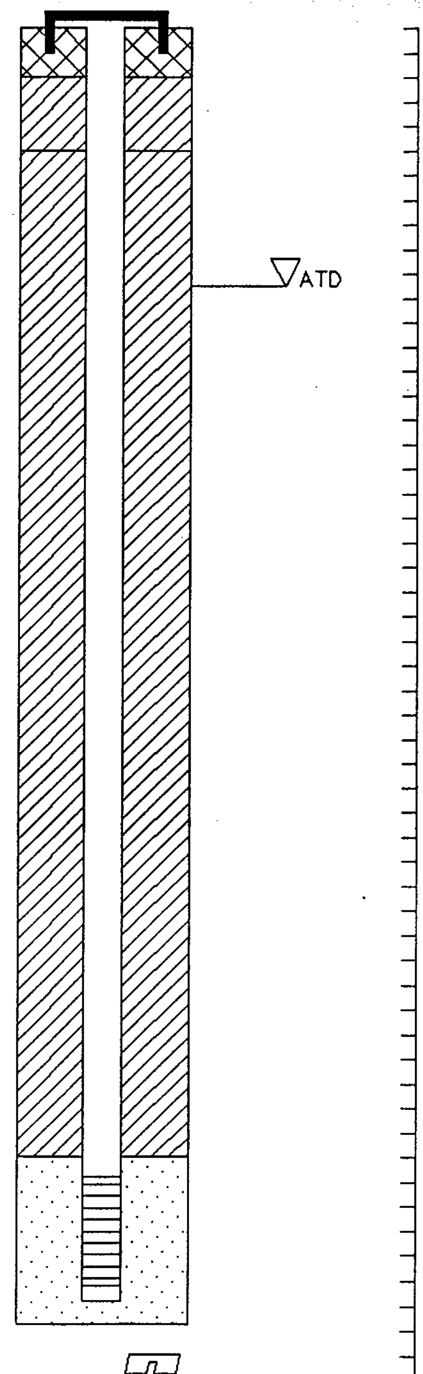
Geologic Log

Approx. Ground Surface Elevation In Feet 30.0

Depth in feet	Description	Sample	N
0–6.5	Loose, moist, light brown, very silty, fine SAND with interbedded silty, fine SAND.	S-1	8
6.5–21	Medium dense to dense, moist to wet, reddish brown to gray, slightly silty to clean, very gravelly, fine to medium SAND to gravelly SAND.	S-2	41
		S-3	32
		S-4	52
21–28.5	Loose, wet, gray, slightly silty, fine SAND with interbedded silty, fine SAND with trace wood.	S-5	12
		S-6 A/B	66
28.5–31	Very dense, wet, slightly silty, sandy GRAVEL.		
31–40	Stiff to very stiff, wet, light brown, fine sandy SILT and brown PEAT.	S-7	17
		S-8 A/B	30
40–52.8	Very dense, wet, gray, fine SAND and very gravelly SAND.	S-9	79
		S-10	75/11"
~51	Cobbles.	*S-11	50/3"
52.8	Bottom of Boring at 52.8 Feet. Completed 9/9/88.		

Monitoring Well Design

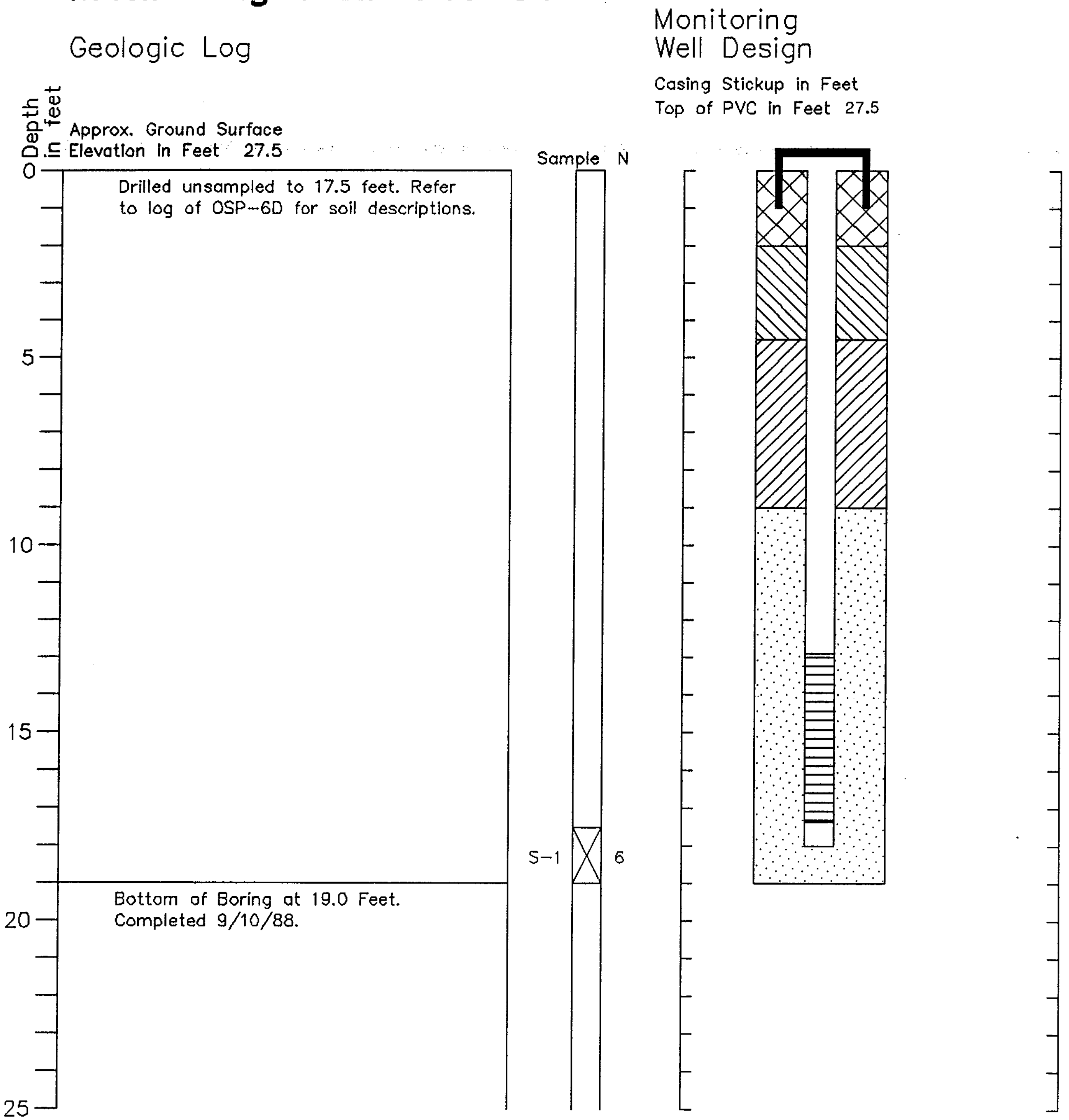
Casing Stickup in Feet
Top of PVC in Feet 30.00



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

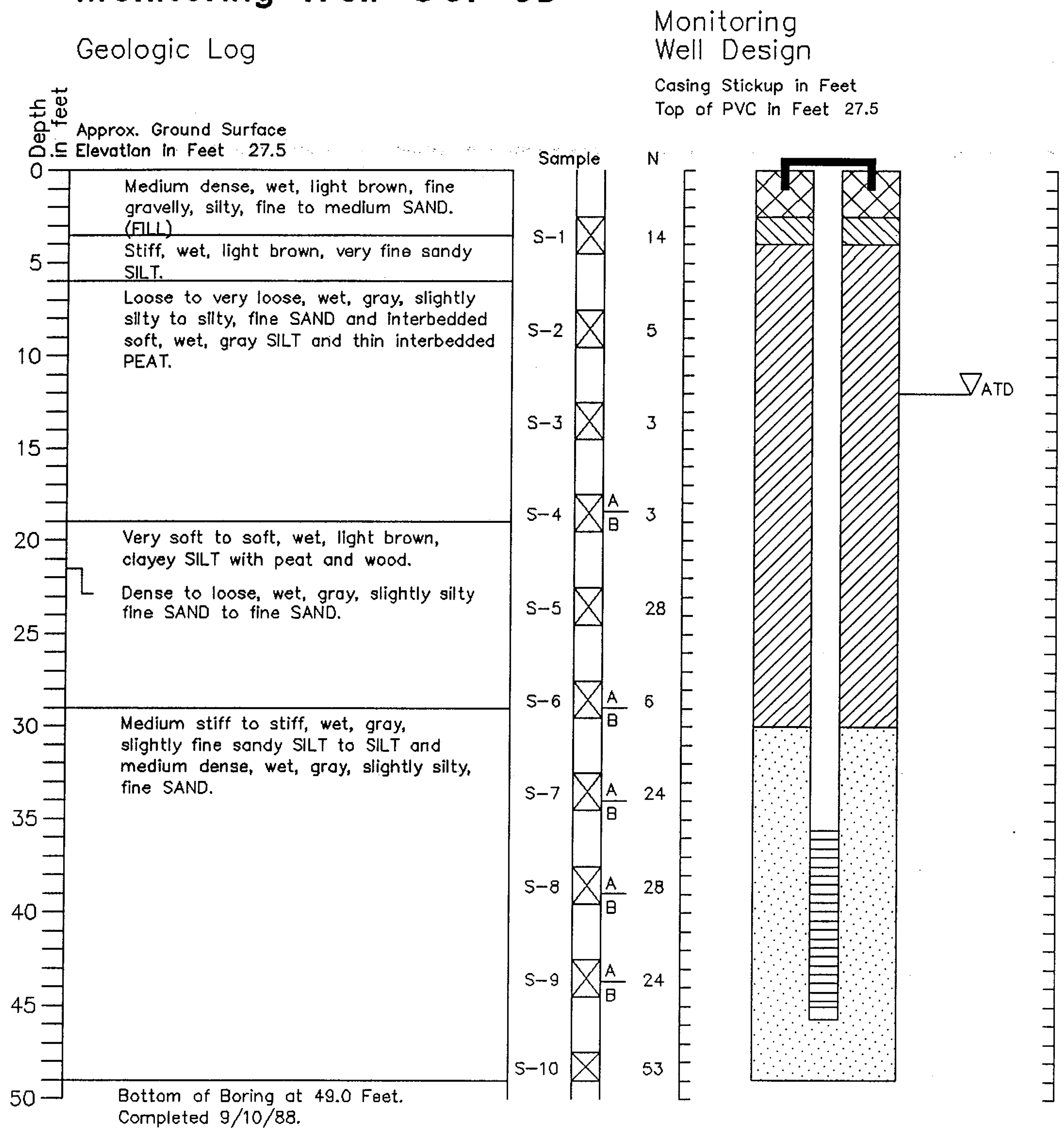
Boring Log and Construction Data for Monitoring Well OSP-6S



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-6D



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

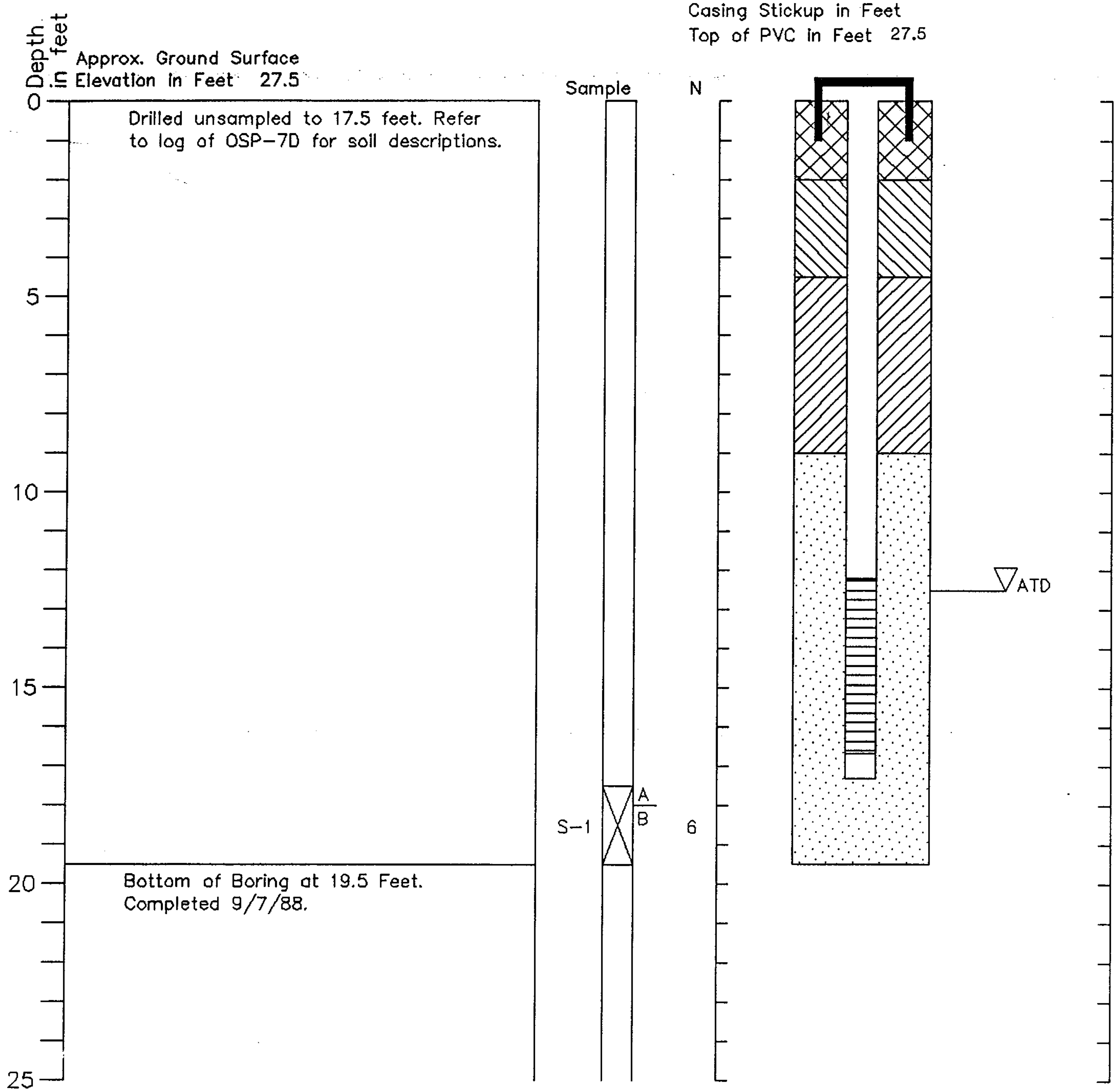
HARTCROWSER
J-1639-09 9/88
Figure

Boring Log and Construction Data for Monitoring Well OSP-7S

Geologic Log

Monitoring Well Design

Casing Stickup in Feet
Top of PVC in Feet 27.5



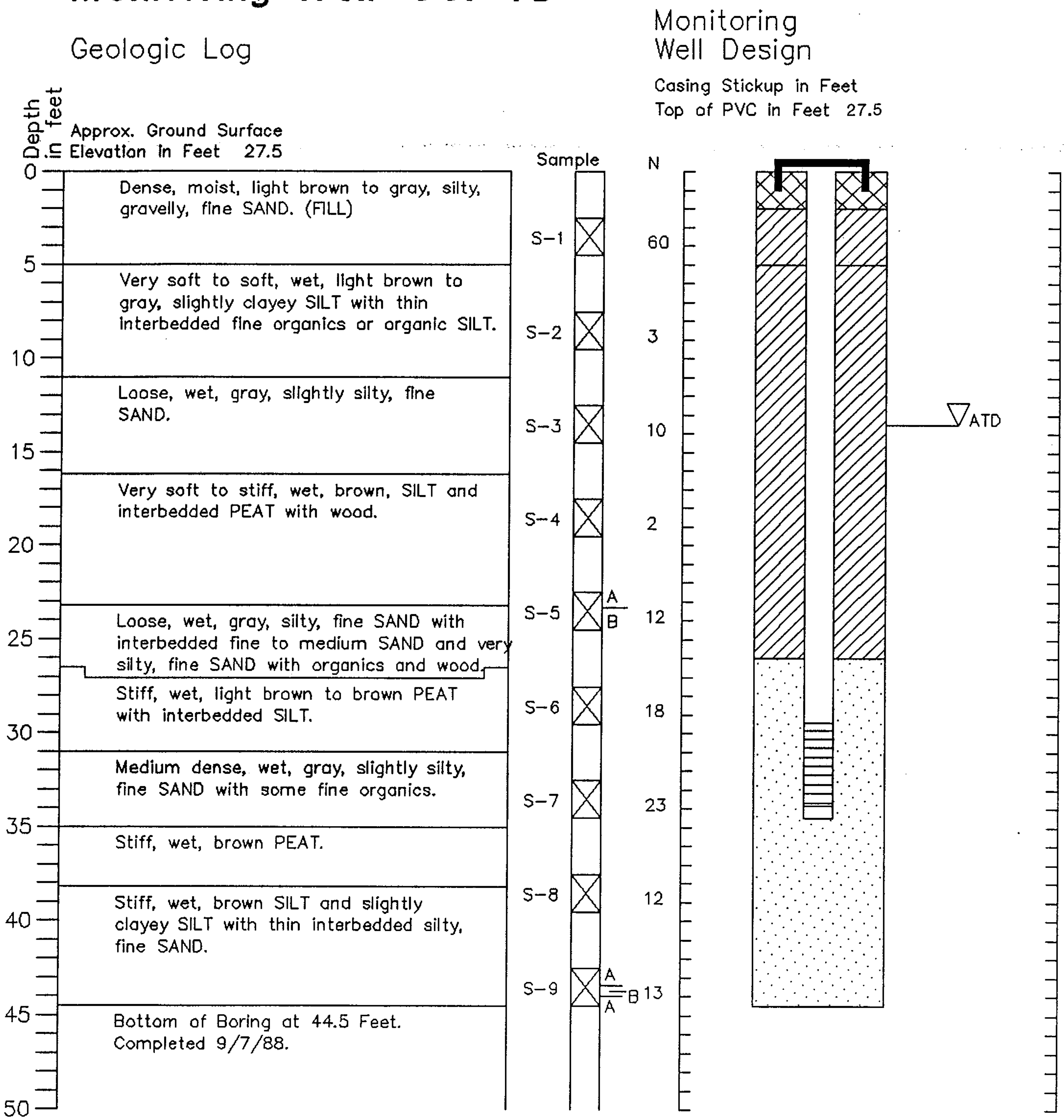
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

J-1639-09 **9/88**

Figure

Boring Log and Construction Data for Monitoring Well OSP-7D



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-1639-09 9/88
Figure

PIEZOMETERS OSP-8 THROUGH OSP-13
HART CROWSER (1988)

Boring Log OSP-8

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense, moist, tan, slightly gravelly, silty SAND to very stiff, slightly sandy SILT with some wood fragments. (FILL?)

Loose, moist, dark brown, sandy SILT with interbedded non-fibrous PEAT lenses.

Medium dense, damp, brown, slightly silty SAND with trace of gravel.

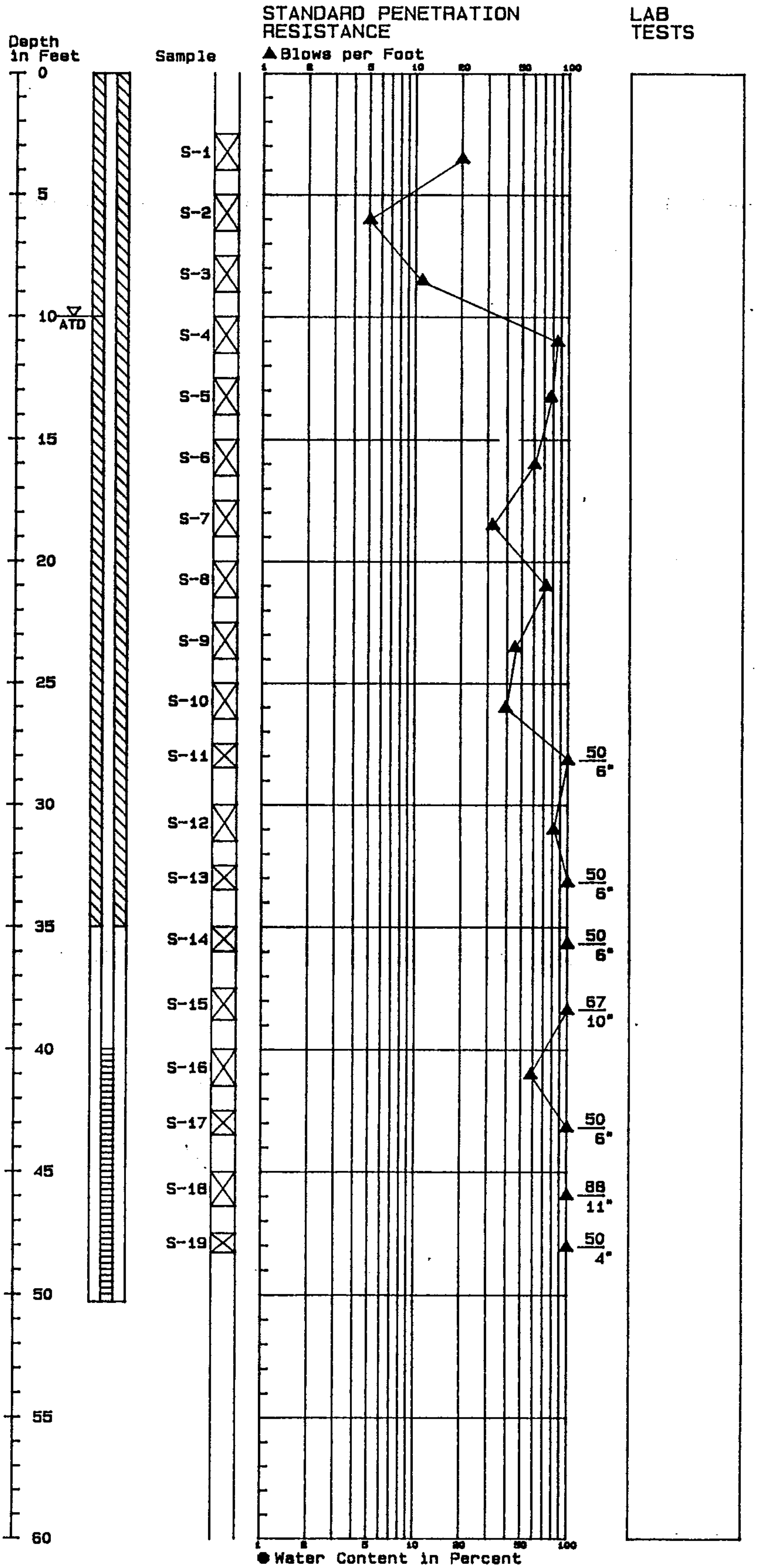
Very dense to medium dense, wet, gray-brown to brown, slightly silty to slightly gravelly to gravelly SAND.

- Grading denser with depth.

Very dense, wet, greenish-gray, slightly gravelly, silty SAND.

Very dense, wet, gray, slightly silty, fine SAND.

Bottom of Boring at 50.3 Feet.
Completed 12/2/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

Boring Log OSP-9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

6 inches ASPHALT over medium dense, moist, gray to dark brown, very silty SAND with trace PEAT. (FILL)

Stiff to very stiff, moist, mottled gray and rusty brown, slightly sandy, silty CLAY.

Dense, wet, brown, silty SAND to slightly silty, sandy GRAVEL.

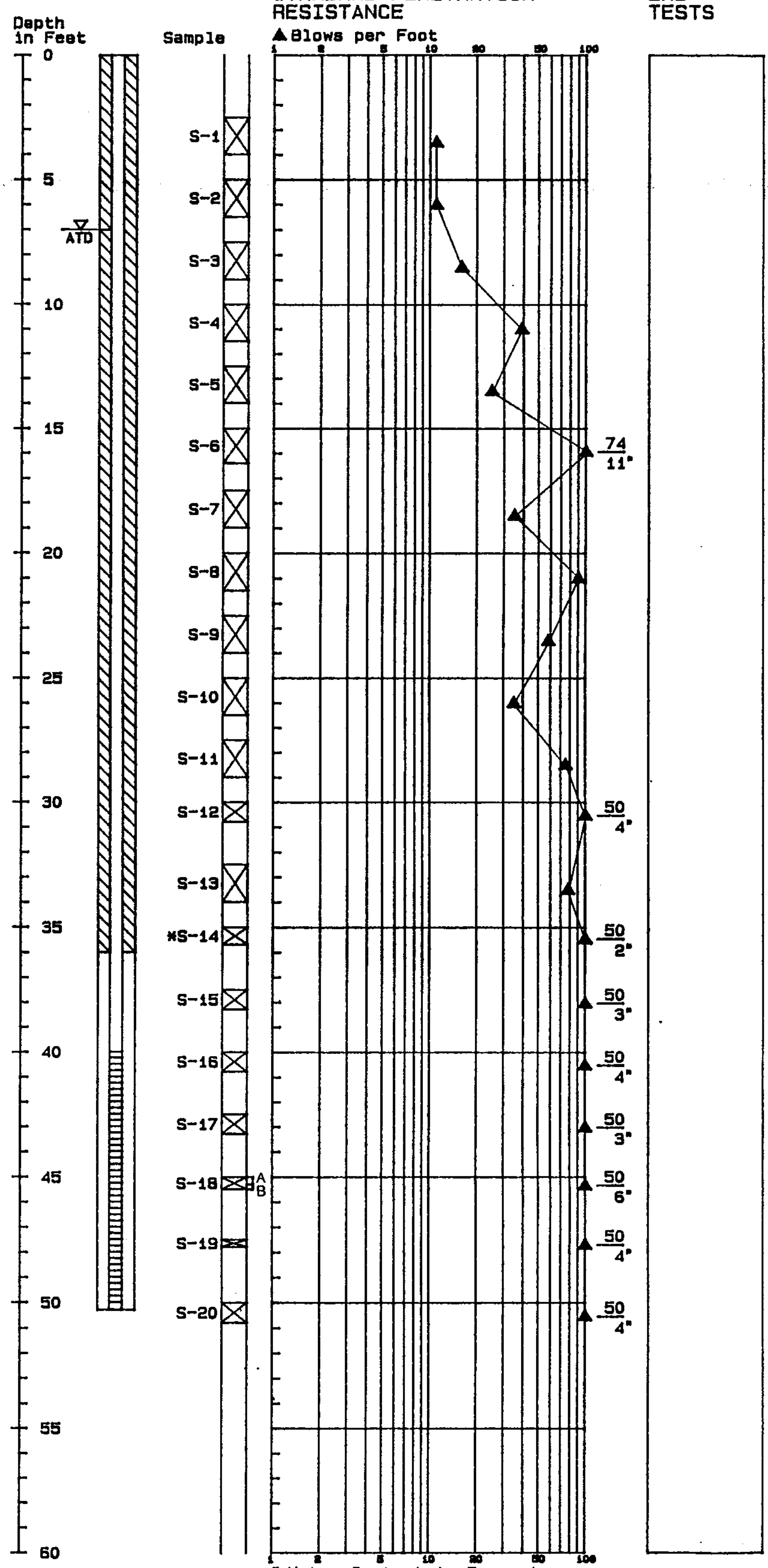
Medium dense to very dense, wet, brown to gray-brown, slightly silty, slightly gravelly, medium to coarse SAND.

Very dense, wet, gray, slightly gravelly, medium to fine SAND

GRAVELS?

Very dense, moist, gray, silty to very silty, fine SAND.

Bottom of Boring at 50.8 Feet.
Completed 12/5/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

Boring Log OSP-10

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense to loose, damp to moist, dark brown, silty SAND with trace wood chips. (FILL?)

Soft, moist, brown-gray, sandy SILT grading to loose, gray, silty SAND with trace small roots and wood fragments.

Dense, wet, gray, gravelly, medium to coarse SAND with sandy GRAVEL interbeds.

Dense, wet, gray, slightly sandy GRAVEL.

Medium dense, wet, gray SAND to very stiff, moist, brown PEAT to very stiff, moist, gray CLAY to gray, slightly silty SAND.

Dense, wet, gray, medium SAND to slightly silty, medium SAND with trace wood.

Stiff, moist, gray-brown, slightly sandy SILT.

Very stiff, moist, dark brown PEAT with some SILT.

Medium dense, wet, gray, silty, fine SAND with interbedded SILT.

Medium dense, wet, gray, medium SAND.

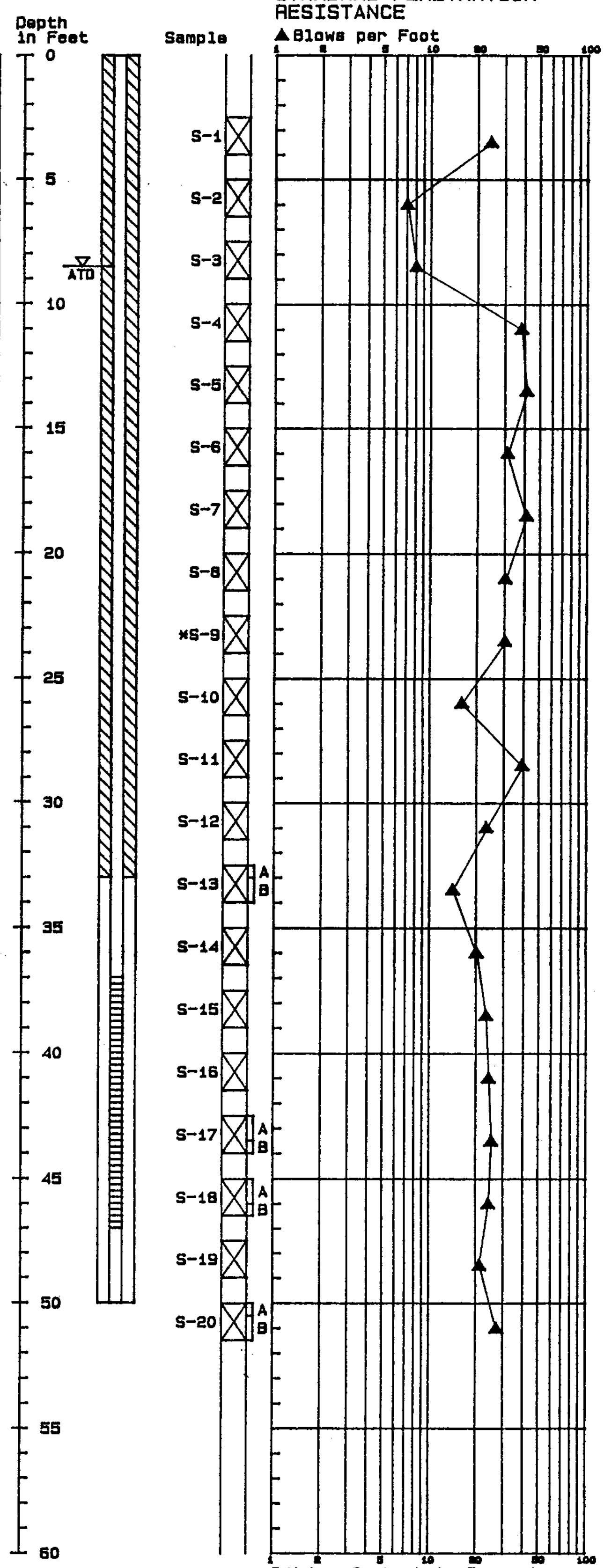
Very stiff, moist, dark brown PEAT.

Medium dense, wet, gray, silty, fine SAND.

Very stiff, moist, dark brown PEAT to medium dense, moist, gray, silty, fine SAND to dark brown PEAT.

Very stiff, moist, blue-gray, clayey SILT.

Bottom of Boring at 51.5 Feet.
Completed 11/30/88.



LAB TESTS

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

Boring Log OSP-11

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Dense, moist, brown-gray, slightly gravelly, slightly clayey, sandy SILT. (FILL)
Standing water at ground surface.

Medium stiff, moist, brown to gray-brown, slightly gravelly, slightly clayey, sandy SILT with interbedded PEAT.

Medium stiff, moist, dark brown PEAT.

Loose, moist, gray, silty to very silty, very fine SAND with trace peat and wood fragments.

Stiff, moist, dark brown, slightly sandy PEAT with wood fragments.

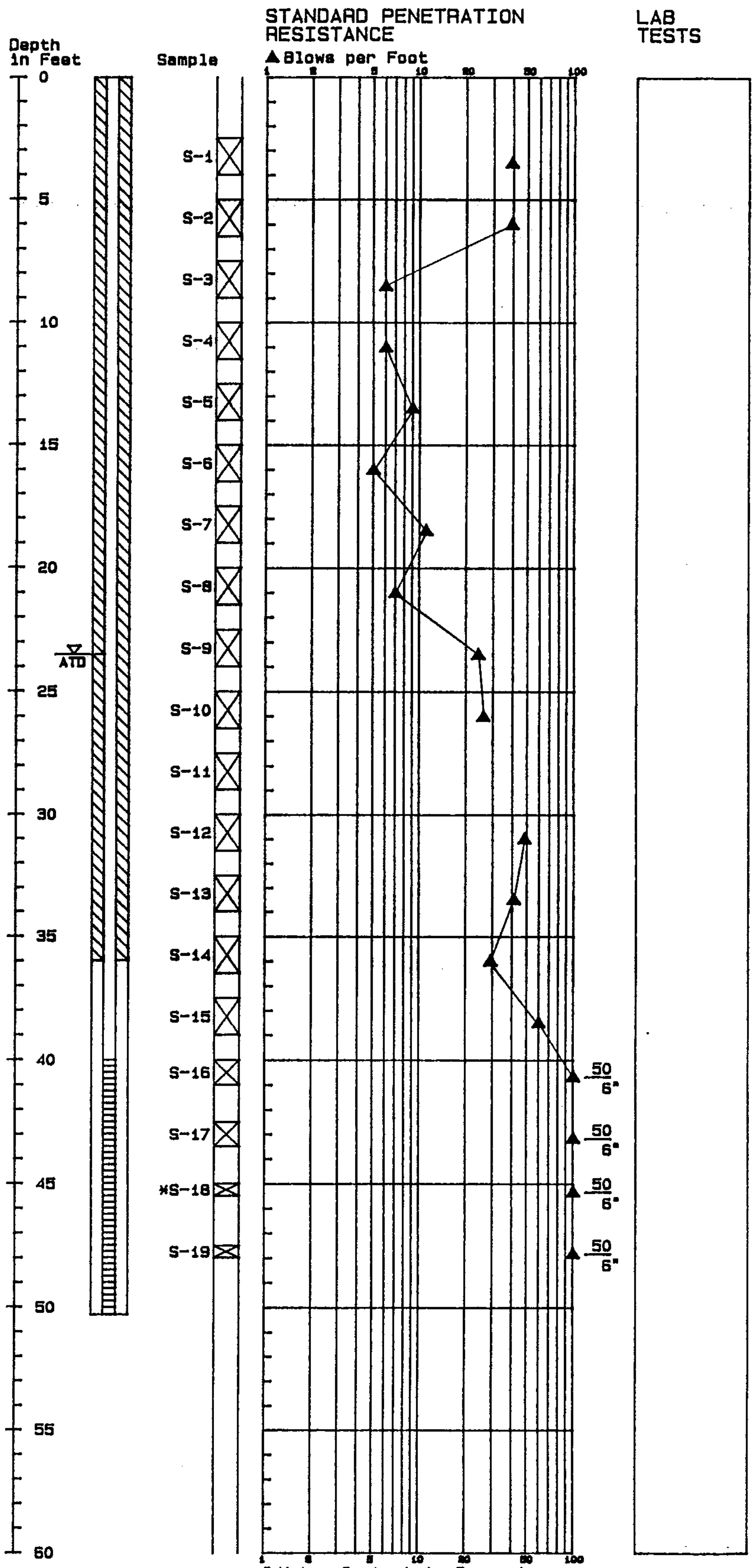
Medium dense to dense, wet, gray, slightly silty, medium SAND.

Slightly silty, sandy gravel seam.

Very dense, wet, greenish-gray, medium SAND.

Very dense, wet, gray, slightly gravelly, slightly sandy SILT.

Bottom of Boring at 50.3 Feet.
Completed 12/6/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

Boring Log OSP-12

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium to very dense, moist, yellow-brown, gravelly, silty, fine SAND. (FILL)

Medium to very stiff, moist, tan, clayey SILT to slightly sandy silty CLAY.

Dense to very dense, wet, gray, slightly silty, medium SAND.

Dense to very dense, wet, gray-brown slightly silty to silty, medium to fine SAND.

Very dense, wet, gray-brown, medium SAND to slightly silty, medium SAND.

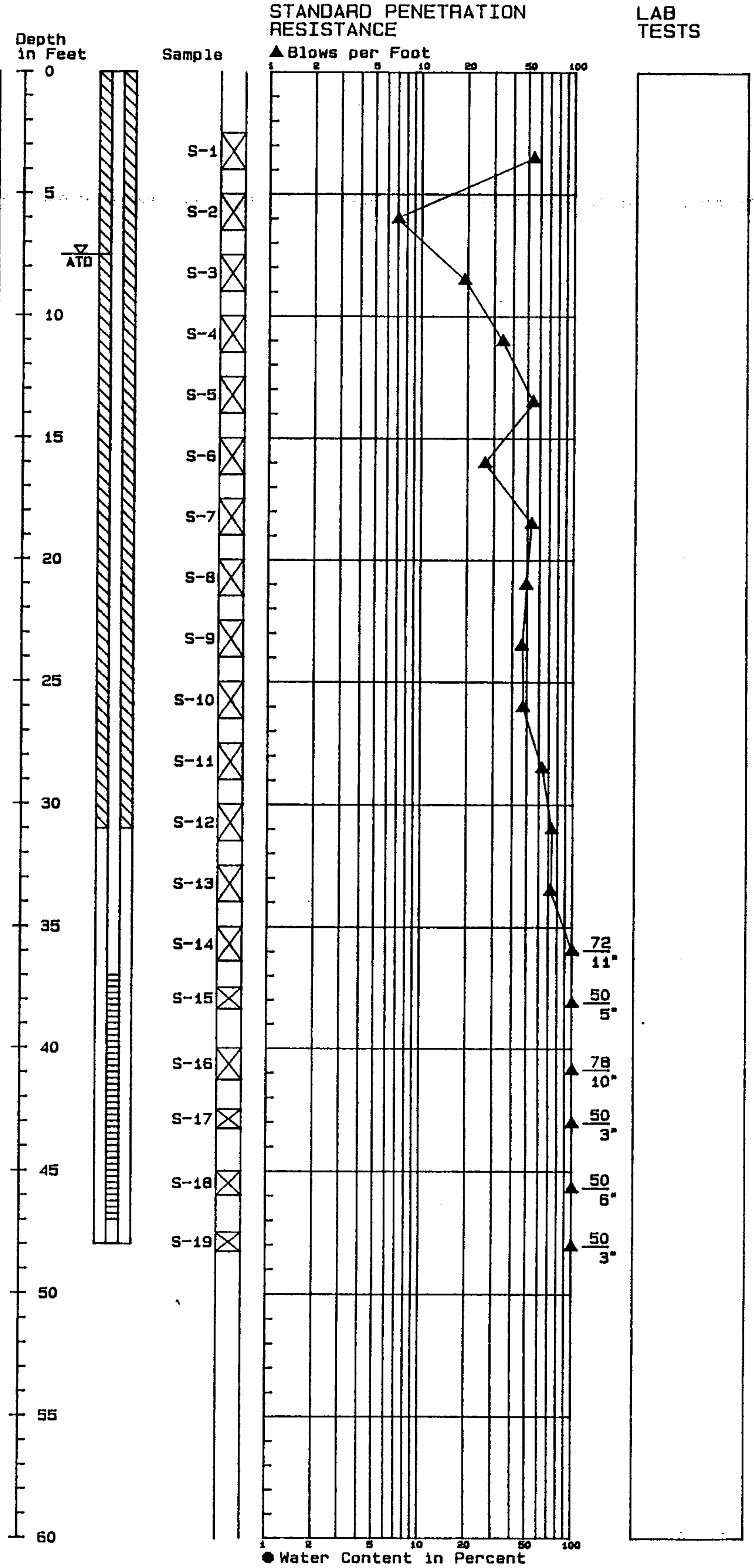
Very dense, wet, gray-brown, medium to fine SAND.

Becomes silty.

Very stiff, moist, gray, clayey SILT.

Very dense, moist, gray, slightly silty, very fine SAND.

Bottom of Boring at 48.3 Feet. Completed 12/1/88.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

Boring Log OSP-13

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

6 inches ASPHALT over dense, moist, gray-brown, medium SAND. (FILL?)

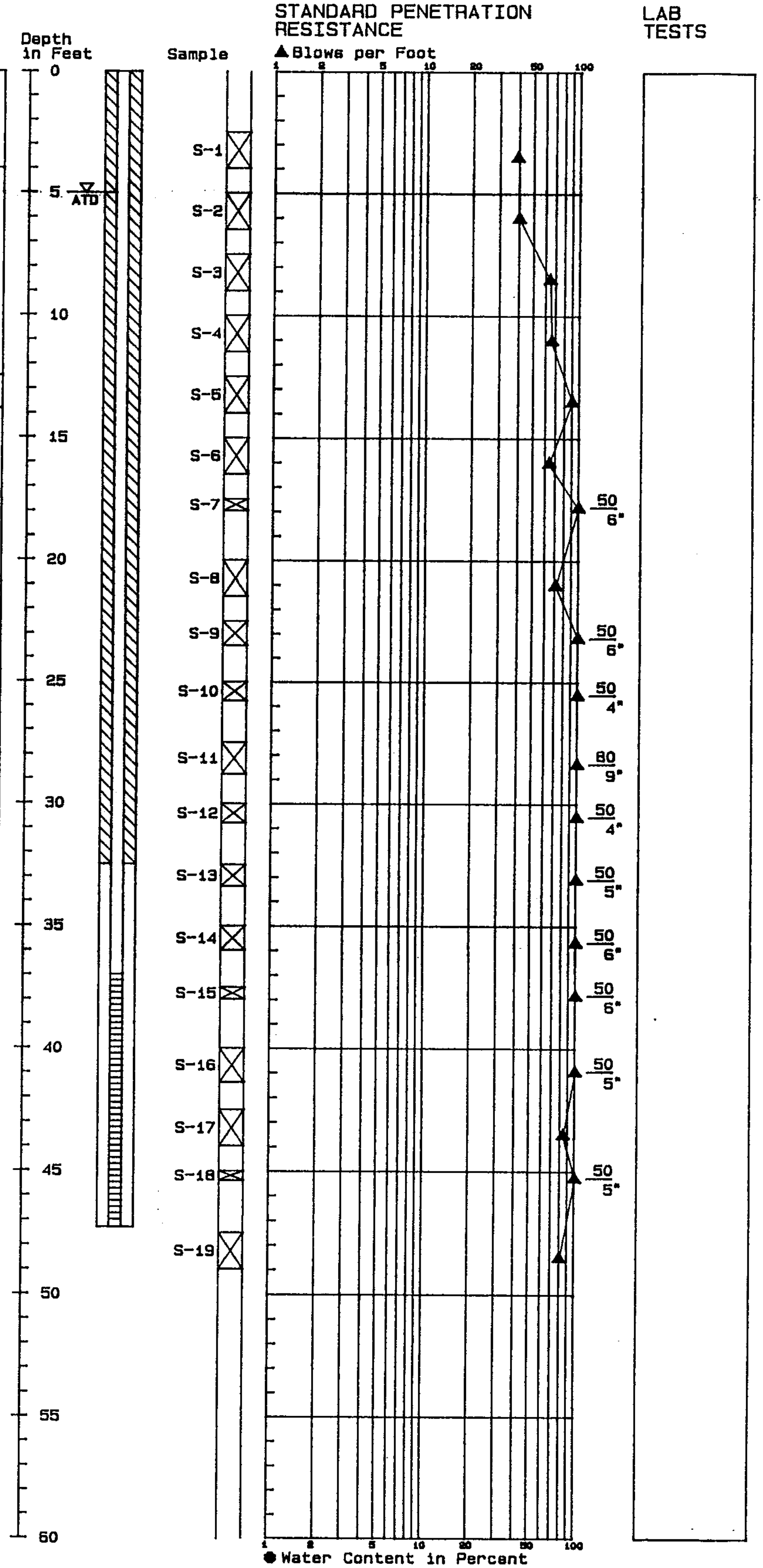
Very dense, wet, gray-brown, slightly silty, medium to fine SAND.

Hard, moist, tan, silty CLAY.

Very dense, wet, gray-brown to brown-gray, slightly silty to silty, slightly gravelly to gravelly SAND to silty, fine SAND.

Very dense, wet, gray-brown, slightly silty

Bottom of Boring at 49.0 Feet.
Completed 12/7/88..



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-1639-09 December 1988

HART-CROWSER & associates, inc.

Figure

PIEZOMETER OSP-13 (MIS)
HART CROWSER (1989)

Boring Log and Construction Data for Monitoring Well OSP-13(MIS)

Geologic Log

Depth in feet

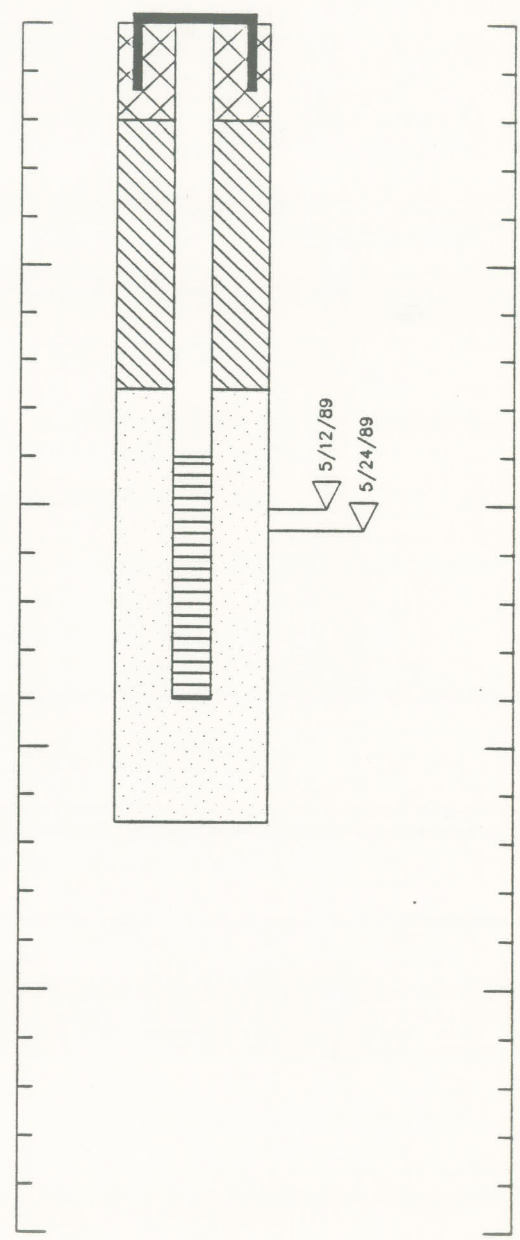
Approx. Ground Surface Elevation in Feet 38.5

Depth (feet)	Description	Sample	N
0–3.5	(Medium dense), damp, light brown to brown, silty, very gravelly, fine to medium SAND.		
3.5–4.5	Hard, damp, light brown mottled, slightly sandy SILT.	S-3	37
4.5–8	Very stiff, damp, gray, slightly sandy, clayey SILT and silty CLAY with mixed plant material.	S-5	19
8–8.5	Damp PEAT.	S-7.5	20
8.5–13	Medium dense, damp to wet, gray, silty, fine to medium SAND. (Drilled through log from 10 feet to 12 feet.)	S-10	50/4
13–16.5	Medium dense, wet, gray, slightly silty, medium to fine SAND.	*S-12.5	42
		S-15	26

Bottom of Boring at 16.5 Feet.
Completed 5/11/89.

Monitoring Well Design

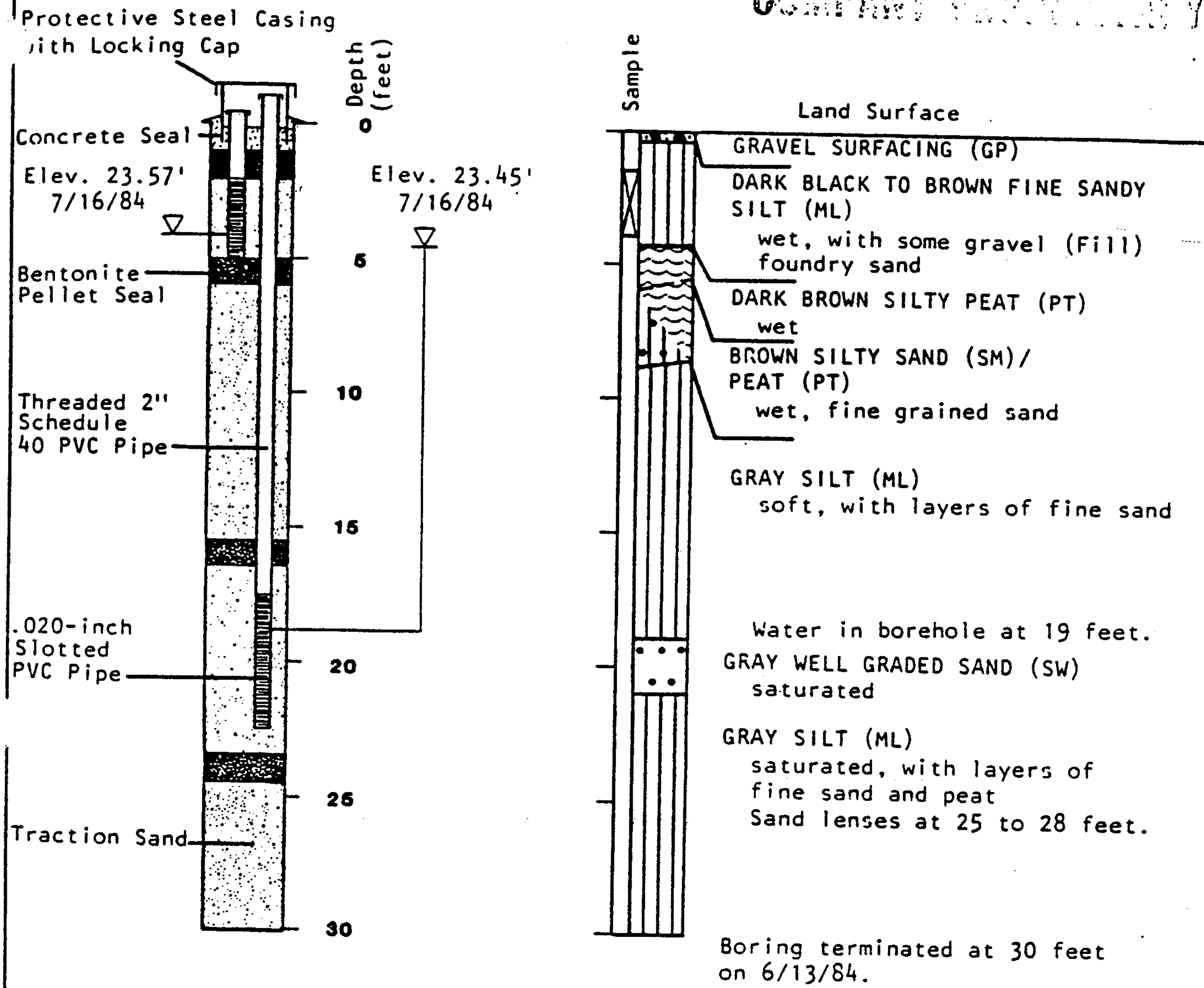
Casing Stickup in Feet
Top of PVC in Feet 0.00



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER
J-2480 5/89

ON-SITE WELLS MW-1 THROUGH MW-4
HNTB/APPLIED GEOTECHNOLOGY (1984)



8-85

COMPANY PROPRIETARY

Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

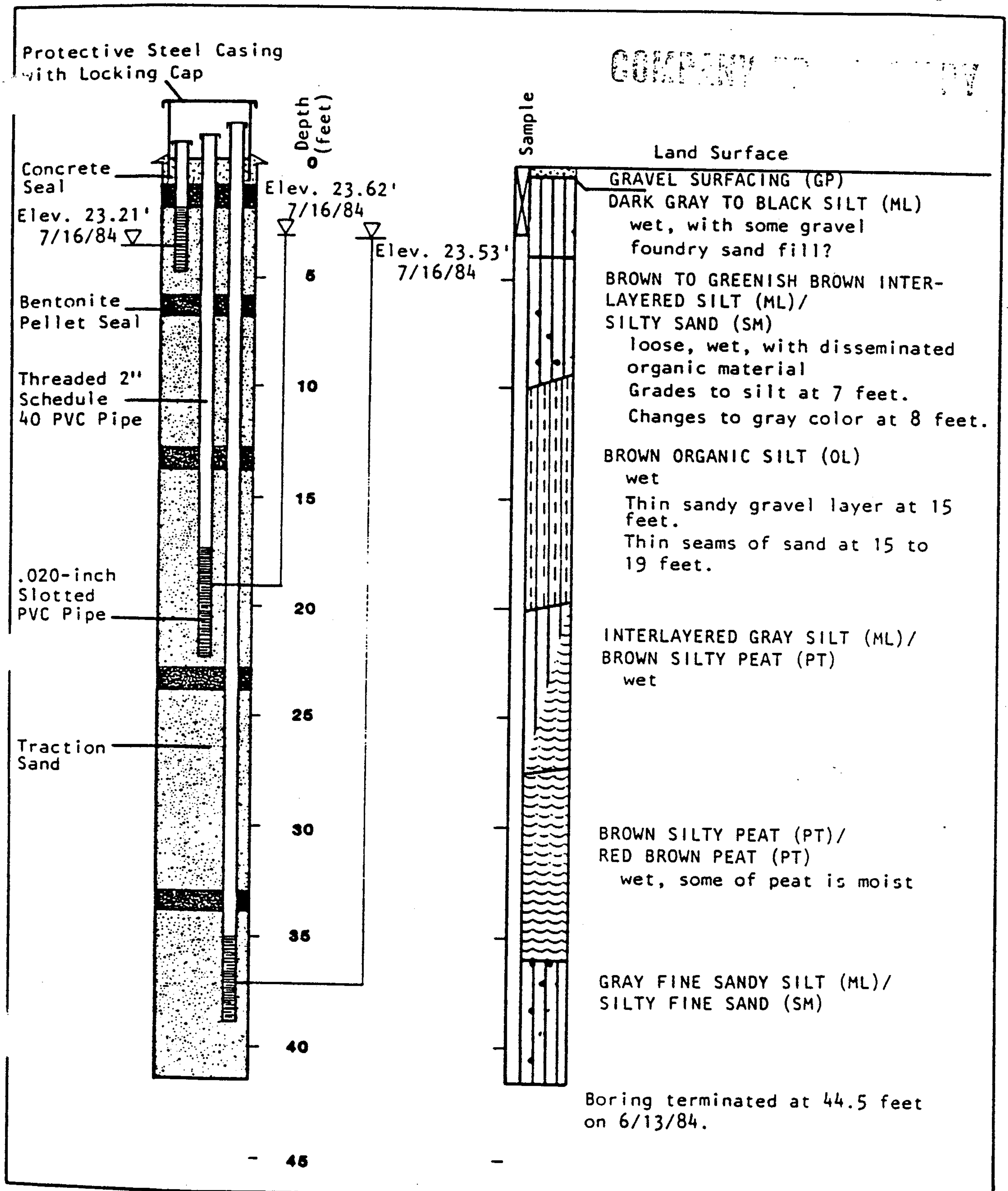
MONITORING WELL MW1

Pacific Car and Foundry Company
Renton, Washington

PLATE 18

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
14,190.004	BJT	MAN	8-7-84		

8-86

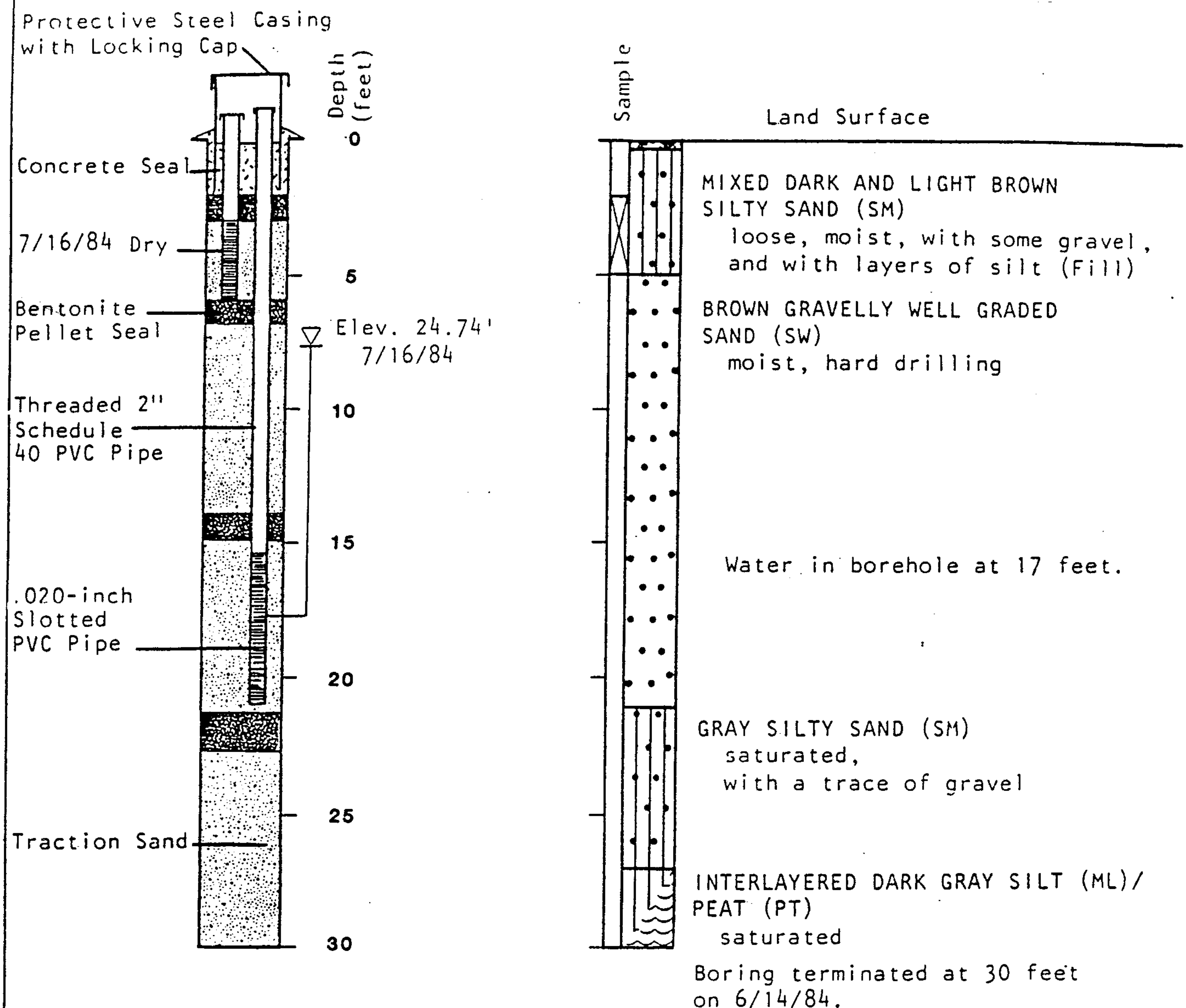


Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

MONITORING WELL MW2
Pacific Car and Foundry Company
Renton, Washington

PLATE **19**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
14,190.004	BJT	MAA	8-7-84		



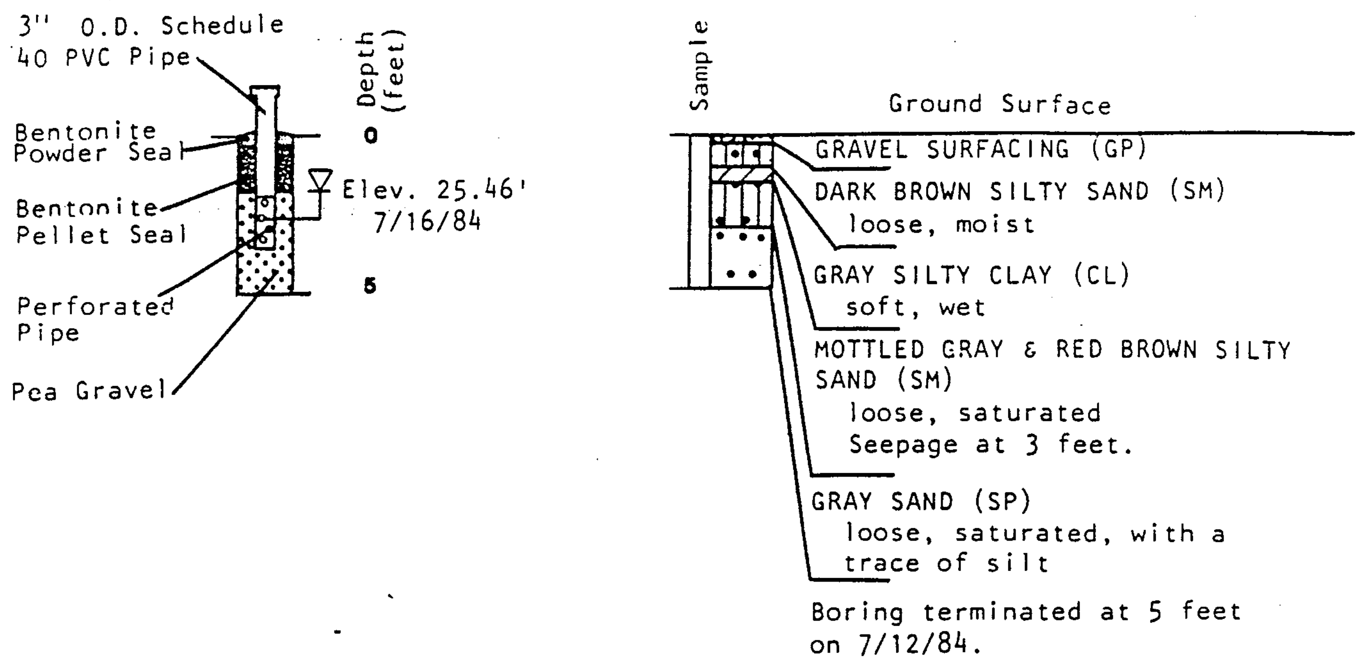
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

MONITORING WELL MW3

Pacific Car and Foundry Company
Renton, Washington

PLATE **20**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
14.190.004	BJT	MAA	8-7-84		



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

MONITORING WELL MW4
Pacific Car and Foundry Company
Renton, Washington

21

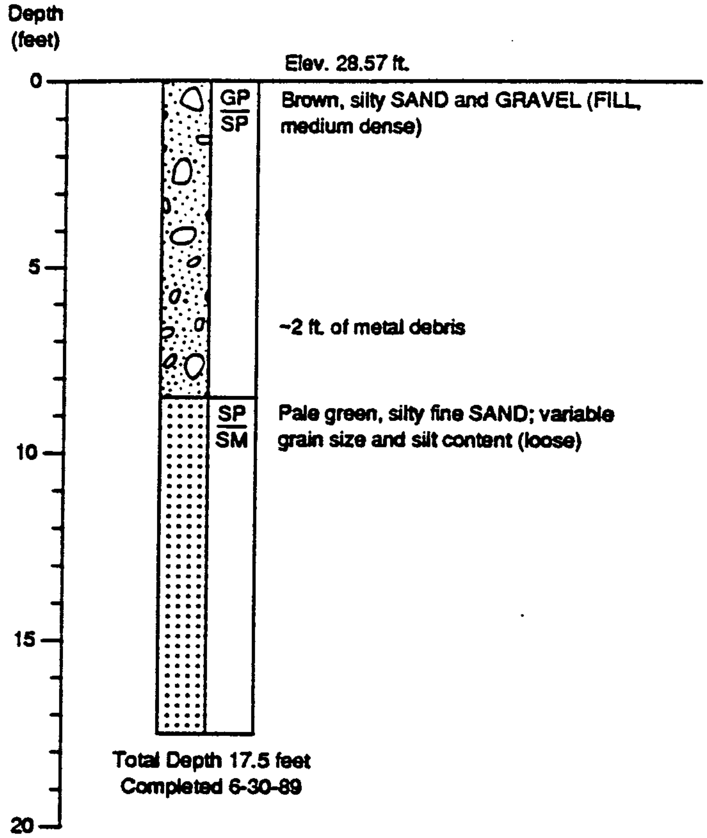
JOB NUMBER	DRAWN	APPROVED	DATE	REVISED
14,190.004	BJT	MAA	8-7-84	

Hart Crowser
J-1639-09

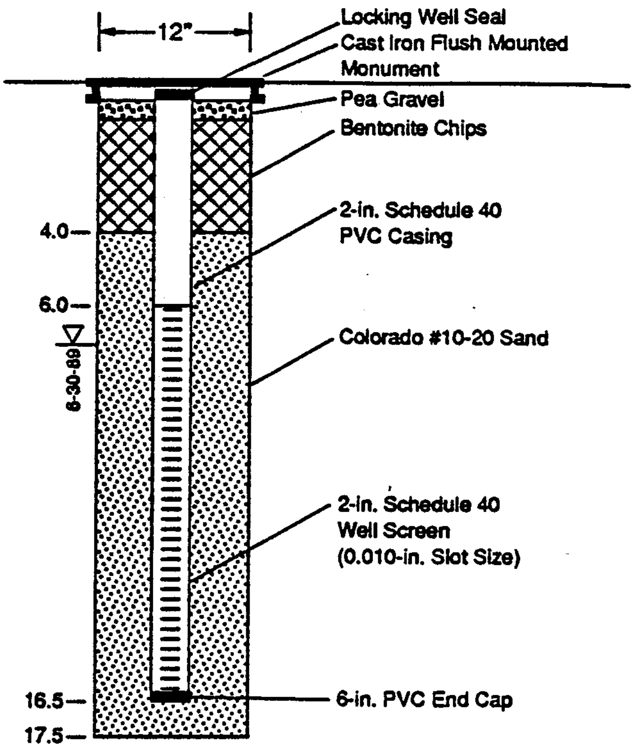
OFF-SITE MONITORING WELLS LMW-1S, LMW-1D,
LMW-2S, LMW-2D, LMW-4,
LMW-6, AND LMW-7
LANDAU ASSOCIATES, INC. (1989)

Boring LMW-1S

Soil Profile

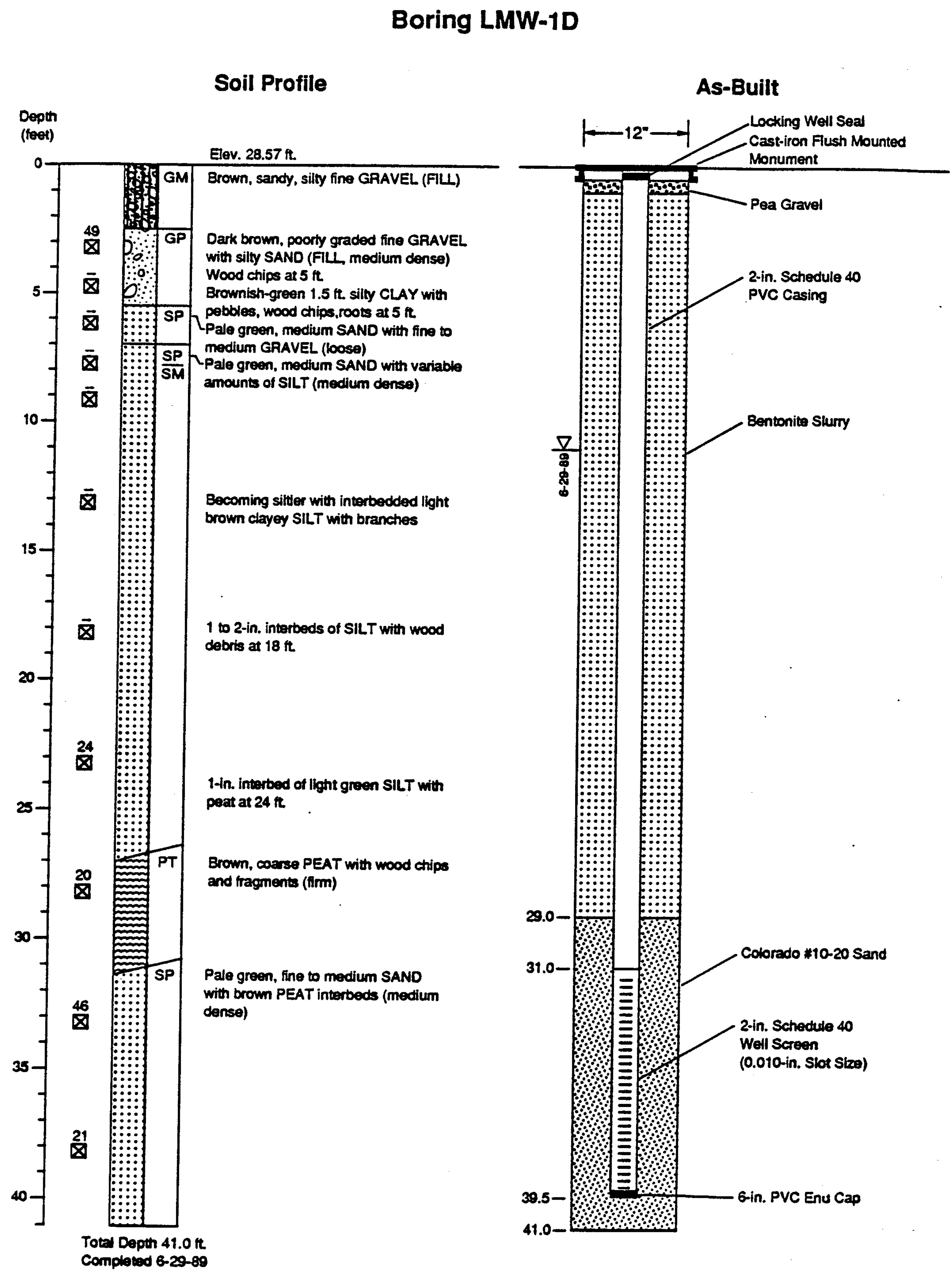


As-Built



Note: No samples were taken; soil descriptions from cuttings. (See Log of adjacent Boring LMW-1D)

LANDAU ASSOCIATES, INC.	Soil Profile and Well Log for Boring LMW-1S

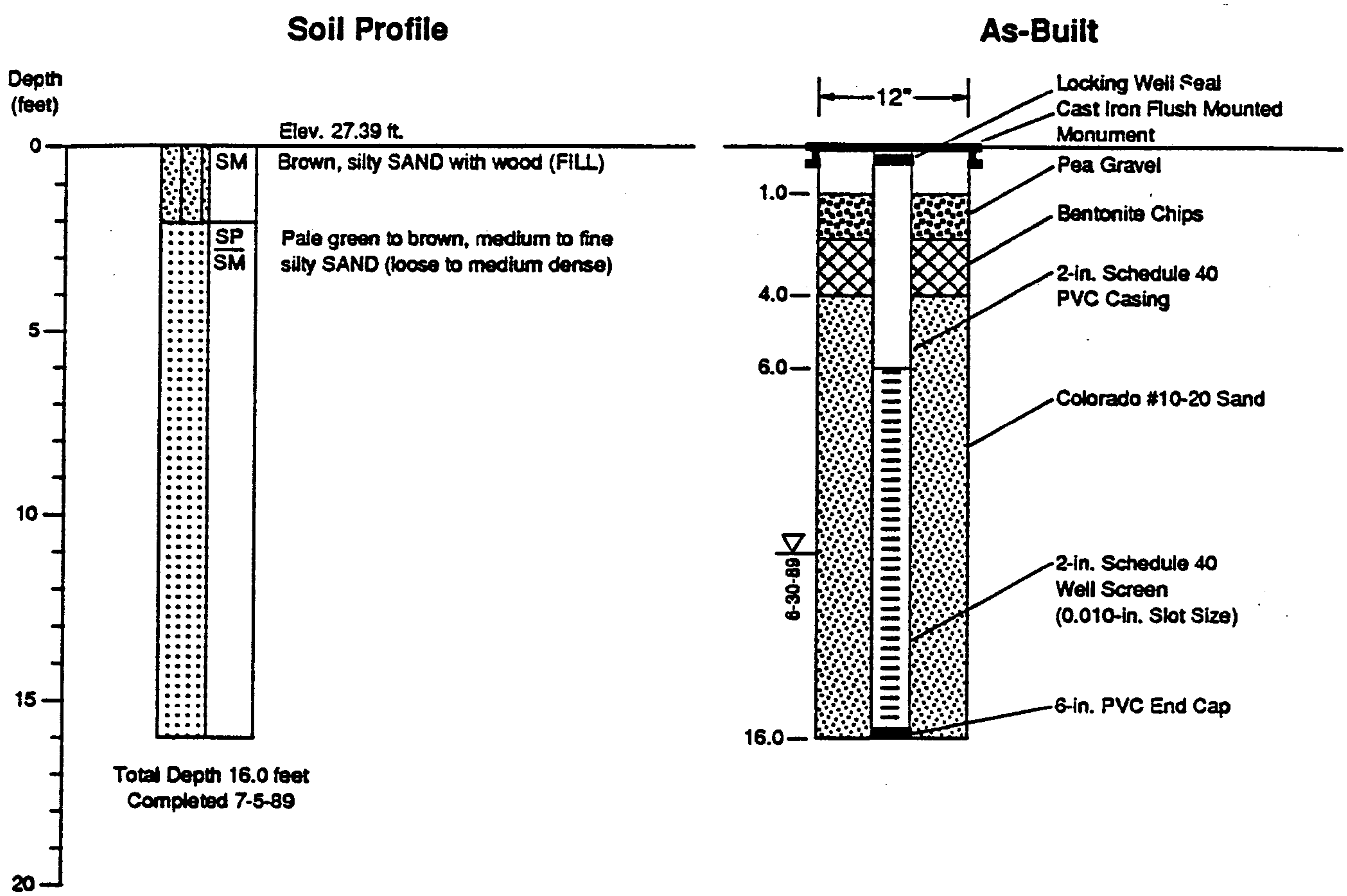


LANDAU ASSOCIATES, INC.

Soil Profile and Well Log for Boring LMW-1D

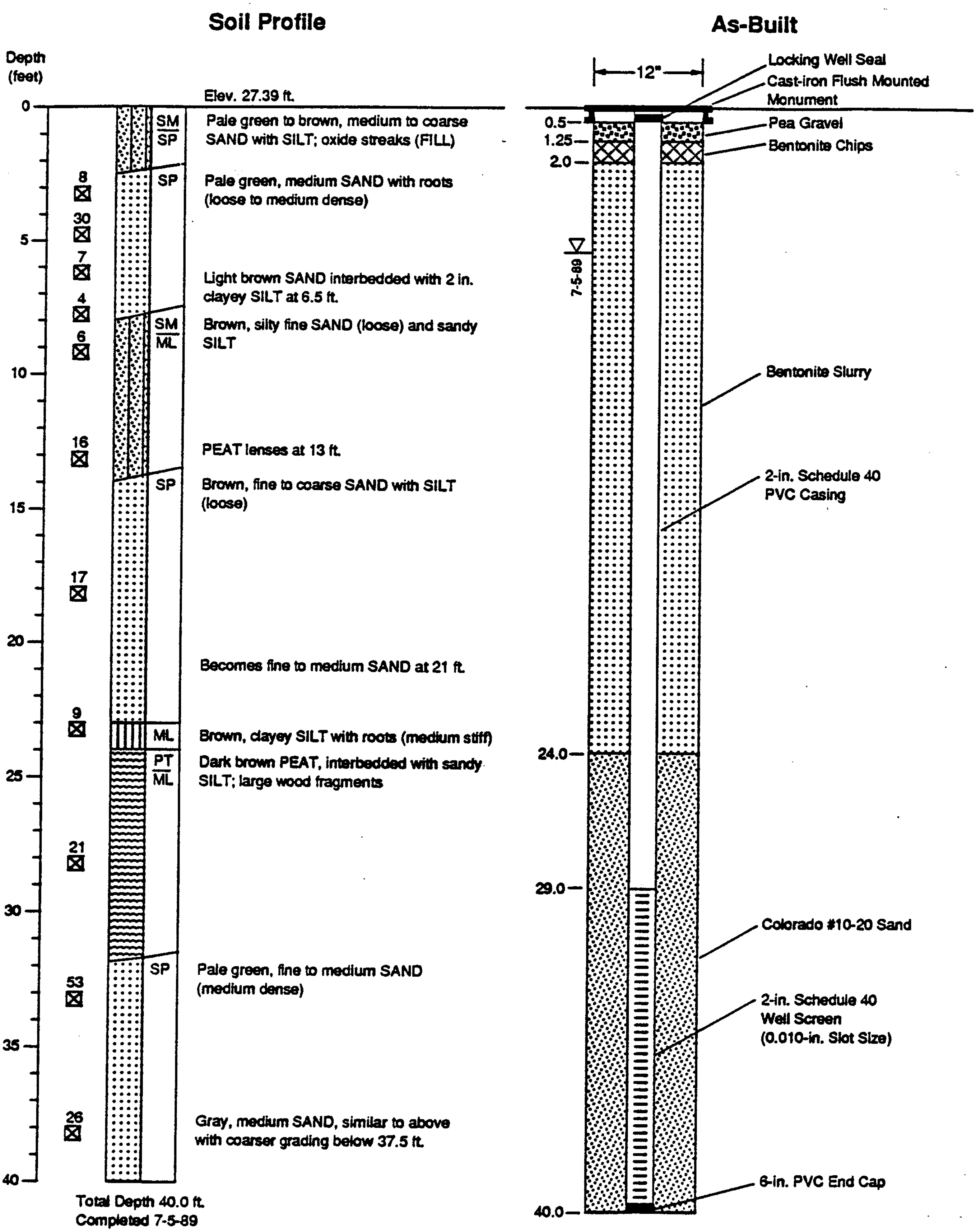
RENTON PRODUCTION WELLS
PW-1 THROUGH PW-3 AND
RENTON REPLACEMENT WELLS
RW-1 THROUGH RW-3

Boring LMW-2S



Note: No samples were taken; soil descriptions from cuttings. (See Log of adjacent Boring LMW-2D)

Boring LMW-2D

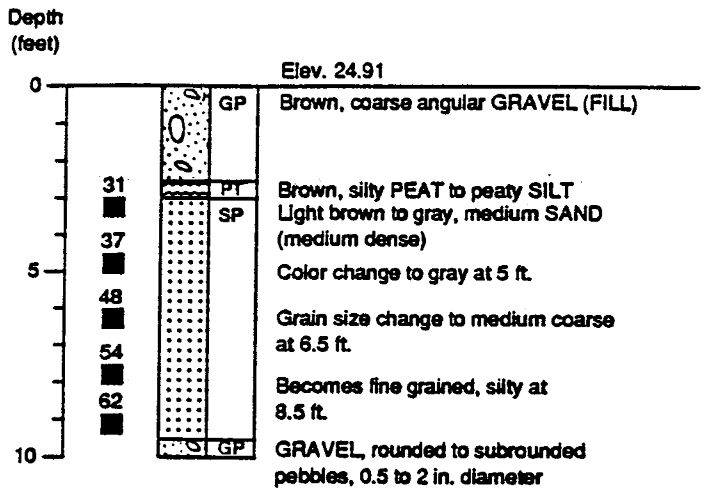


25-42.10 Property Transfer Assessment - E&H Properties/Draft Report 7-24-89

LANDAU ASSOCIATES, INC. | Soil Profile and Well Log for Boring LMW-2D

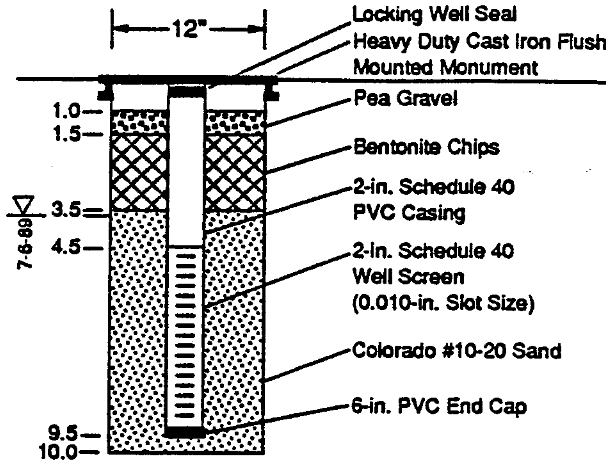
Boring LMW-4

Soil Profile



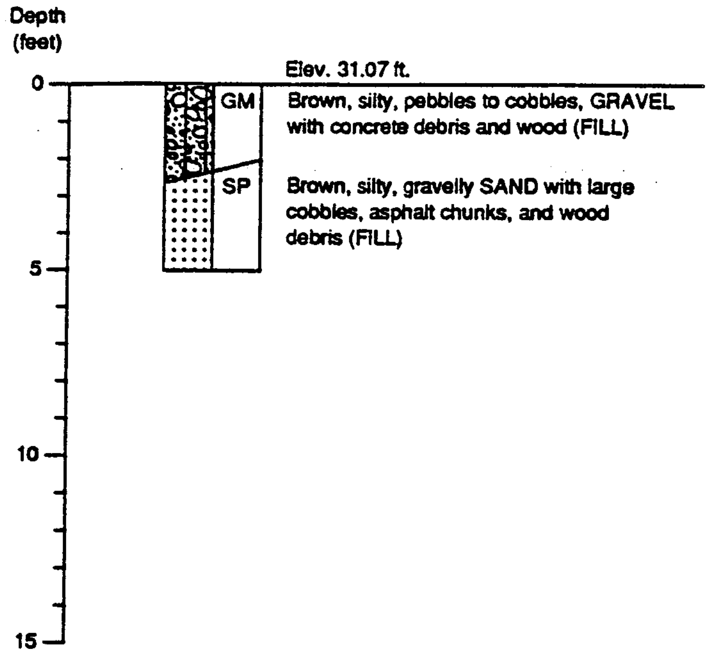
Total Depth 10.0 feet
Completed 7-6-89

As-Built

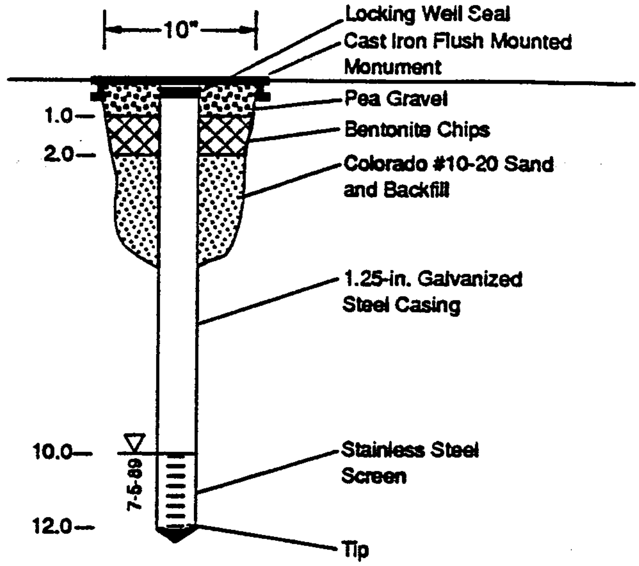


Boring LMW-6

Soil Profile



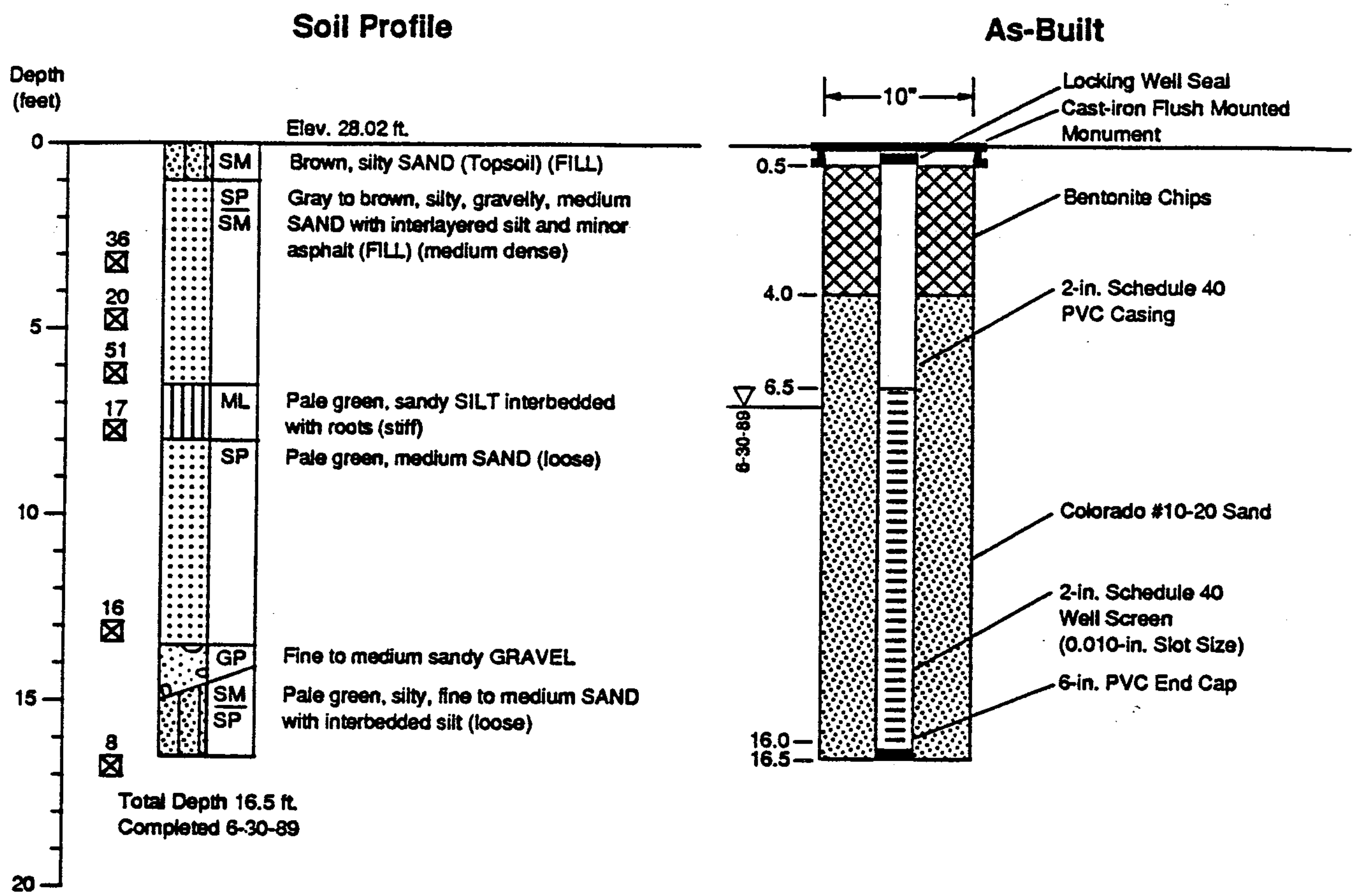
As-Built



Note: Hand Dug to 3 ft.; Hand augered to 5 ft.; No Soil log below 5.0 ft.; Well point driven to 12.0 feet. Completed 7-6-89.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Log for Boring LMW-6

Boring LMW-7



LANDAU ASSOCIATES, INC.	Soil Profile and Well Log for Boring LMW-7

RENTON MONITORING WELLS
MW-1 THROUGH MW-27
AND RENTON PRODUCTION WELLS
PW-8, PW-9

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: January 23, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 40.9 ft, MSL
PVC CASING ELEVATION: 40.91 ft MSL

DEPTH TO WATER FROM
GROUND & DATE: 21.1 ft., 2-22-86

WELL: MW-1

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

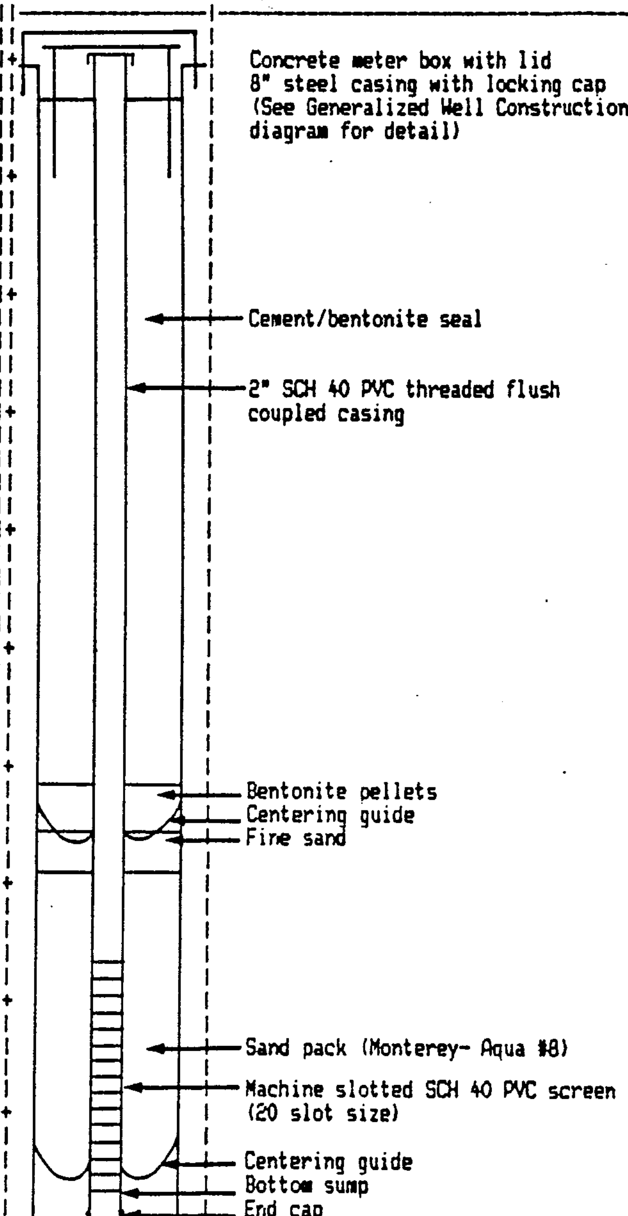
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

INSPECTOR: SCOTT MCKINLEY / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SANDY LOAM, brown
	SAND AND GRAVEL, fine to coarse sand and fine to med gravel
5	GRAVEL, fine to med rounded gravel with some fine to coarse sand
10	
15	
	GRAVEL, fine to coarse gravel with some coarse sand
	SAND, med to coarse sand with some fine to coarse gravel
20	SAND AND GRAVEL, coarse sand and fine to med gravel
25	
30	
35	
40	
45	
50	
55	
60	CLAY, grayish-white clay, good plasticity, extremely dense (refusal) End of Boring

RECORD DRAWING / WELL CONSTRUCTION DETAILS



MW-1 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: April 29, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 51.2 ft, MSL
PVC CASING ELEVATION: 53.32 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 26.6 ft, 4-30-86

WELL: MW-2

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

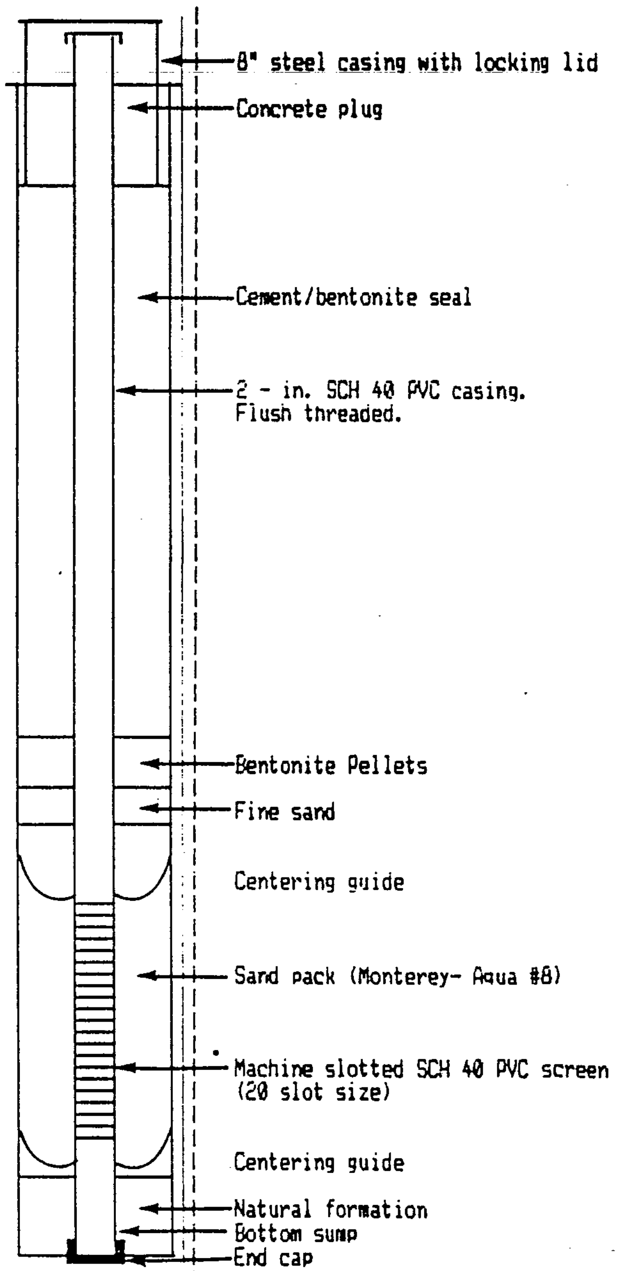
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

INSPECTOR: J. NINTEMAN / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SILTY, SANDY LOAM, organic odor, black, soft
	SAND, med to coarse, with some silt
5	
	SAND AND GRAVEL, med to coarse sand and fine to med gravel with a little fine sand and silt, brown, dense
10	silt layer
15	
20	SAND AND GRAVEL, poorly sorted, with some silt, gray-brown, dense
25	
30	
35	
	GRAVEL, mostly med to coarse and some med to coarse sand and a little silt, brown, easier drilling, cleaner, hole begins making water
40	
45	
50	END OF BORING

RECORD DRAWING | WELL CONSTRUCTION DETAILS



MW-2 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: January 27, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 36.1 ft, MSL
PVC CASING ELEVATION: 35.50 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 16.1 ft., 2-22-86

WELL: MW-3

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

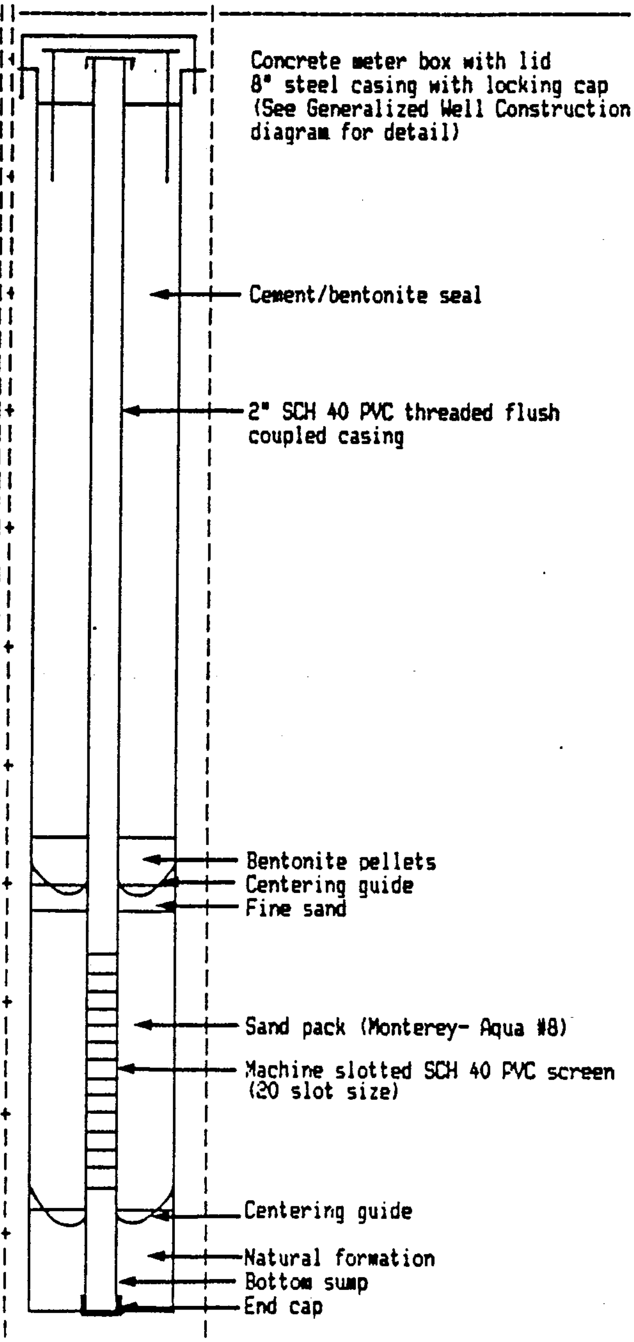
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO,
GRAHAM, WA

INSPECTOR: SCOTT MCKINLEY / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SILTY LOAM, gray-brown, loose
	SILTY LOAM, brown, wet
5	SAND, fine to coarse with some silt and clay, low plasticity
	GRAVEL, fine to coarse, with some fine to coarse sand
10	
15	GRAVEL, fine to coarse, rounded gravel
20	GRAVEL, fine gravel with trace med to coarse sand
	SAND, coarse sand with some fine to med,
25	rounded gravel
	GRAVEL, fine to coarse, rounded gravel with some coarse sand
30	
	SILTY SAND, fine silty sand, brown with some clay, med plasticity
35	
	SAND AND GRAVEL, coarse sand with fine to coarse, rounded gravel
40	
	SAND, coarse sand with some fine gravel
45	
	SAND AND GRAVEL, fine to coarse sand with fine gravel
50	
	End of boring

RECORD DRAWING | WELL CONSTRUCTION DETAILS



MW-3 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

WELL: MW-4

COMPLETION DATE: January 29, 1986

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

LOCATION: RENTON, WASHINGTON

DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

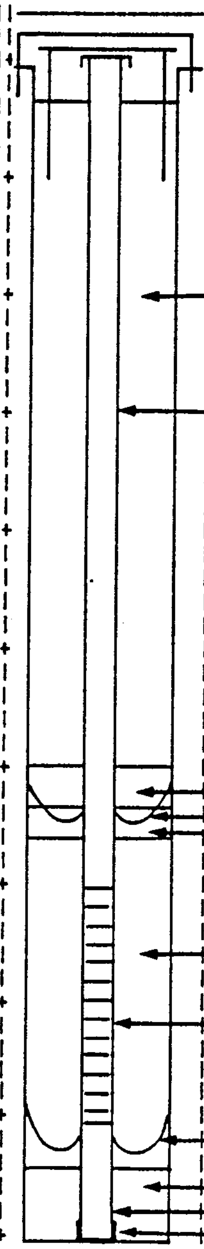
GROUND ELEVATION: 36.9 ft, MSL
PVC CASING ELEVATION: 36.44 ft, MSL

INSPECTOR: SCOTT MCKINLEY / SEA

DEPTH TO WATER FROM
GROUND & DATE: 16.9 ft., 2-22-86

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

RECORD DRAWING



DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS	WELL CONSTRUCTION DETAILS
0	SANDY LOAM, coarse sand, brown and some silty clay	Concrete meter box with lid 8" steel casing with locking cap (See Generalized Well Construction diagram for detail)
5	SAND AND GRAVEL, coarse sand with fine, rounded gravel	
10	SAND, coarse sand and some fine gravel	Cement/bentonite seal
15		2" SCH 40 PVC threaded flush coupled casing
20	SAND, coarse sand and some fine to coarse, rounded gravel	
25		
	SAND, fine to coarse sand and minor fine gravel	
30		Bentonite pellets Centering guide Fine sand
	GRAVEL, fine to med rounded gravel and some coarse sand	
35		
		Sand pack (Monterey- Aqua #8)
40	SAND AND GRAVEL, coarse sand with fine to med, rounded gravel	Machine slotted SCH 40 PVC screen (20 slot size)
45		Centering guide
	SAND, fine to coarse sand and minor fine gravel	Natural formation
50	END OF BORING	Bottom sump End cap

MW-4 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: January 31, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 38.8 ft, MSL
PVC CASING ELEVATION: 38.32 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 17.4 ft, 2-22-86

WELL: MW-5

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

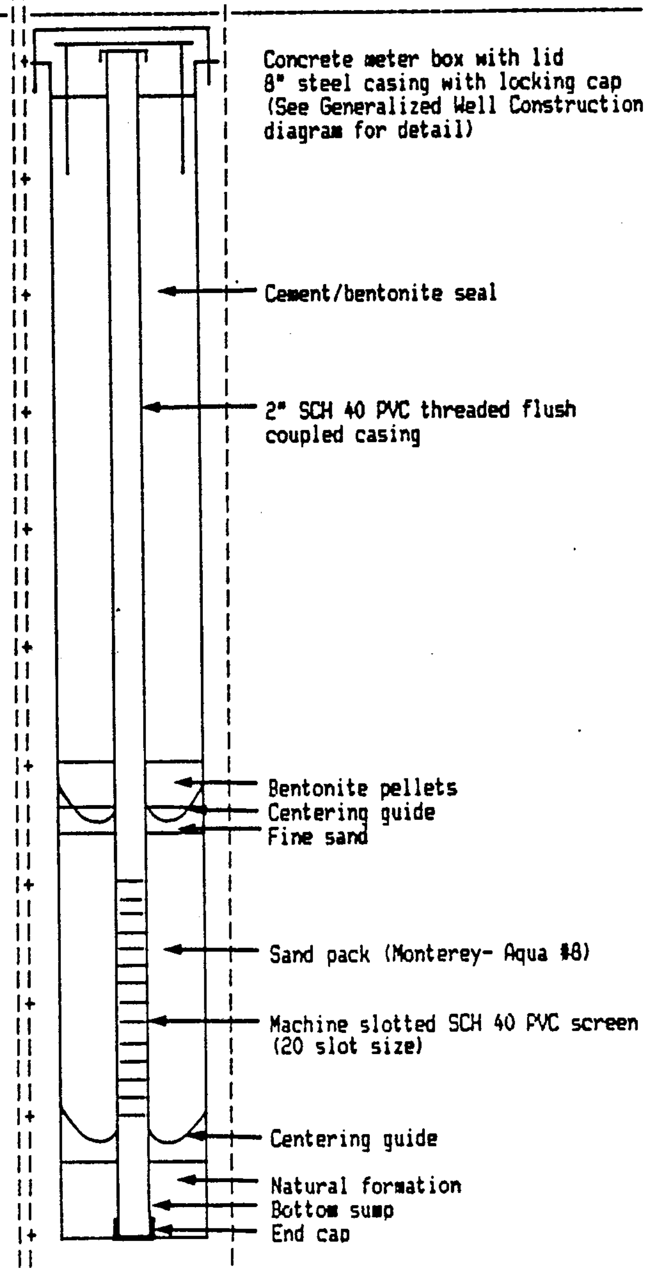
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO,
GRAHAM, WA

INSPECTOR: SCOTT MCKINLEY / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SILTY-CLAY LOAM, brown
5	
	CLAY, approximate 4" layer of gray clay SAND, fine to coarse sand and some fine to med, rounded gravel. Trace of brown silt
10	SAND AND GRAVEL, coarse sand with fine gravel
15	
	SAND, coarse sand and some fine to coarse rounded gravel
20	
25	SILTY CLAY, dark gray-brown, plastic and clumpy
30	GRAVEL, fine to med, rounded gravel and some coarse sand, grayish in color
35	
	SAND, med to coarse sand and some fine to med, rounded gravel, brown
40	
45	
50	END OF BORING

RECORD DRAWING / WELL CONSTRUCTION DETAILS



MW-5 WELL LOG AND
CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: FEBRUARY 5, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 39.1 ft, MSL
PVC CASING ELEVATION: 38.83 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 19.4 ft, 2-22-86

WELL: MW-6

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

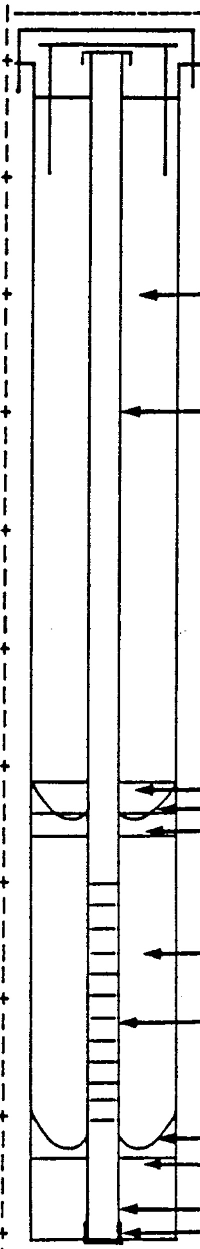
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

INSPECTOR: SCOTT MCKINLEY / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS	WELL CONSTRUCTION DETAILS
0	SILTY-CLAY LOAM, brown, moist, clumpy, and trace coarse sand	Concrete meter box with lid 8" steel casing with locking cap (See Generalized Well Construction diagram for detail)
5		
10	SAND, fine to coarse sand and some fine to coarse, rounded gravel, loose	Cement/bentonite seal
15		2" SCH 40 PVC threaded flush coupled casing
	SAND, fine to coarse sand	
20		
25	SAND, med to coarse sand and minor fine gravel	
30		Bentonite pellets Centering guide Fine sand
35		Sand pack (Monterey-aqua #8)
40		Machine slotted SCH 40 PVC screen (20 slot size)
	SAND, coarse sand and some fine, rounded gravel	
45	GRAVEL, fine to coarse rounded gravel and some coarse sand	Centering guide Natural formation
		Bottom sump
50	END OF BORING	End cap

RECORD DRAWING



MW-6 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: January 17, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 47.12 ft, MSL
PVC CASING ELEVATION: 47.16 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 23.1 ft., 2-22-86

WELL: MW-7

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

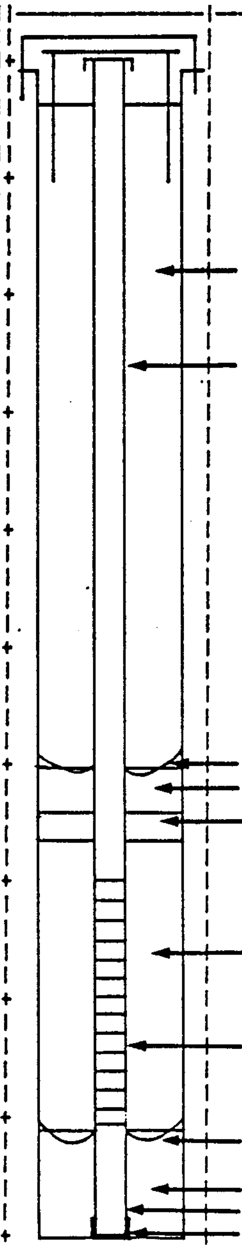
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

INSPECTOR: SCOTT MCKINLEY / SEA

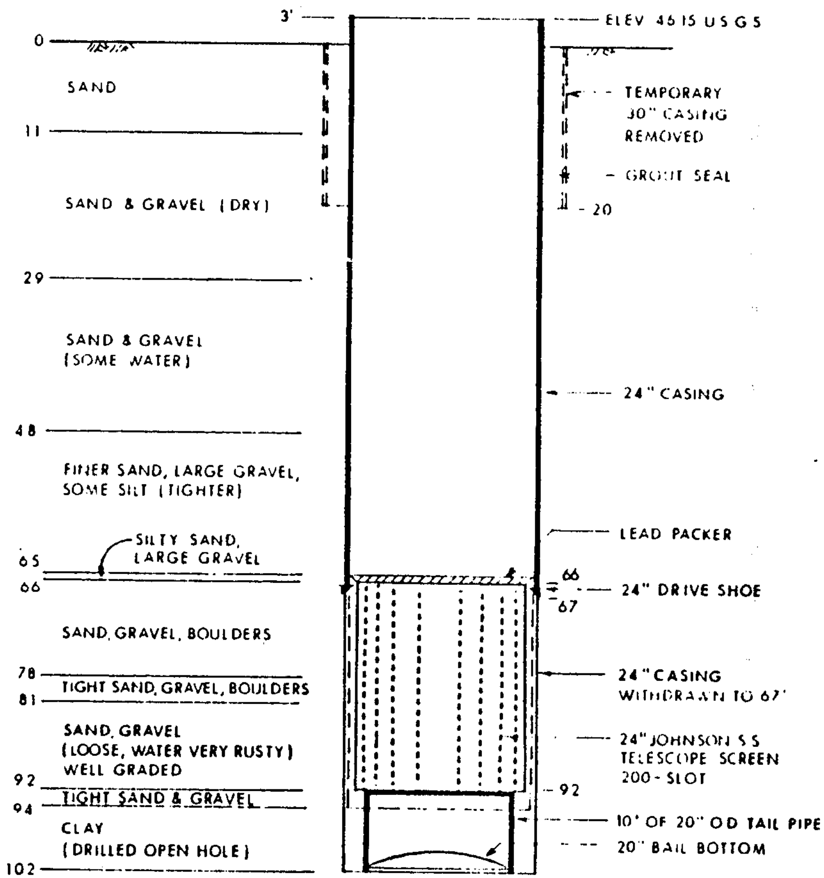
SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SILTY SAND, fine sand, brown and wet
5	SAND AND GRAVEL, coarse sand to fine rounded gravel
	SAND AND GRAVEL, fine to coarse sand and fine rounded gravel
10	
15	SAND AND GRAVEL, coarse sand to fine gravel with some fine to med sand
20	
25	SAND AND GRAVEL, fine to coarse sand and fine gravel with a little med to coarse gravel
30	SAND AND GRAVEL, coarse sand to medium rounded gravel with some fine to med sand and coarse gravel
35	
40	
45	SAND AND GRAVEL, coarse sand to coarse rounded gravel with some fine to med sand
50	End of boring

RECORD DRAWING / WELL CONSTRUCTION DETAILS

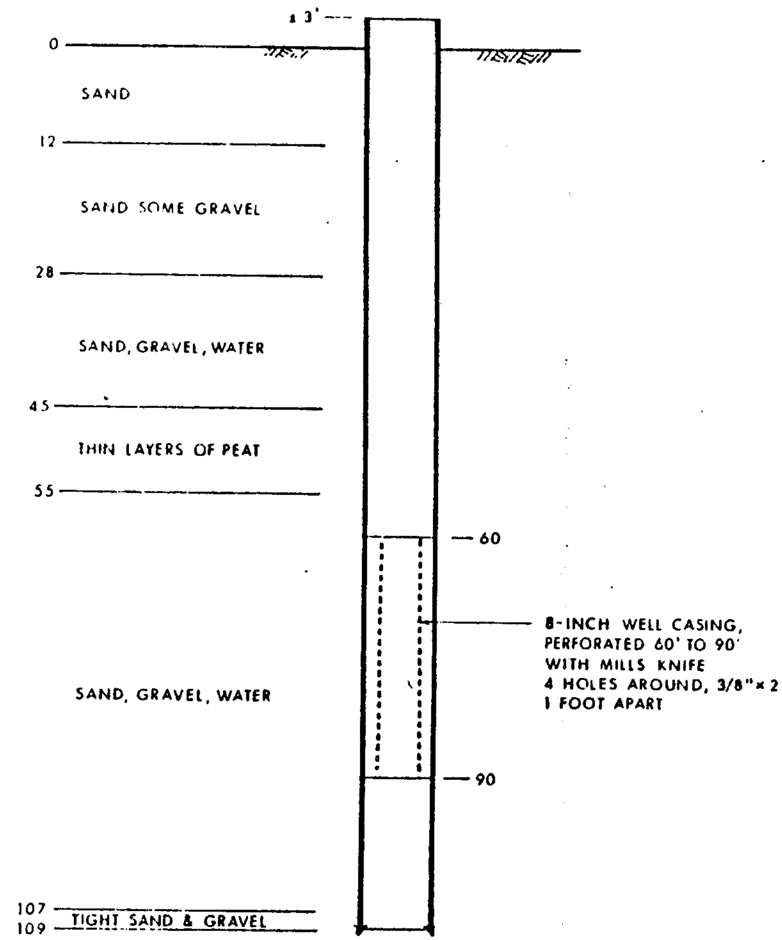


MW-7 WELL LOG AND CONSTRUCTION DIAGRAM



WELL NO. 8

NOT TO SCALE



8-INCH OBSERVATION WELL

NOT TO SCALE

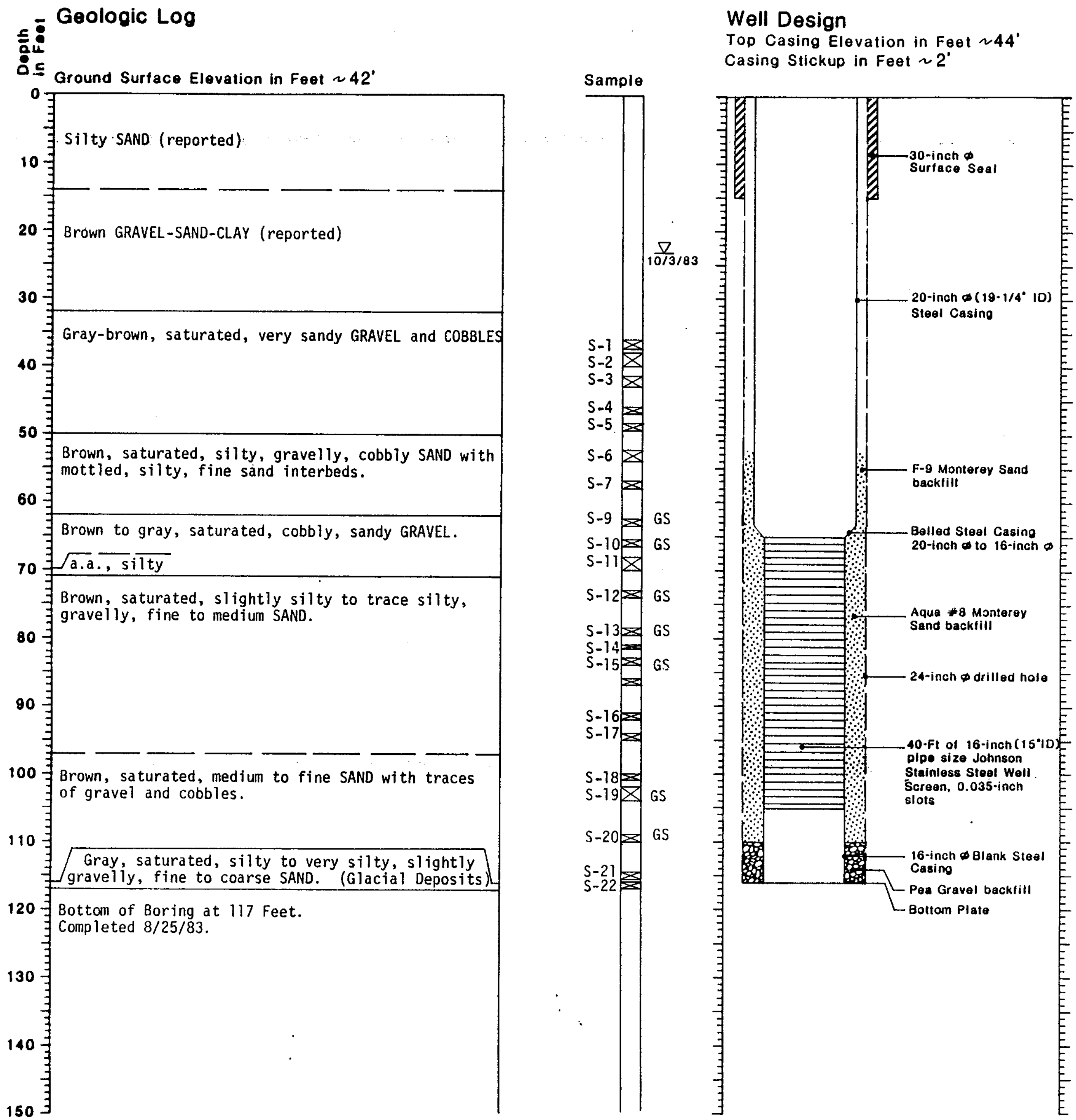
CITY OF RENTON, WASHINGTON

WELL LOGS & CONSTRUCTION DETAILS

CORNELL, HOWLAND, HAYES & MERRYFIELD
Engineers and Planners
SEATTLE CORVALLIS BOISE PORTLAND

4790.2 FEBRUARY 1968

Boring Log and Construction Data for Well 9



(reported) Refers to material type encountered as reported by driller.

GS Grain Size Analysis

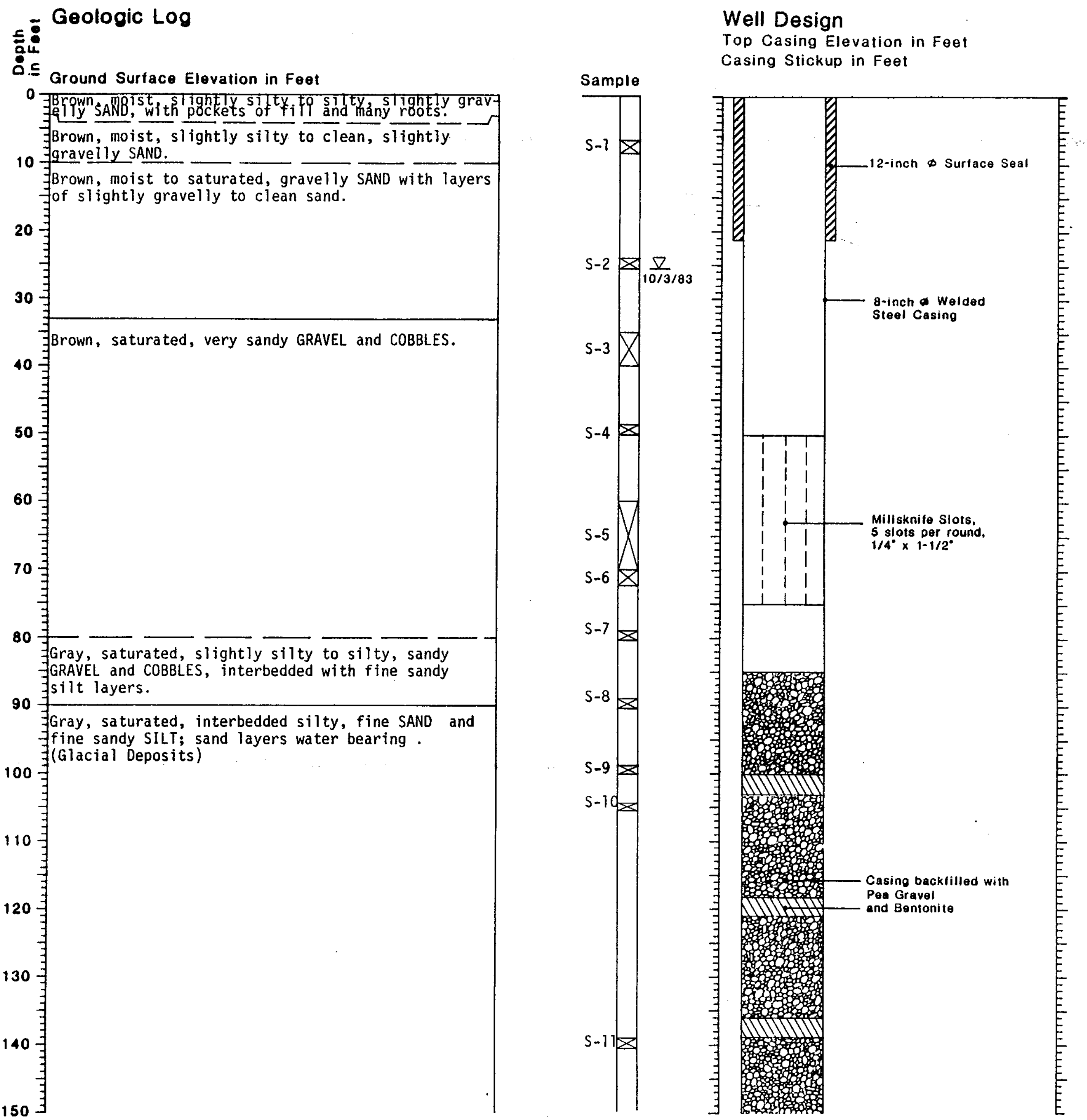
a.a. As Above

NOTES:
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level ▽ is for date indicated and may vary with time of year.
   ATD: At Time of Drilling
3. Elevation estimated to be same as Observation Well 8 and was obtained from City of Renton Well Location Map W665, Sheet 2 of 2, drawn by RH2 Engineering, 1982.

J-1148 September 1983

HART-CROWSER & associates, inc.

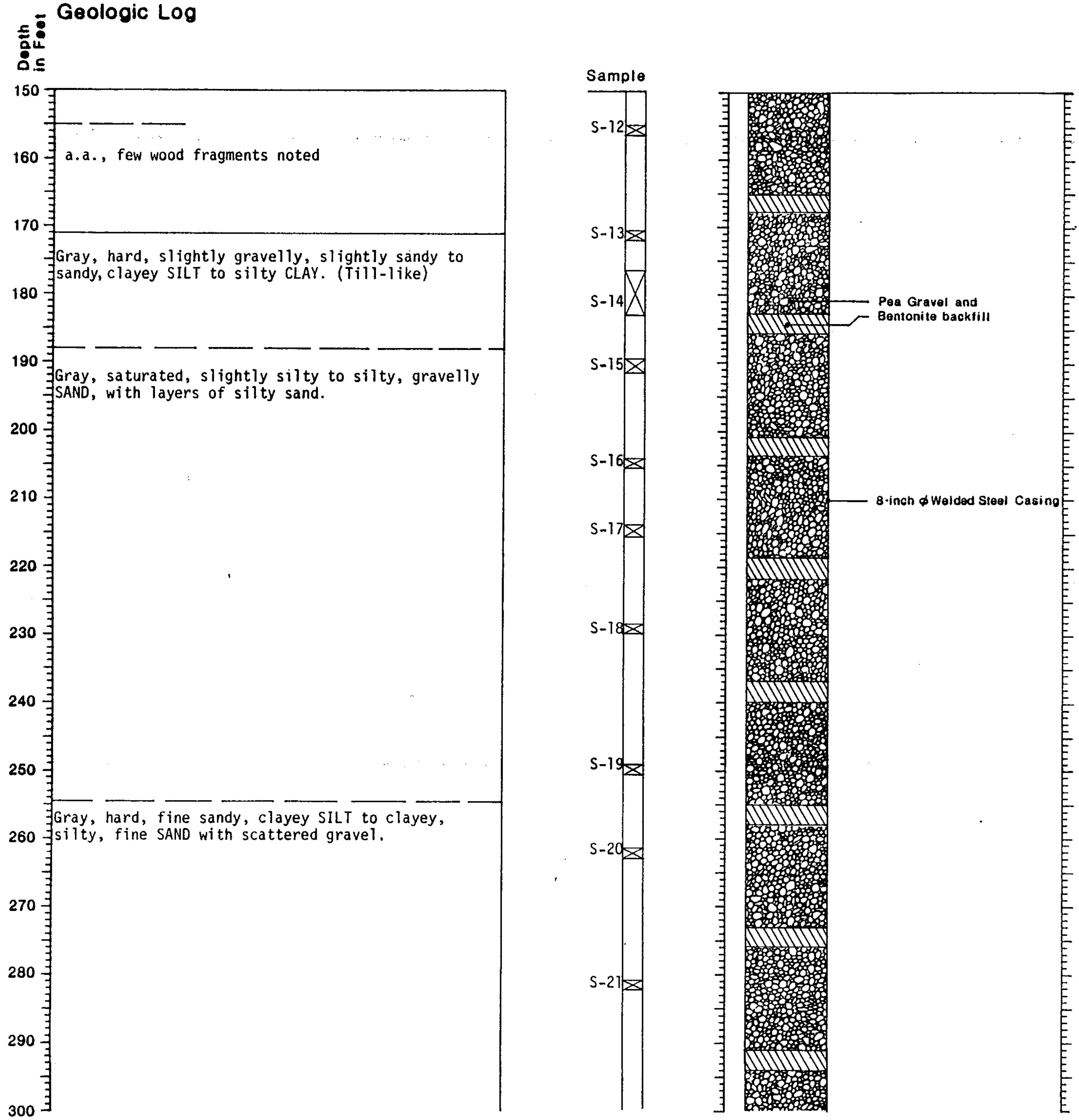
Boring Log and Construction Data for Observation Well 9



NOTES: 1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level ▽ is for date indicated and may vary with time of year.
ATD: At Time of Drilling

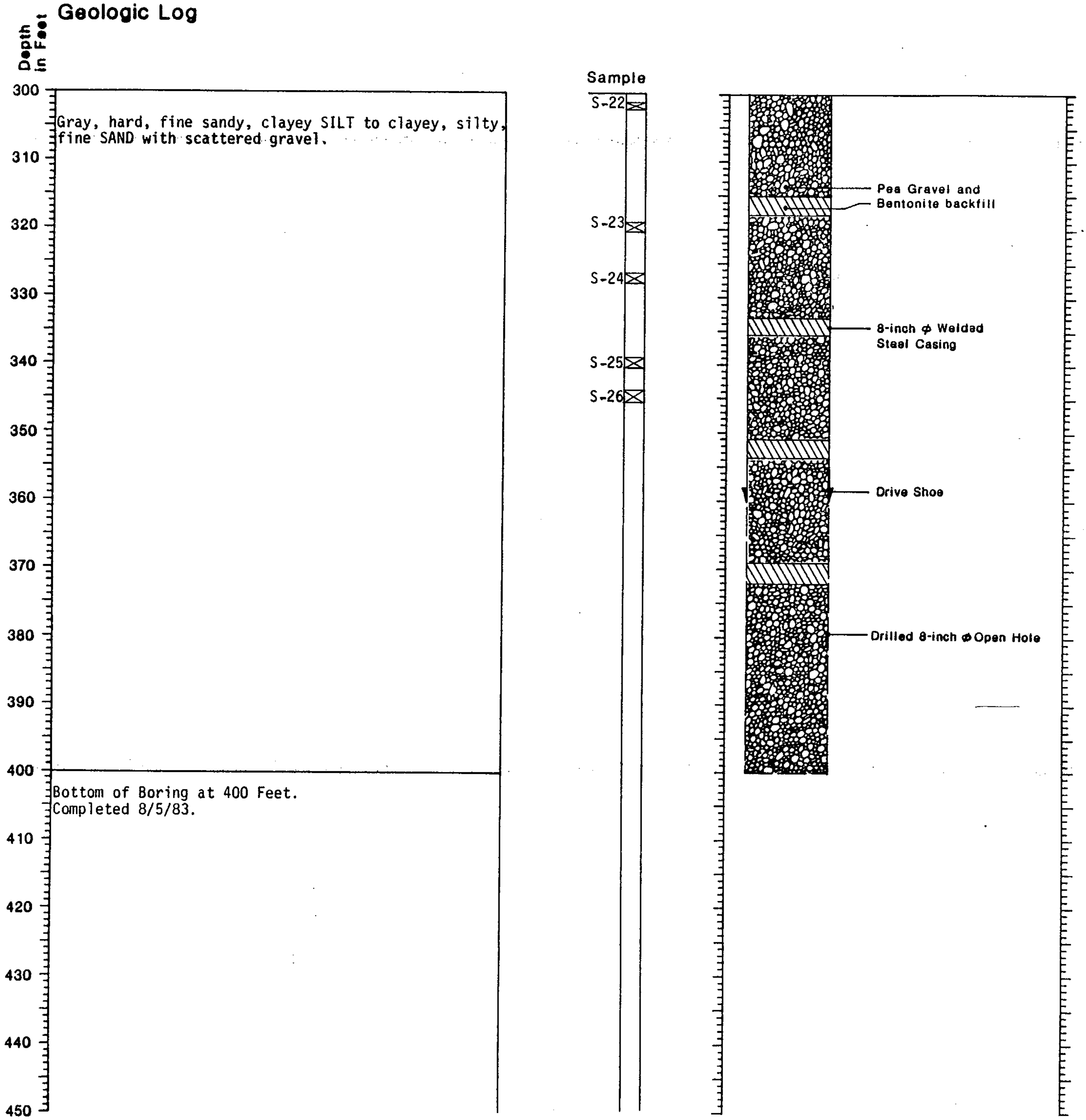
J-1148 September 1983
HART-CROWSER & associates, inc.
Sheet 1 of 3

Boring Log and Construction Data for Observation Well 9



J-1148 September 1983
HART-CROWSER & associates, inc.
Sheet 2 of 3

Boring Log and Construction Data for Observation Well 9



J-1148 September 1983
HART-CROWSER & associates, inc.
Sheet 3 of 3

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: April 23, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 34.0 ft, MSL
PVC CASING ELEVATION: 34.12 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 13.8 ft., 4-30-86

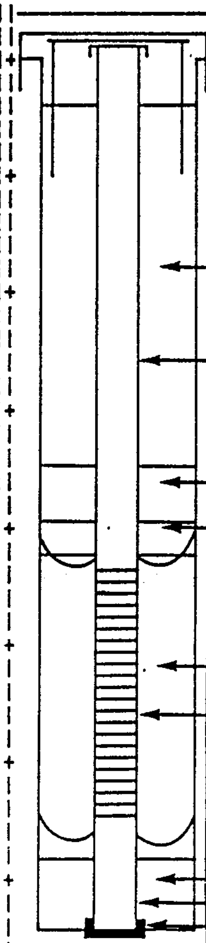
WELL: MW-10

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO,
GRAHAM, WA

INSPECTOR: J. NINTEMAN / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS	RECORD DRAWING	WELL CONSTRUCTION DETAILS
0	SILTY LOAM, brown to black		Concrete meter box with lid 8" steel casing with locking cap (See Generalized Well Construction diagram for detail)
	SANDY SILT, fine sand with some med to coarse sand and fine gravel, brown		
5			
	SILTY SAND AND GRAVEL, brown silt, mostly coarse sand to fine gravel		Cement/bentonite seal
10			
			2 - in. SCH 40 PVC casing. Flush threaded.
15	SANDY, GRAVELLY SILT, layered zones of silty sand and gravel, and gravelly silt, fine to med gravel, gray silt		
			Bentonite pellets
20			Fine sand Centering guide
25			Sand pack (Monterey- Aqua #8)
			Machine slotted SCH 40 PVC screen (20 slot size)
30	SILTY CLAY, with some fine to med gravel and a little fine sand, soft, no thread, blue-gray		
35			Natural formation Bottom sump End cap
	END OF BORING		
40			

MW-10 WELL LOG AND CONSTRUCTION DIAGRAM

CH2M HILL MONITORING WELL LOG

PROJECT: CITY OF RENTON GROUNDWATER MONITORING WELLS
NUMBER: S20080.A0

COMPLETION DATE: April 27, 1986

LOCATION: RENTON, WASHINGTON

GROUND ELEVATION: 32.0 ft, MSL
PVC CASING ELEVATION: 32.24 ft, MSL

DEPTH TO WATER FROM
GROUND & DATE: 12.0 ft, 4-30-86

WELL: MW-11

DRILLING METHOD: CABLE TOOL, 8-INCH CASING

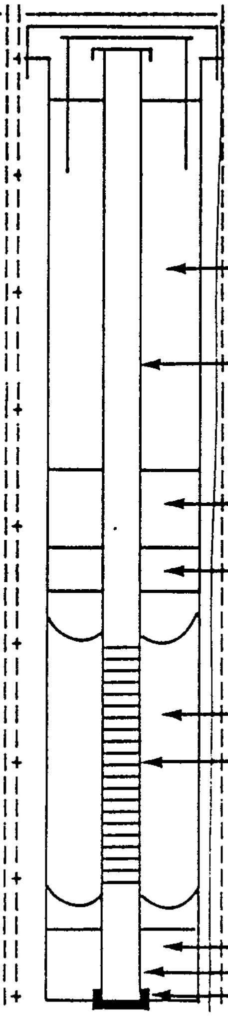
DRILLER: HOKKAIDO DRILLING AND DEVELOPEMENT CO, GRAHAM, WA

INSPECTOR: J. NINTEMAN / SEA

SAMPLING METHOD: EXAMINATION OF BAILED CUTTINGS

DEPTH BELOW SURFACE (feet)	DESCRIPTION OF MATERIALS
0	SANDY SILT, fine sand, with a trace of fine gravel, soft, brown
	increasing sand and gravel content
5	
10	SILTY SAND AND WOOD DEBRIS, fine sand, dark brown to black, soft
15	
	SANDY SILT, with trace of wood debris, dark gray
20	
	SAND AND GRAVEL, mostly coarse sand to fine gravel and some brown silt
25	
	same but with some wood chips
30	
35	SAND AND GRAVEL, coarse sand to med gravel, rounded, hole is making alot of water
40	END OF BORING

RECORD DRAWING



WELL CONSTRUCTION DETAILS

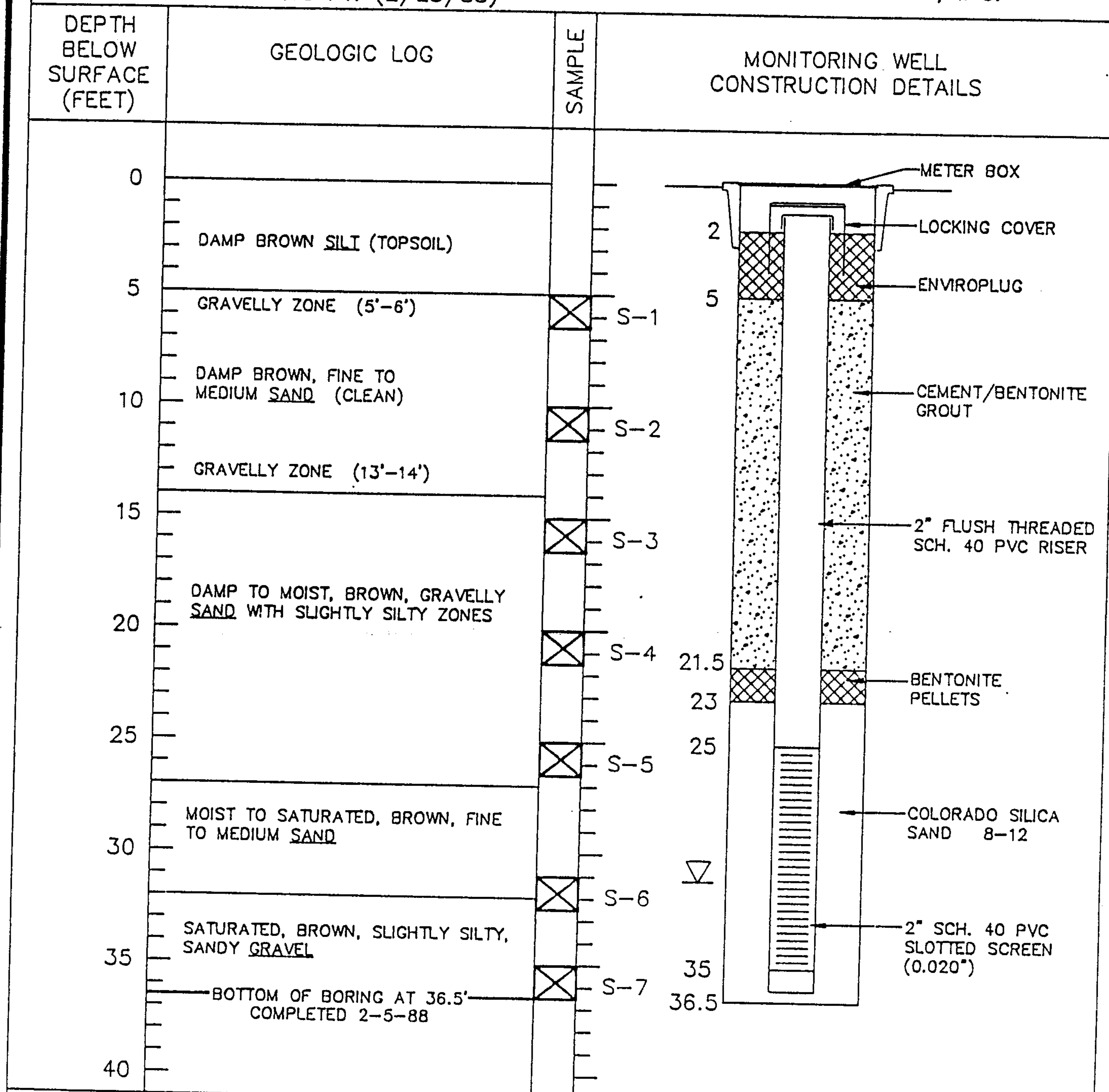
- Concrete meter box with lid
- 8" steel casing with locking cap (See Generalized Well Construction diagram for detail)
- Cement/bentonite seal
- 2 - in. SCH 40 PVC casing. Flush threaded.
- Bentonite Pellets
- Fine sand
- Centering guide
- Sand pack (Monterey- Aqua #8)
- Machine slotted SCH 40 PVC screen (20 slot size)
- Centering guide
- Natural formation
- Bottom sump
- End cap

MW-11 WELL LOG AND CONSTRUCTION DIAGRAM

RENTON MONITORING WELL LOG
REN-MW-12

COMPLETION DATE: FEB. 5, 1988
GROUND ELEVATION: 40.5 FT.
PVC CASING ELEVATION: 39.56 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 30.18 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.



GENERAL NOTES:

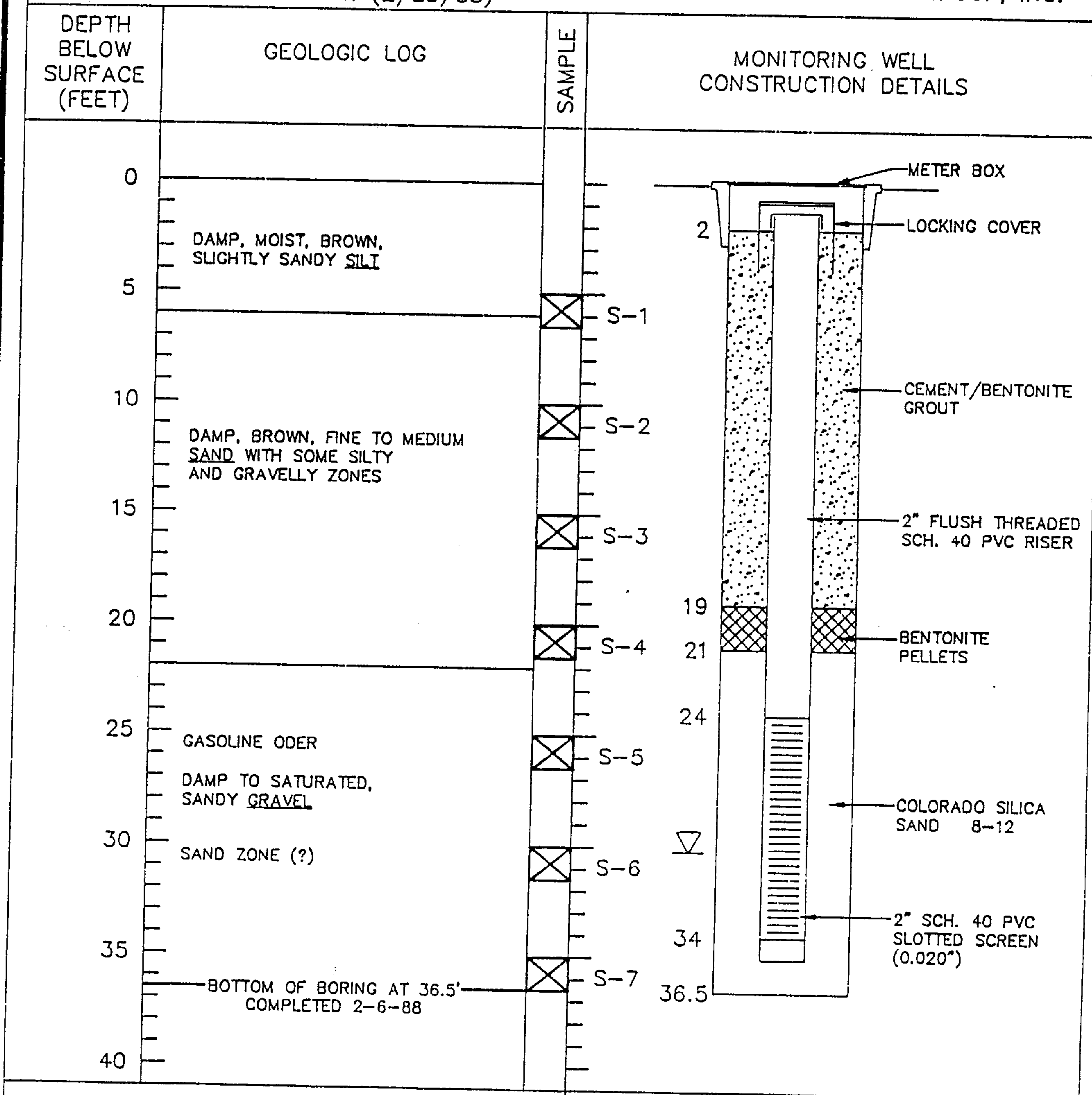
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ⊠ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-13

COMPLETION DATE: FEB. 6, 1988
GROUND ELEVATION: 39.9 FT.
PVC CASING ELEVATION: 39.00 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 29.26 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
HYDROGEOLOGIST: CHARLES ELLINGSON, THE HYDROGROUP, INC.



GENERAL NOTES:

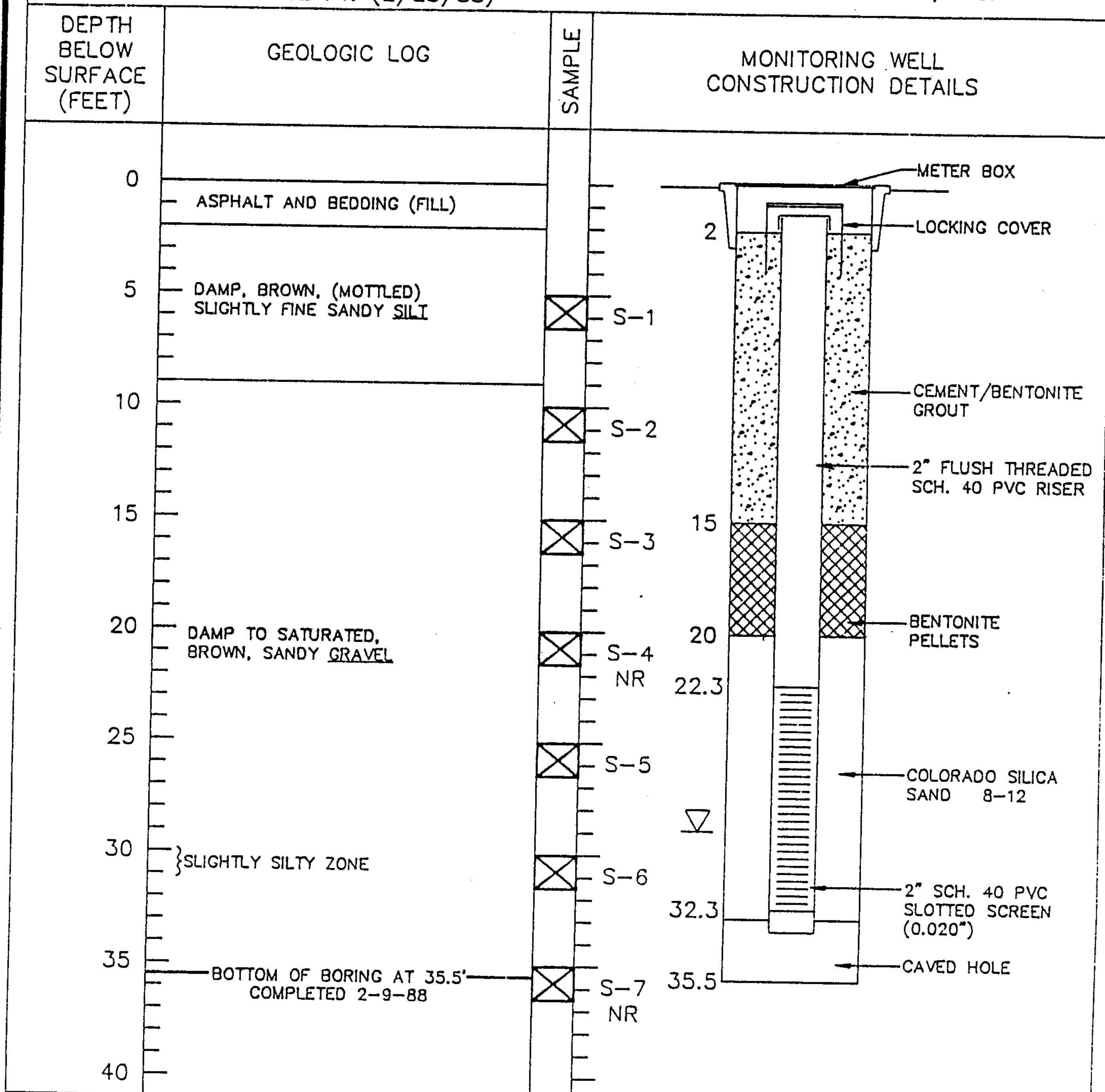
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-14

COMPLETION DATE: FEB. 9, 1988
GROUND ELEVATION: 39.5 FT.
PVC CASING ELEVATION: 38.80 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 28.12 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.



GENERAL NOTES:

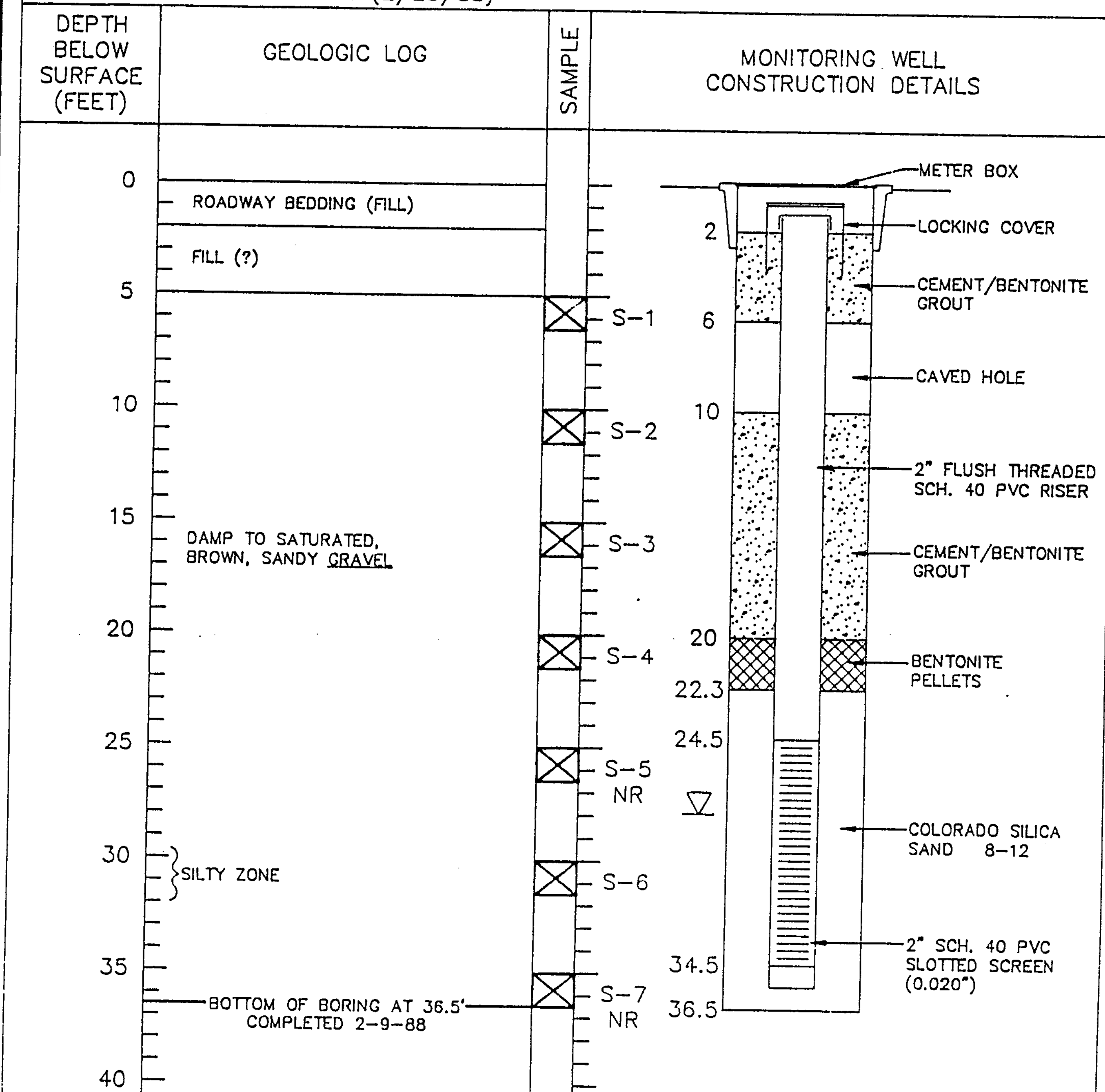
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-15

COMPLETION DATE: FEB. 9, 1988
GROUND ELEVATION: 38.4 FT.
PVC CASING ELEVATION: 37.60 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 27.04 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.



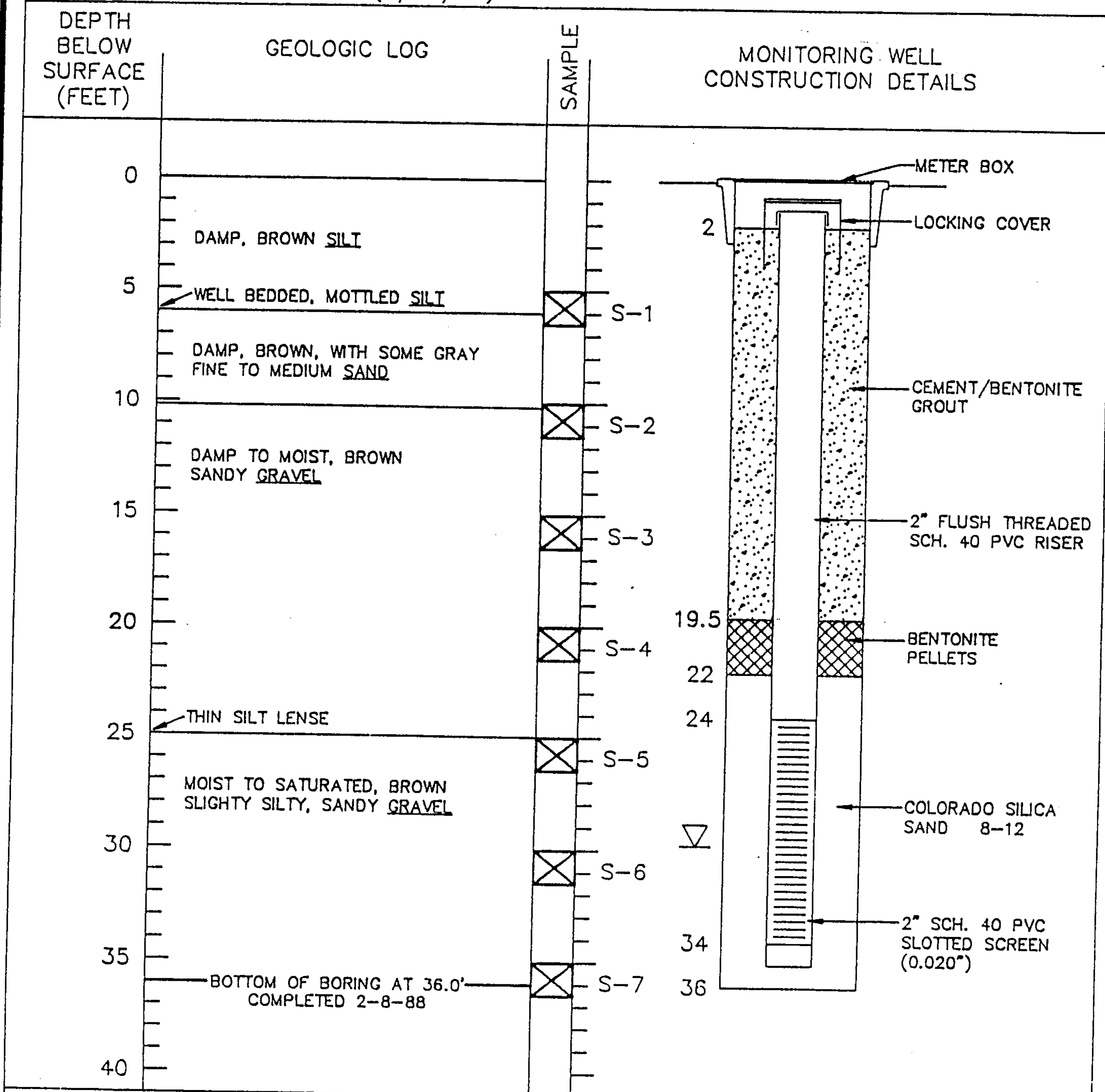
GENERAL NOTES:
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-16

COMPLETION DATE: FEB. 8, 1988
GROUND ELEVATION: 39.9 FT.
PVC CASING ELEVATION: 39.17 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 29.00 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.



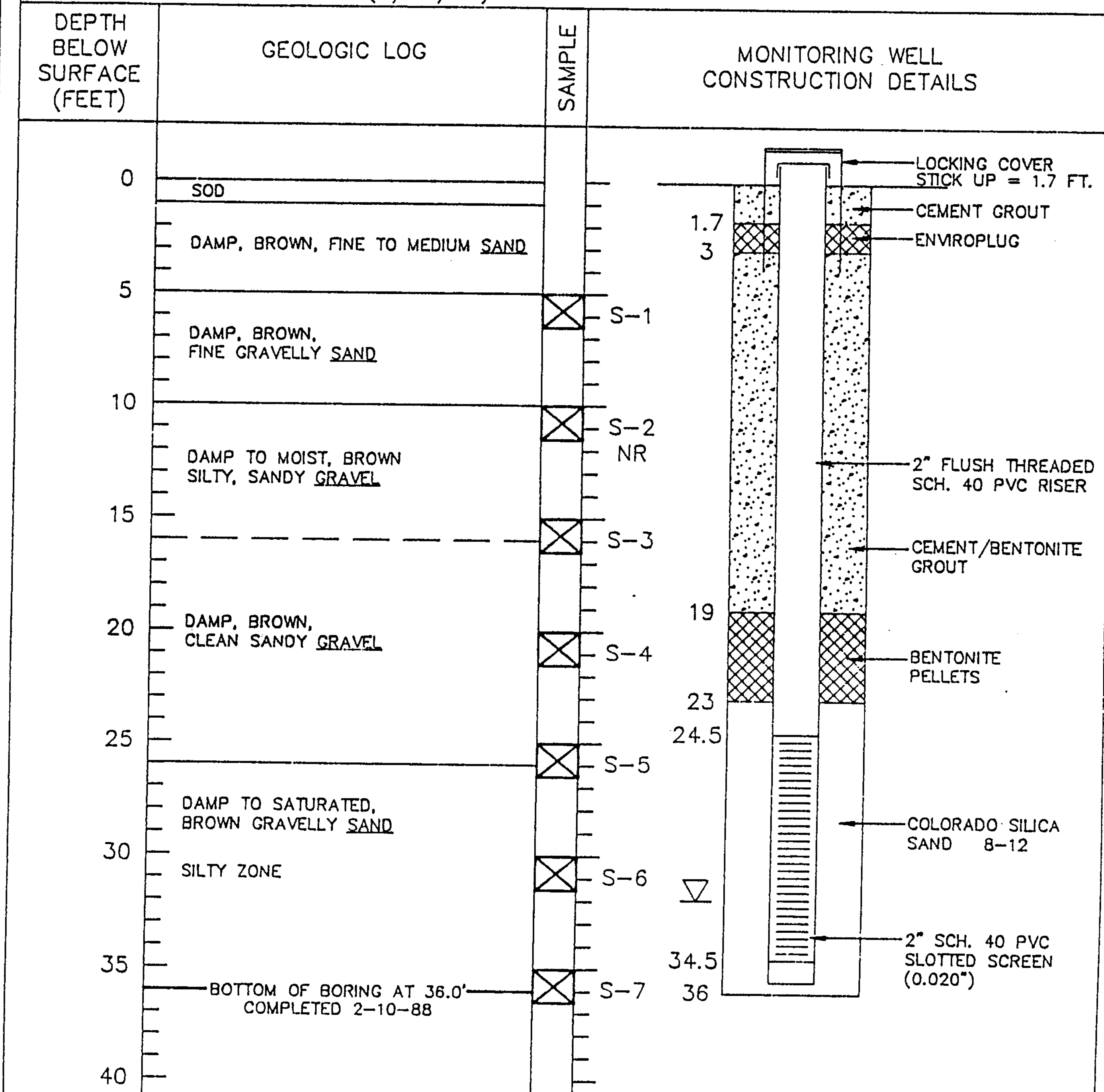
GENERAL NOTES:
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ⊠ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-17

COMPLETION DATE: FEB. 10, 1988
GROUND ELEVATION: 41.5 FT.
PVC CASING ELEVATION: 43.17 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 33.61 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.



GENERAL NOTES:

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2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
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RH2 ENGINEERING, P.S.

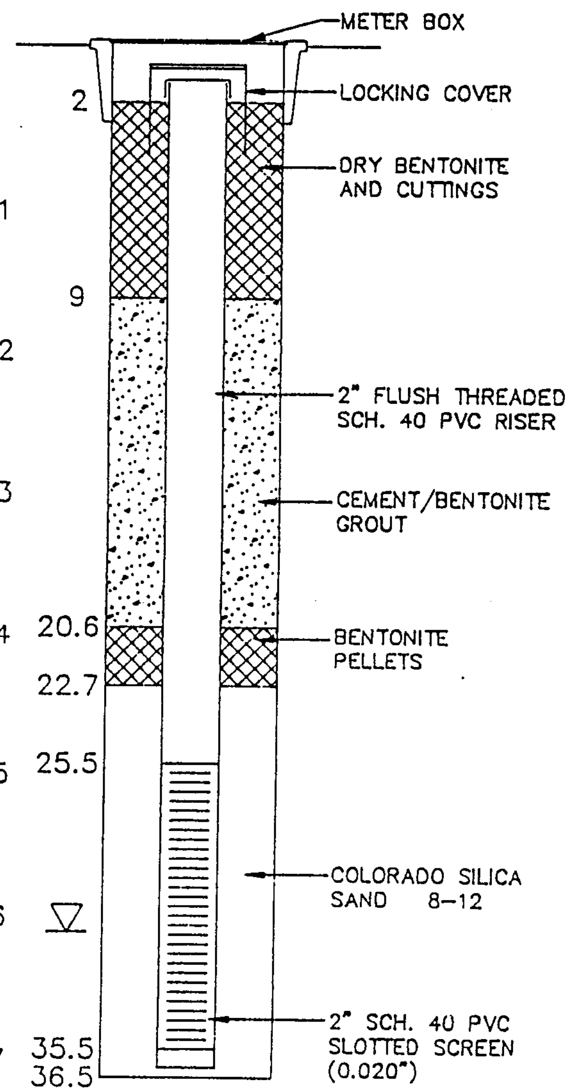
RENTON MONITORING WELL LOG
REN-MW-18

COMPLETION DATE: FEB. 5, 1988
GROUND ELEVATION: 41.6 FT.
PVC CASING ELEVATION: 40.84 FT.
DEPTH TO WATER FROM TOP OF PVC CASING: 30.65 FT. (2/25/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: TACOMA PUMP AND DRILLING, GRAHAM, WA
GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.

DEPTH BELOW SURFACE (FEET)	GEOLOGIC LOG	SAMPLE
0		
	DAMP, BROWN, SILTY FINE TO MEDIUM <u>SAND</u>	
5		
	SILTY <u>SAND</u> INTERBEDS	S-1
	GRADATIONAL	
10	DAMP, BROWN, FINE TO COURSE <u>SAND</u>	S-2
15		
	DAMP, BROWN, GRAVELLY <u>SAND</u>	S-3
	? ? ?	
20	MOIST BROWN <u>SILT</u> BED (6" THICK)	S-4
25	MOIST TO SATURATED, BROWN, SILTY, SANDY <u>GRAVEL</u>	S-5
	GRADES TO	
30		S-6
	CLEAN SANDY <u>GRAVEL</u>	
35		
	BOTTOM OF BORING AT 36.5' COMPLETED 2-5-88	S-7
40		

MONITORING WELL CONSTRUCTION DETAILS



GENERAL NOTES:
1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED MAY VARY WITH TIME OF YEAR.
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4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
REN-MW-19

GROUND ELEVATION: 41.5

PVC CASING ELEVATION: 41.45

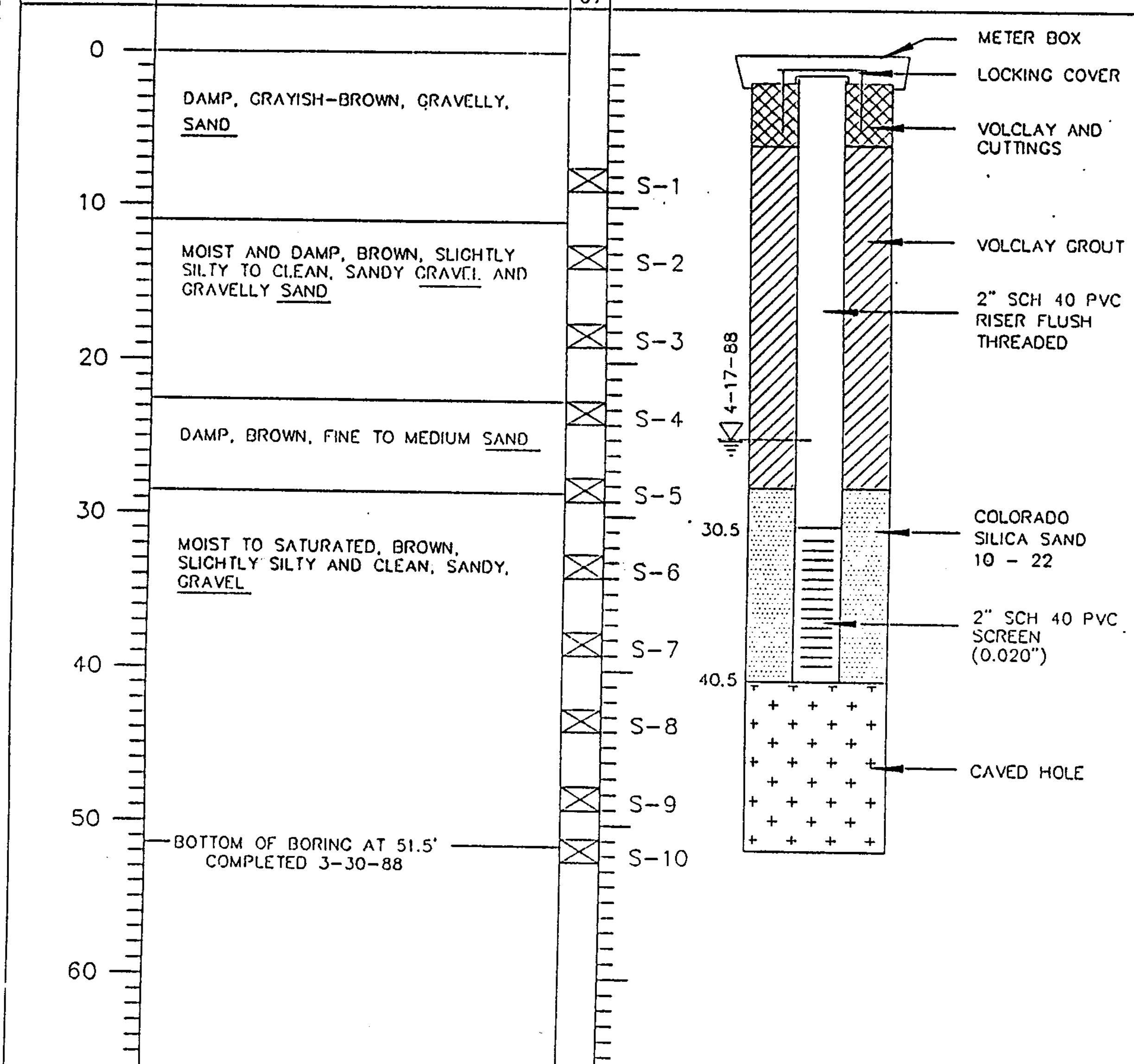
DEPTH TO WATER FROM TOP OF PVC CASING: 24.7 FT.(4/17/88)

DRILLING METHOD: HOLLOW-STEM AUGER

DRILLER: GEOBORING AND DEVELPOMENT PUYALLUP, WASHINGTON

GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.

DEPTH (FEET)	GEOLOGIC LOG	SAMPLE	MONITORING WELL CONSTRUCTION DETAILS



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2. WATER LEVEL IS FOR DATE INDICATED AND MAY VARY WITH TIME OF YEAR.
3. NR = NO RECOVERY
4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
MW-20

GROUND ELEVATION: 41.7

PVC CASING ELEVATION: 41.64

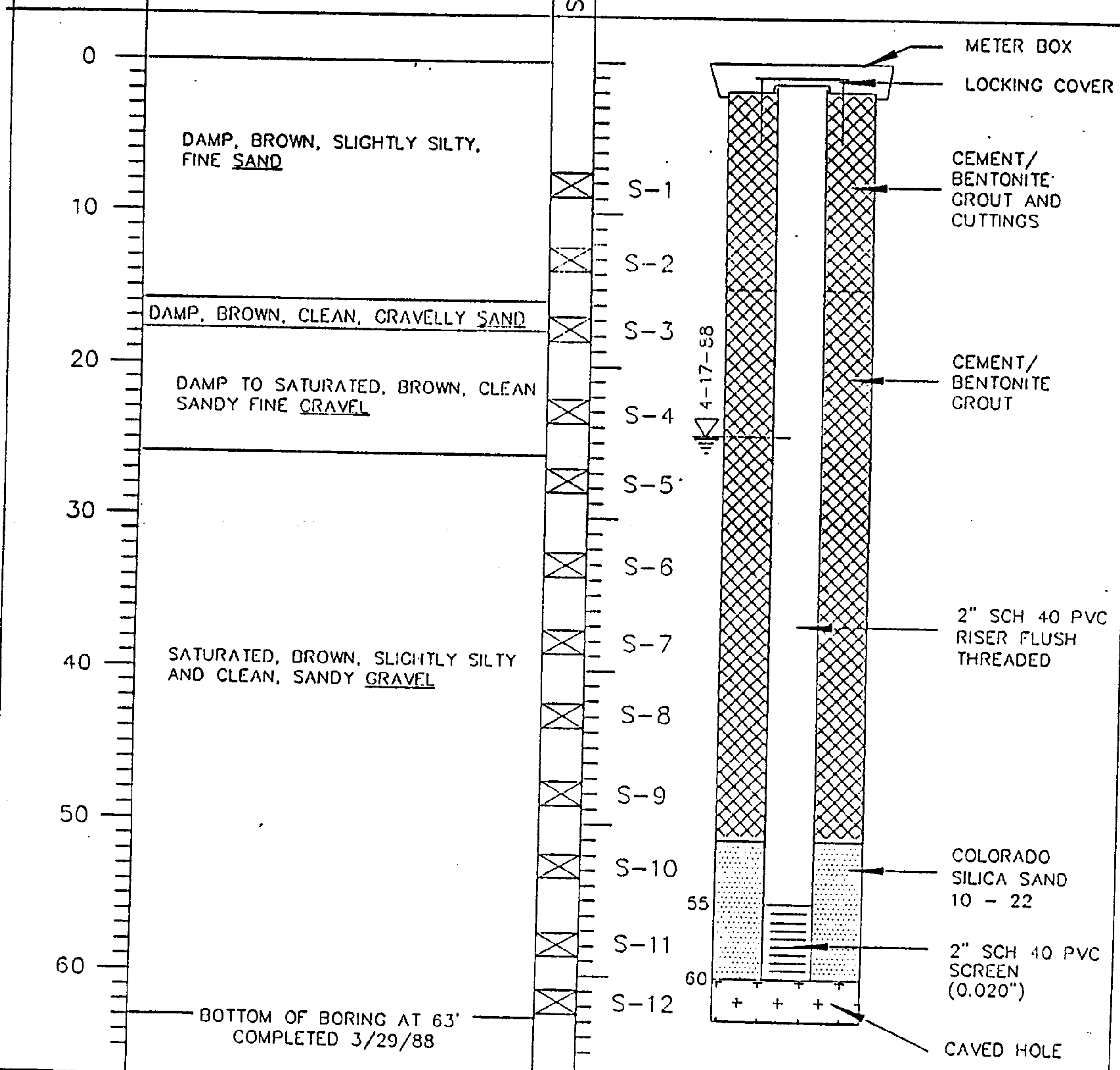
DEPTH TO WATER FROM TOP OF PVC CASING: 24.12 FT (4/17/88)

DRILLING METHOD: HOLLOW-STEM AUGER

DRILLER: GEOBORING AND DEVELPOMENT PUYALLUP, WASHINGTON

GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.

DEPTH (FEET)	GEOLOGIC LOG	SAMPLE	MONITORING WELL CONSTRUCTION DETAILS



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4. ☒ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
MW-21

GROUND ELEVATION: 39.0

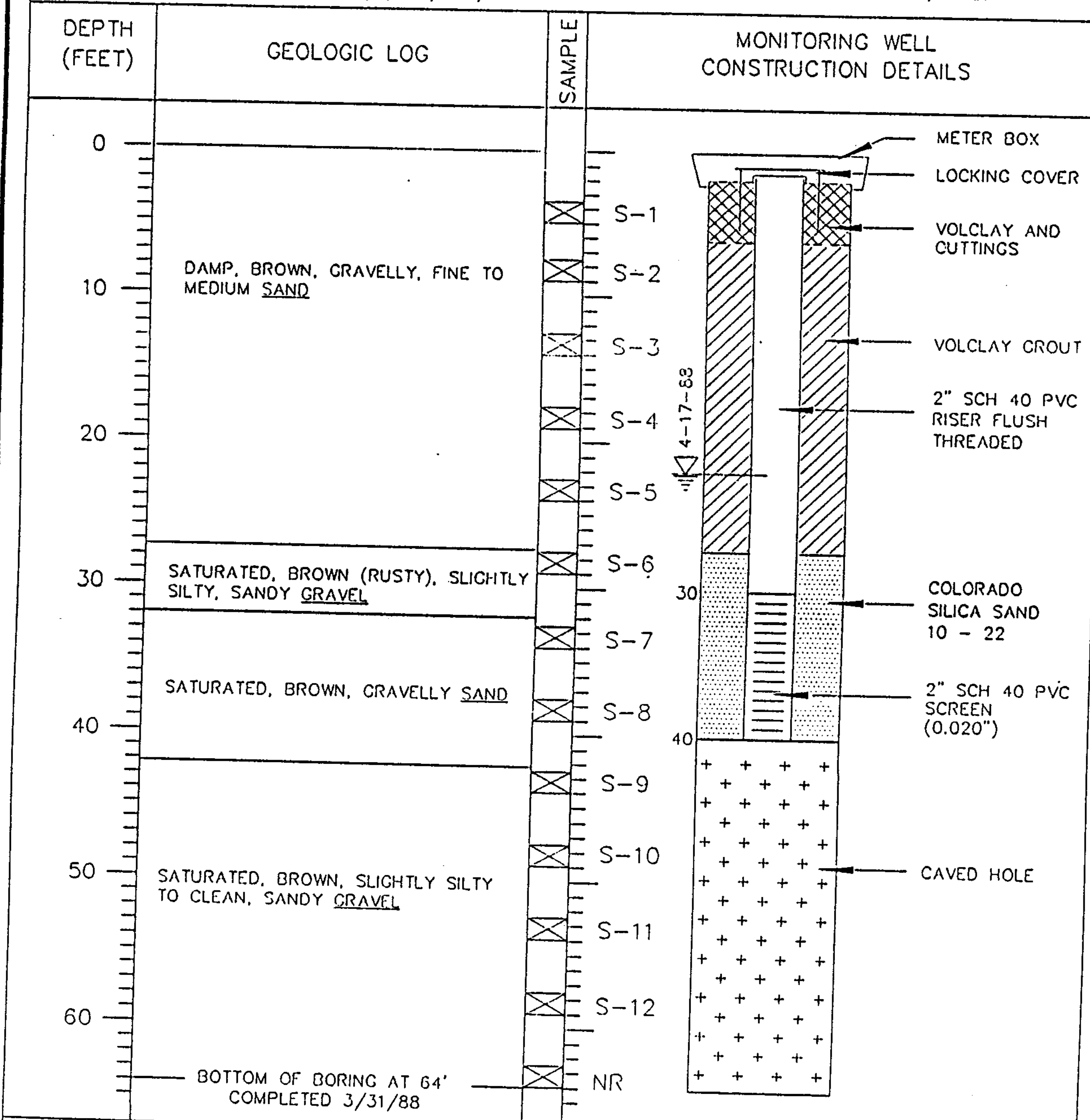
PVC CASING ELEVATION: 38.96

DEPTH TO WATER FROM TOP OF PVC CASING: 21.77 FT.(4/17/88)

DRILLING METHOD: HOLLOW-STEM AUGER

DRILLER: GEOBORING AND DEVELPOMENT
PUYALLUP, WASHINGTON

GEOLOGIST: RUSSELL PRIOR,
THE HYDROGROUP, INC.



1. SOIL DESCRIPTIONS ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. WATER LEVEL IS FOR DATE INDICATED AND MAY VARY WITH TIME OF YEAR.
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4. ⊠ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
MW-22

GROUND ELEVATION: 39.5

PVC CASING ELEVATION: 39.03

DEPTH TO WATER FROM TOP OF PVC CASING: 21.6 FT. (4/17/88)

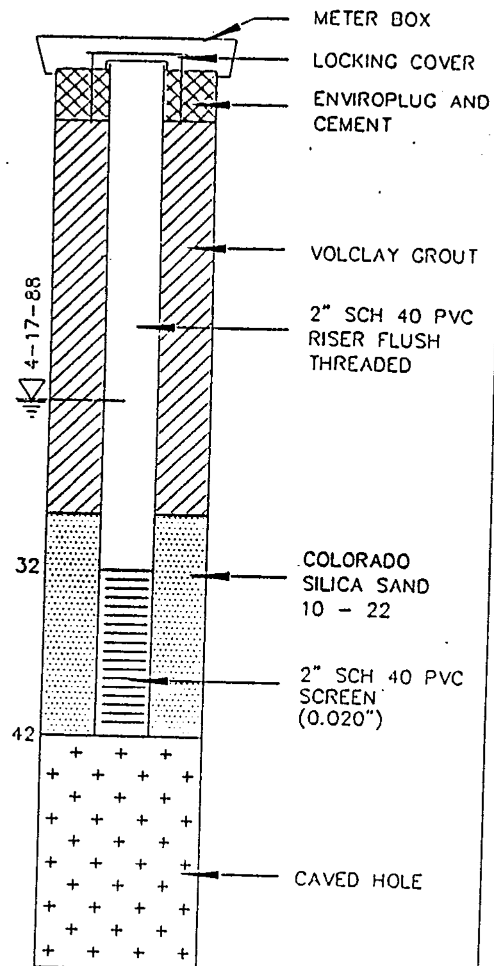
DRILLING METHOD: HOLLOW-STEM AUGER

DRILLER: GEOBORING AND DEVELPOMENT PUYALLUP, WASHINGTON

GEOLOGIST: RUSSELL PRIOR, THE HYDROGROUP, INC.

DEPTH (FEET)	GEOLOGIC LOG	SAMPLE
0–11	DAMP, BROWN, SLIGHTLY FINE, SANDY SILT	S-1, S-2
11–17	DAMP, GRAY, CLEAN, FINE TO MEDIUM SAND	S-3
17–56	DAMP TO SATURATED, BROWN, CLEAN TO SLIGHTLY SILTY, SANDY GRAVEL	S-4, S-5, S-6, S-7, S-8, S-9, S-10, S-11
56–59	SATURATED, BROWN, SILTY, GRAVELLY SAND	S-12
59	BOTTOM OF BORING AT 59' COMPLETED 4/1/88	

MONITORING WELL CONSTRUCTION DETAILS



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RH2 ENGINEERING, P.S.

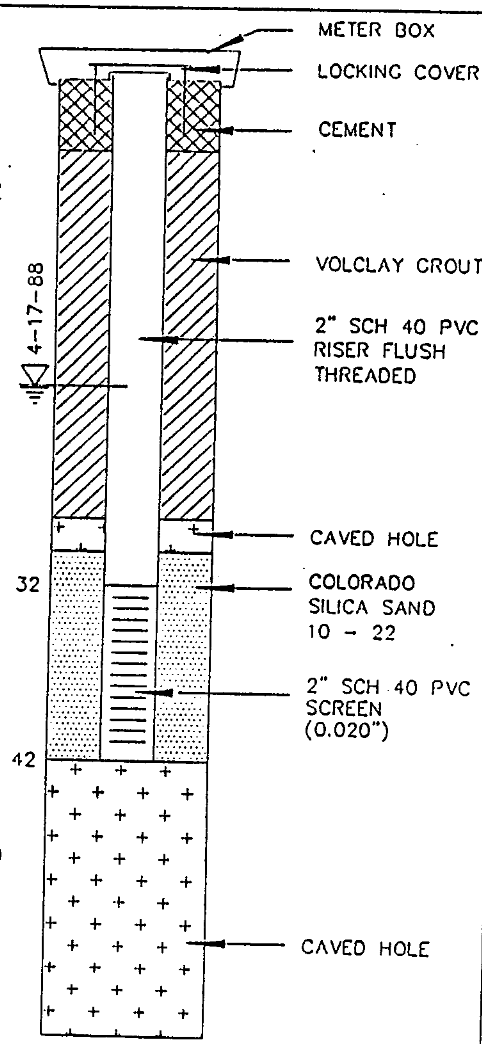
RENTON MONITORING WELL LOG
MW-23

GROUND ELEVATION: 37.3
PVC CASING ELEVATION: 37.28
DEPTH TO WATER FROM TOP OF PVC CASING: 19.8 FT (4/17/88)

DRILLING METHOD: HOLLOW-STEM AUGER
DRILLER: GEOBORING AND DEVELPOMENT
PUYALLUP, WASHINGTON
GEOLOGIST: RUSSELL PRIOR,
THE HYDROGROUP, INC.

DEPTH (FEET)	GEOLOGIC LOG	SAMPLE
0	FILL	
	DAMP, BROWN, FINE TO MED SAND	S-1
10	DAMP, BROWN, SAND AND GRAVEL AND GRAVELLY SAND	S-2, S-3, S-4
20	MOIST, BLUE GRAY, FINE, SANDY SILT TO SILTY, FINE SAND	
30	SATURATED, BROWN, GRAVELLY SAND	S-5, S-6, S-7
	FINE TO MEDIUM SAND	
40	SATURATED, BROWN, GRAVELLY SAND	S-8
	SATURATED, GRAY, SLIGHTLY GRAVELLY SANDY SILT W/ WOOD, (MUDFLOW?)	S-9
50	SATURATED, BROWN, GRAVELLY, FINE TO COARSE SAND	S-10, S-11
60	BOTTOM OF BORING AT 59 ' COMPLETED 4/4/88	S-12

MONITORING WELL CONSTRUCTION DETAILS



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3. NR = NO RECOVERY
4. ⊠ = SPLIT SPOON SAMPLE

RH2 ENGINEERING, P.S.

RENTON MONITORING WELL LOG
MW-24

GROUND ELEVATION: 37.5

PVC CASING ELEVATION: 37.45

DEPTH TO WATER FROM TOP OF PVC CASING: 20.2 FT. (4/17/88)

DRILLING METHOD: HOLLOW-STEM AUGER

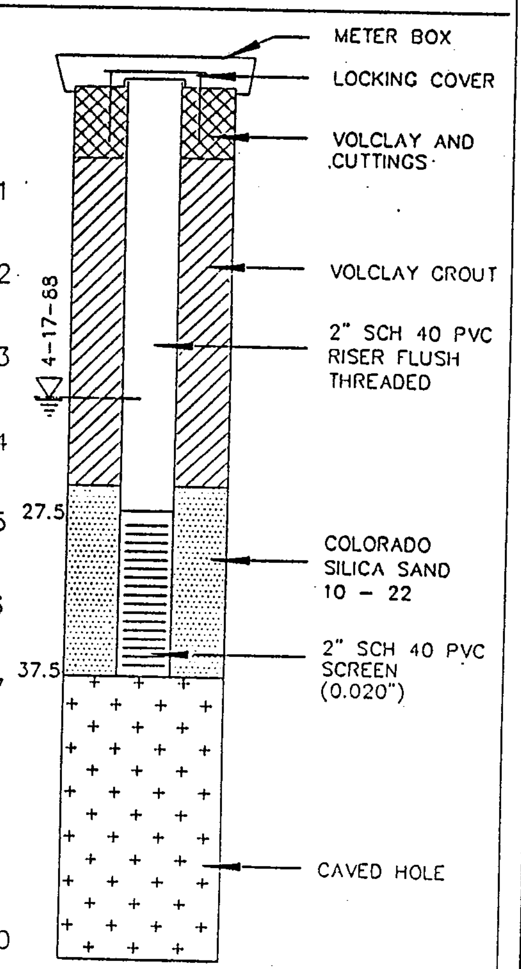
DRILLER: GEOBORING AND DEVELPOMENT
PUYALLUP, WASHINGTON

GEOLOGIST: RUSSELL PRIOR,
THE HYDROGROUP, INC.

GEOLOGIC LOG	SAMPLE
DAMP, BROWN, SANDY SILT (LOAM)	
DAMP, BROWN SAND AND GRAVEL	S-1
DAMP TO MOIST, BROWN, GRAVELLY SAND & SANDY GRAVEL	S-2
INTERBEDDED SAND AND SOFT CLAY	S-3
DAMP TO MOIST, BROWN, GRAVELLY SAND & SANDY GRAVEL	S-4, S-5
SATURATED, BROWN, SLIGHTLY SILTY TO CLEAN, SANDY GRAVEL	S-6, S-7, S-8, S-9, S-10
BOTTOM OF BORING AT 55.5' COMPLETED 4/5/88	

DEPTH (FEET): 0, 10, 20, 30, 40, 50, 60

MONITORING WELL CONSTRUCTION DETAILS



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RH2 ENGINEERING, P.S.

MONITORING WELL GEOLOGIC & CONSTRUCTION LOG

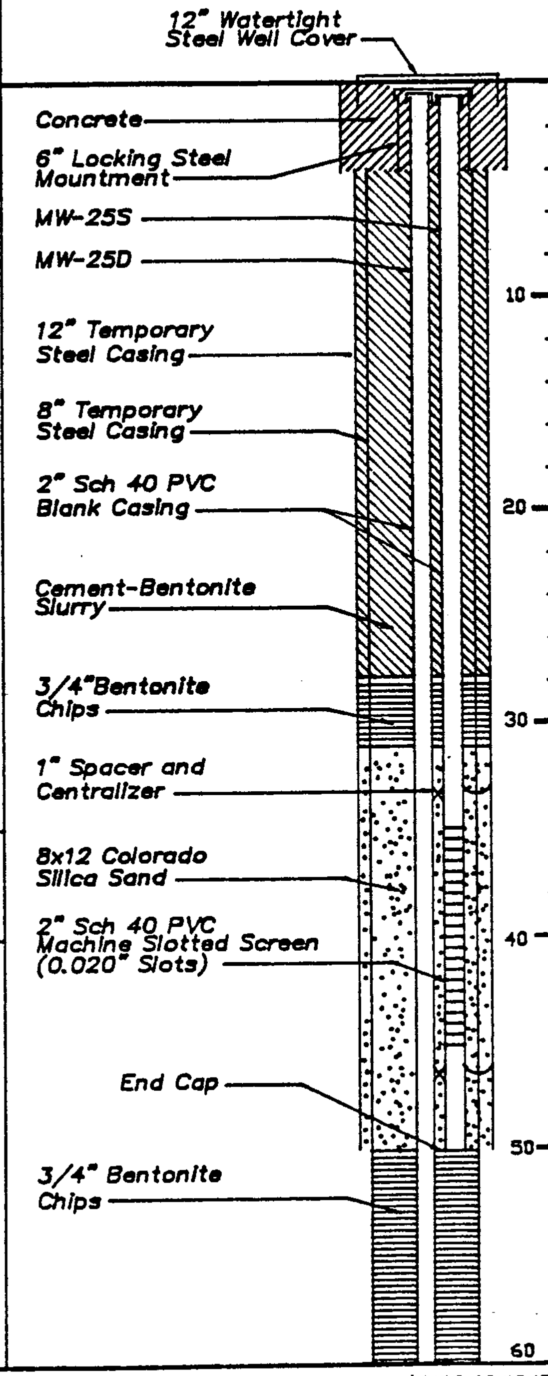
CH2M HILL

PROJECT NUMBER	WELL NUMBER	
SEA20080.F0	MW-25S,D	SHEET 1 OF 2

PROJECT CITY OF RENTON COORDINATES 178966(N) 1661015(E) LAMBERT GRID COORD.
ELEVATION, NGVD (Top of PVC Casing) 35.46 (25S) 35.54 (25D) SURFACE ELEVATION, NGVD 36.1
WATER LEVEL ELEVATION, NGVD 15.44(25S) 15.44(25D) 10/19/88 START DATE 10/5/88
DRILLING CONTRACTOR HOLT DRILLING INC. FINISH DATE 10/19/88
DRILLING METHOD CABLE TOOL (BUCYRUS ERIE 22-W)
SAMPLING METHOD 2.5" ID Split-Spoon Sampler Where Blows Are Noted, 300 lb Hammer, 30" Drop

DEPTH (Ft)	SAMPLE Recovery (%)	SAMPLE Blows	GEOLOGIC LOG & USCS DESIGNATION	USCS CLASSIFICATION (FIELD APPROX.)
0			Concrete surface SAND, brown, fine, some silt	SP/SM
	90	6-5-4	GRAVEL, fine to coarse, rounded, with SAND, brown, fine to medium, trace silt	GW
10	50	5-17	As above with decreasing sand content and some fine cobbles	
	60	13-15-20		
20	15	4-15-10		
	100	15-17-17		
30	60	13-11-12		
			GRAVEL, fine to coarse, some cobble, fine to medium, a little sand, brown, fine to medium, trace silt	GW
40			GRAVEL, fine to coarse, some sand, fine to medium, a little silt, red-brown	GW
50				
			As above but light brown, some fine to medium cobble	
60				

WELL CONSTRUCTION (NOT TO SCALE)



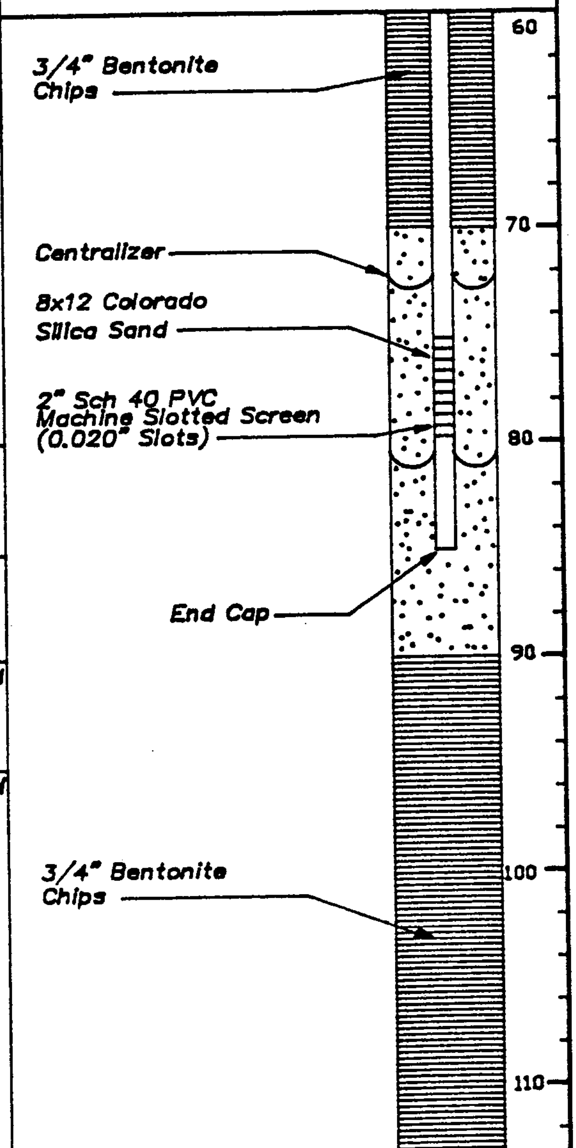
HW25 12/13/88

MONITORING WELL GEOLOGIC & CONSTRUCTION LOG

PROJECT NUMBER	WELL NUMBER	
SEA20080.F0	MW-25S,D	SHEET 2 OF 2

DEPTH (Ft)	SAMPLE: Recovery (%)	SAMPLE: Blows	GEOLOGIC LOG & USCS DESIGNATION	USCS CLASSIFICATION (FIELD APPROX.)
60			GRAVEL, black, fine to coarse, rounded, with SAND, grey-brown, fine to medium, a little cobble, fine to medium, trace silt, light brown	GW
			COBBLE, fine to medium, with GRAVEL, fine to coarse, some sand, fine to coarse, trace silt, brown	GW
70				
80			GRAVEL, black and brown, medium and coarse, rounded, some fine gravel, subangular, black, some cobbles, fine to medium, some sand, a little silt, grey-brown	GW
			As above but increasing silt content	GW
90		50 (4")	SILTY SAND, black and grey, medium, with GRAVEL, black, fine, subangular, some coarse gravel	SM/GM
			SILTY GRAVEL, grey-brown, fine to coarse, rounded, firm, some sand, fine to medium As above with red precipitate and layers of silty sand, grey, firm	SM/GM
100				
110	100	30,30,23		
	70	20,21,22	SILTY SAND, grey-brown, fine, firm, some clay, brown (end of boring @ 113 feet)	SM/SC

WELL CONSTRUCTION (NOT TO SCALE)



MONITORING WELL GEOLOGIC & CONSTRUCTION LOG

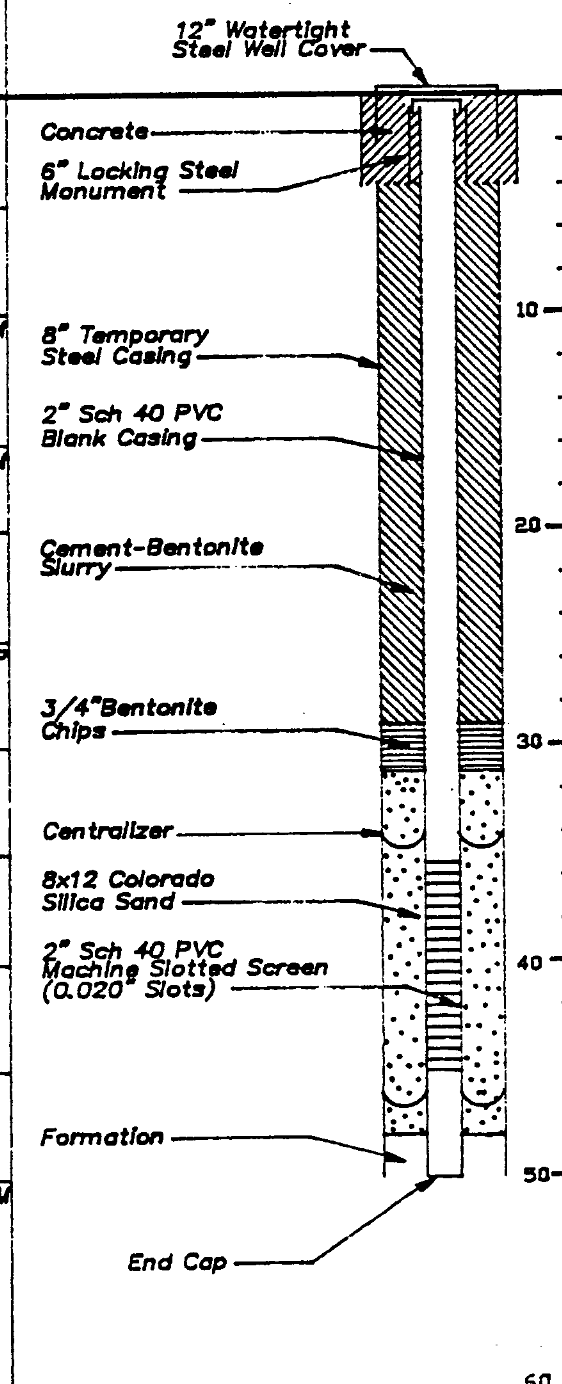
CH2M HILL

PROJECT NUMBER	WELL NUMBER	
SEA20080.F0	MW-26	SHEET 1 OF 1

PROJECT: CITY OF RENTON
COORDINATES: 177638(N) 1660375(E) LAMBERT GRID COORD.
ELEVATION, NGVD (Top of Well Casing): 33.74
SURFACE ELEVATION, NGVD: 34.4
WATER LEVEL ELEVATION, NGVD:
START DATE: 9/30/88
DRILLING CONTRACTOR: HOLT DRILLING INC.
FINISH DATE: 10/4/88
DRILLING METHOD: CABLE TOOL (BUCYRUS ERIE 22-W)
SAMPLING METHOD: Samples Collected at 5' Intervals Using 2.5" I.D. Split Spoon Sampler; 300 lb Hammer, 30" Drop.

DEPTH (Ft)	SAMPLE Recovery (%)	SAMPLE Blows	GEOLOGIC LOG & USCS DESIGNATION	USCS CLASSIFICATION (FIELD APPROX.)
			asphalt surface FILL, dark brown, medium to fine gravel with fine sand and silt	
	100	5-4-4	SAND, light brown, fine with SILTY SAND, gray, with thin red oxidized layers	SM
10	40	13-17-7	GRAVEL, fine to coarse, well graded, rounded, black and brown, some fine sand and trace of silt	GW/GM
	20	4-4-7	SILTY SAND, grey	GW/SM
20	10	3-4-4	GRAVEL, fine to coarse, some silty sand, fine, grey	GM
	100	6-11-11	SAND, fine to medium, with layers of SILTY SAND, grey	SM/SP
30	90	6-13-20	GRAVEL, fine to coarse, with SILTY SAND, fine to medium, grey, trace of wood fragments	GM
	80	40-25-30	GRAVEL, fine to coarse, with SAND, fine to medium, trace of silt, grey	GW
40	20	3-3-20	SANDY SILT, plastic, grey, with GRAVEL, fine to coarse	GM
	100	15-50	SAND, medium, light brown, with GRAVEL, fine to coarse, well graded, loose, trace of silt	GW
50	30	50 (5")	GRAVEL, fine to medium, rounded, mostly black, a little silty sand, brown (end of boring @ 50')	GW/GM
60				

WELL CONSTRUCTION (NOT TO SCALE)



MW26 12/13/88

MONITORING WELL GEOLOGIC & CONSTRUCTION LOG

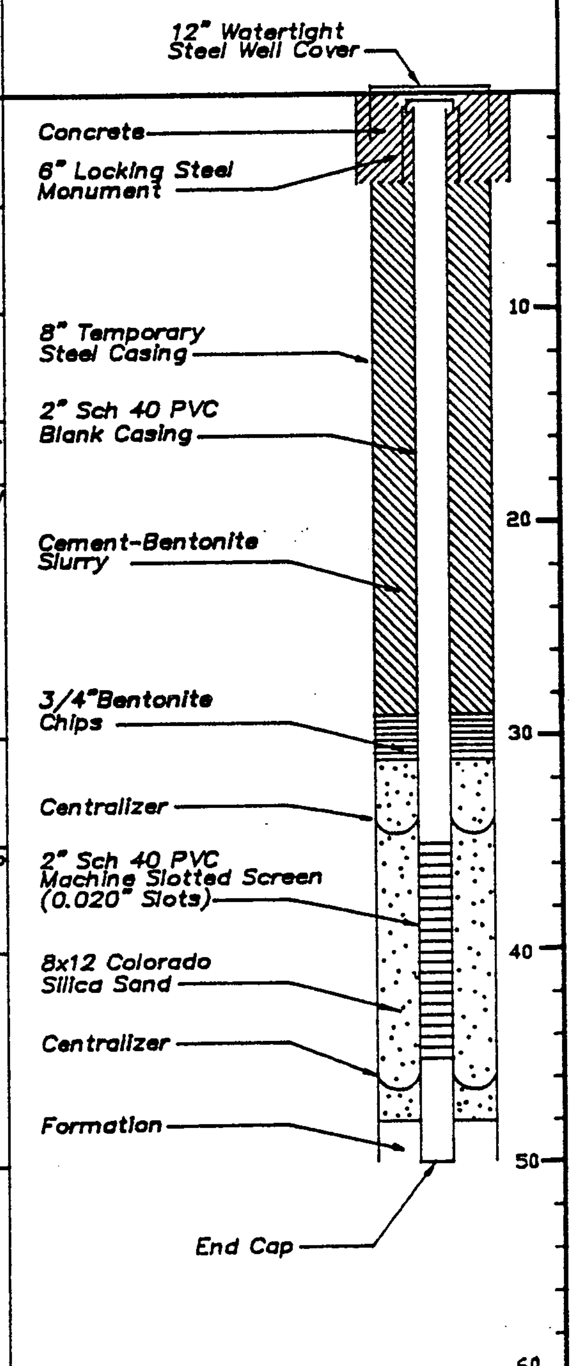
CH2M HILL

PROJECT NUMBER	WELL NUMBER	
SEA20080.F0	MW-27	SHEET 1 OF 1

PROJECT: CITY OF RENTON
COORDINATES: 179333(N) 1660077(E) LAMBERT GRID COORD.
ELEVATION, NGVD (Top of Well Casing): 30.83
SURFACE ELEVATION, NGVD: 31.2
WATER LEVEL ELEVATION, NGVD: 14.78 (10/13/88)
START DATE: 9/28/88
DRILLING CONTRACTOR: HOLT DRILLING INC.
FINISH DATE: 9/30/88
DRILLING METHOD: CABLE TOOL (BUCYRUS ERIE 22-W)
SAMPLING METHOD: Samples Collected at 5' Intervals Using 2.5" I.D. Spoon Sampler; 300 lb Hammer, 30" Drop.

DEPTH (Ft)	SAMPLE Recovery (%)	SAMPLE Blows	GEOLOGIC LOG & USCS DESIGNATION	USCS CLASSIFICATION (FIELD APPROX.)
			Grassy surface SILTY SAND, brown, fine to medium, some fine to medium gravel	
	100	2-7-9	SILT, brown, with thin layers of SAND, brown, fine to medium, some roots, some red precipitate	OL/SM
10	100	2-2-1	SILT, grey, soft, some red precipitate, trace coal fragments	ML
	100	3-4-4	SANDY SILT, grey, very fine	SM/ML
20	60	32/40/45	GRAVEL, medium to coarse, rounded, with SAND, medium to coarse, little to some grey silt, some red precipitate	GM/GW
	100	36/20/30		
30	30	50 (5")	GRAVEL, fine to coarse, rounded, some sand and cobbles	GP
	100	21-31-25	SAND, brown, medium to coarse, some gravel, medium to coarse, rounded	SP/GP
40	60	20-40-50	SAND, brown, with GRAVEL, some cobbles, trace fine sand and silt, loose	GM
50	10	50 (5.5")	SILTY SAND, grey, firm, dry, some gravel (end of boring @ 50')	GM
60				

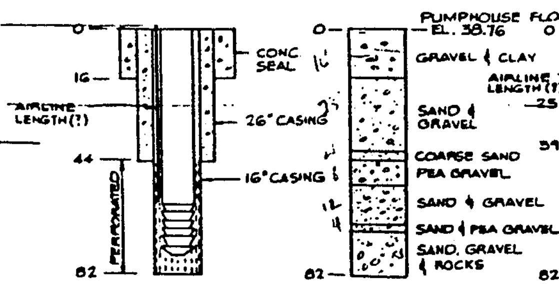
WELL CONSTRUCTION (NOT TO SCALE)



MW27 12/13/88

LIBERTY PARK WELLS

WELL Nº 1



60' OF 10" COLUMN
6'-6" OF PUMP
2' OF SCREEN (?)

200 HP 1800 RPM G.E. MOTOR Nº WVJ 922001

7-STAGE 12 ES CORNELL PUMP SERIAL 342

NOMINAL CAPACITY 2,000 GPM

(WELL IS CROOKED - TIGHT AT 41 FEET)

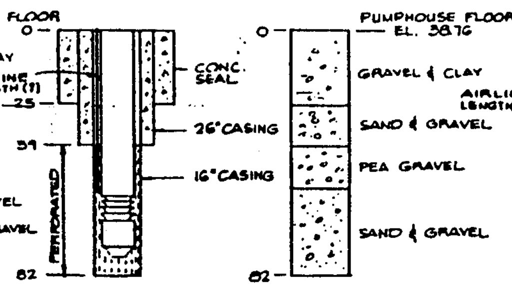
DRILLED JANNSEN DRILLING 1942

WELL IN SERVICE JANUARY 1944

75 HP PUMP CHANGED TO 200 HP EQUIPMENT IN MARCH 1962

DEPTH TO BOTTOM OF WELL 75 FT.

WELL Nº 2



60' OF 12" COLUMN
4'-6" OF PUMP
2' OF SCREEN

200 HP 1800 RPM G.E. MOTOR Nº WVJ 429001

3-STAGE 14 EC CORNELL PUMP SERIAL 341

NOMINAL CAPACITY 5,000 GPM

DRILLED JANNSEN DRILLING 1942

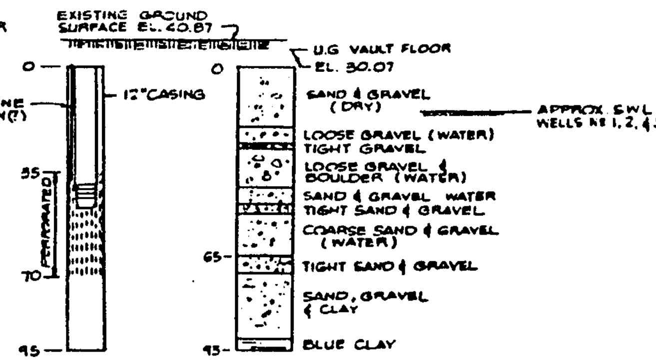
WELL IN SERVICE JANUARY 1944

75 HP PUMP CHANGED TO 200 HP EQUIPMENT IN FEBRUARY 1962

DEPTH TO BOTTOM OF WELL 76 FT.

WELL Nº 3

(ALSO KNOWN AS TEST WELL Nº 2)



40' OF 8" COLUMN
5'-0" OF PUMP
3' OF SCREEN

100 HP 1800 RPM G.E. MOTOR Nº 2VJ 1229122

5-STAGE 12 DC CORNELL PUMP SERIAL 352

NOMINAL CAPACITY 1600 GPM

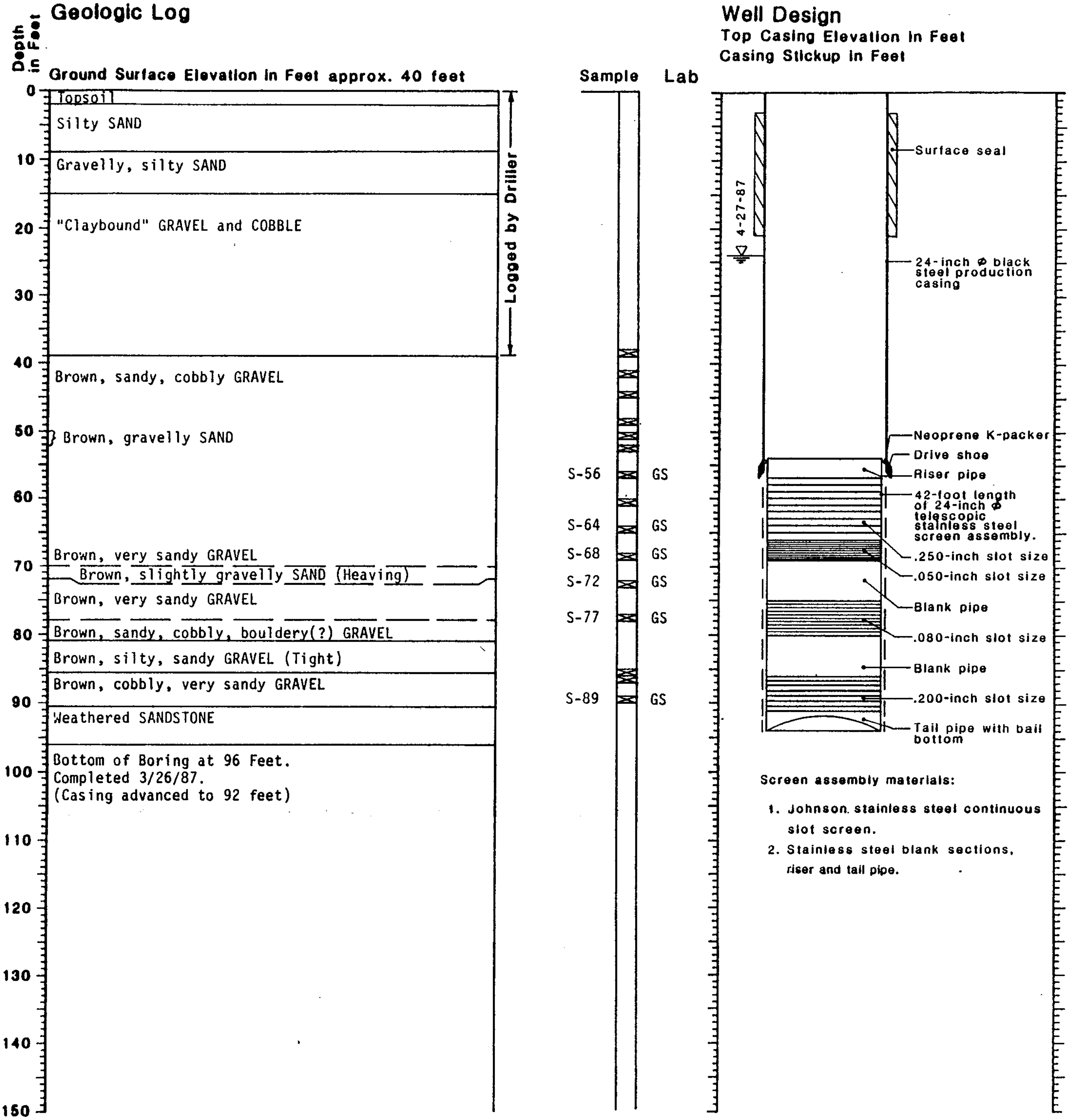
? WELL SCREEN FROM 50 FT. TO 56 FT.

EQUIPMENT IN LARGE UNDERGROUND VAULT

DRILLED GAUDIO DRILLING 1959

WELL IN SERVICE AUGUST 1962

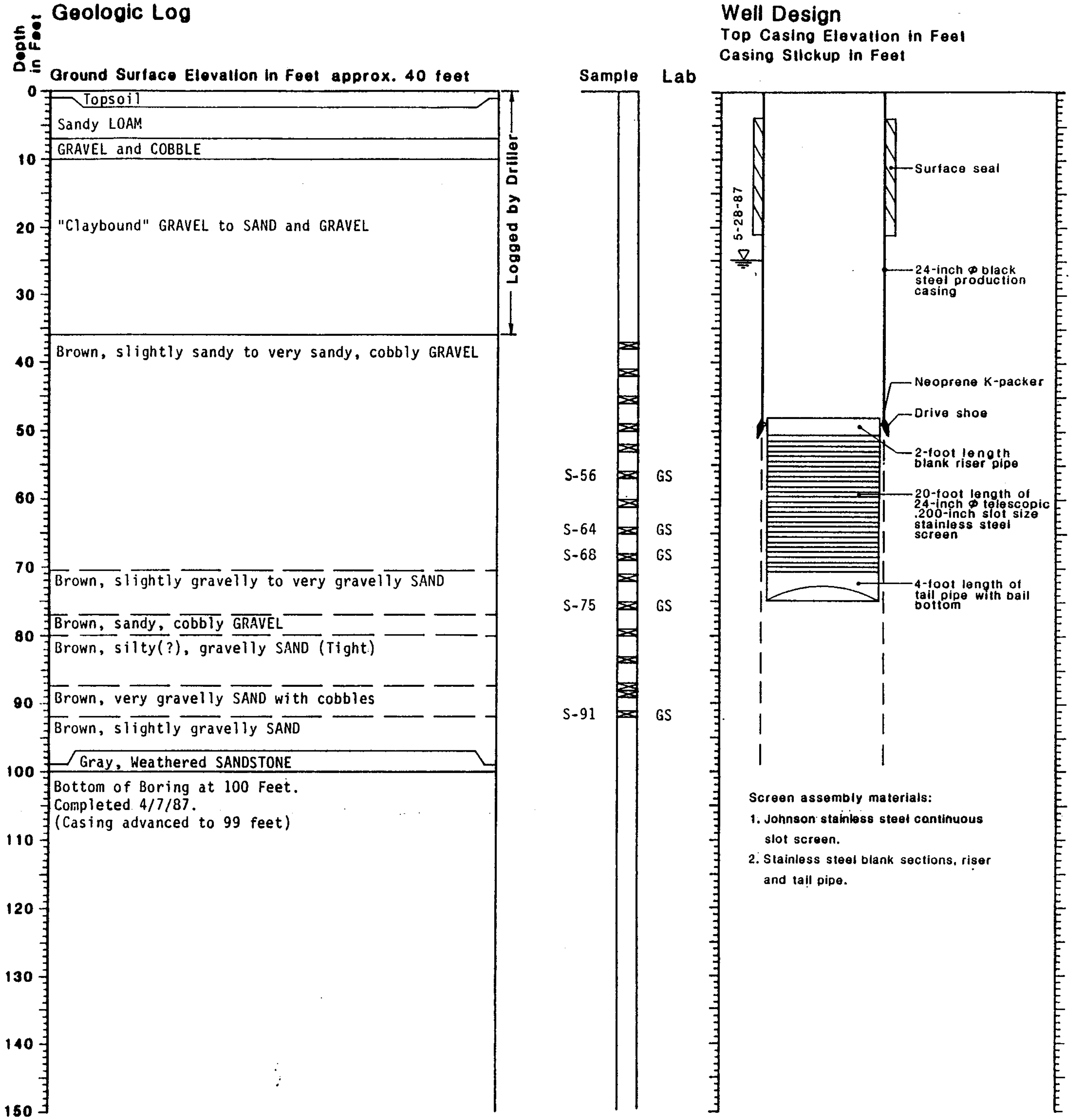
Boring Log and Construction Data for Well RW-1



NOTES: 1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level ∇ is for date indicated and may vary with time of year.
ATD: At Time of Drilling

Hart Crowser, Inc.
J-1667 7/87

Boring Log and Construction Data for Well RW-2



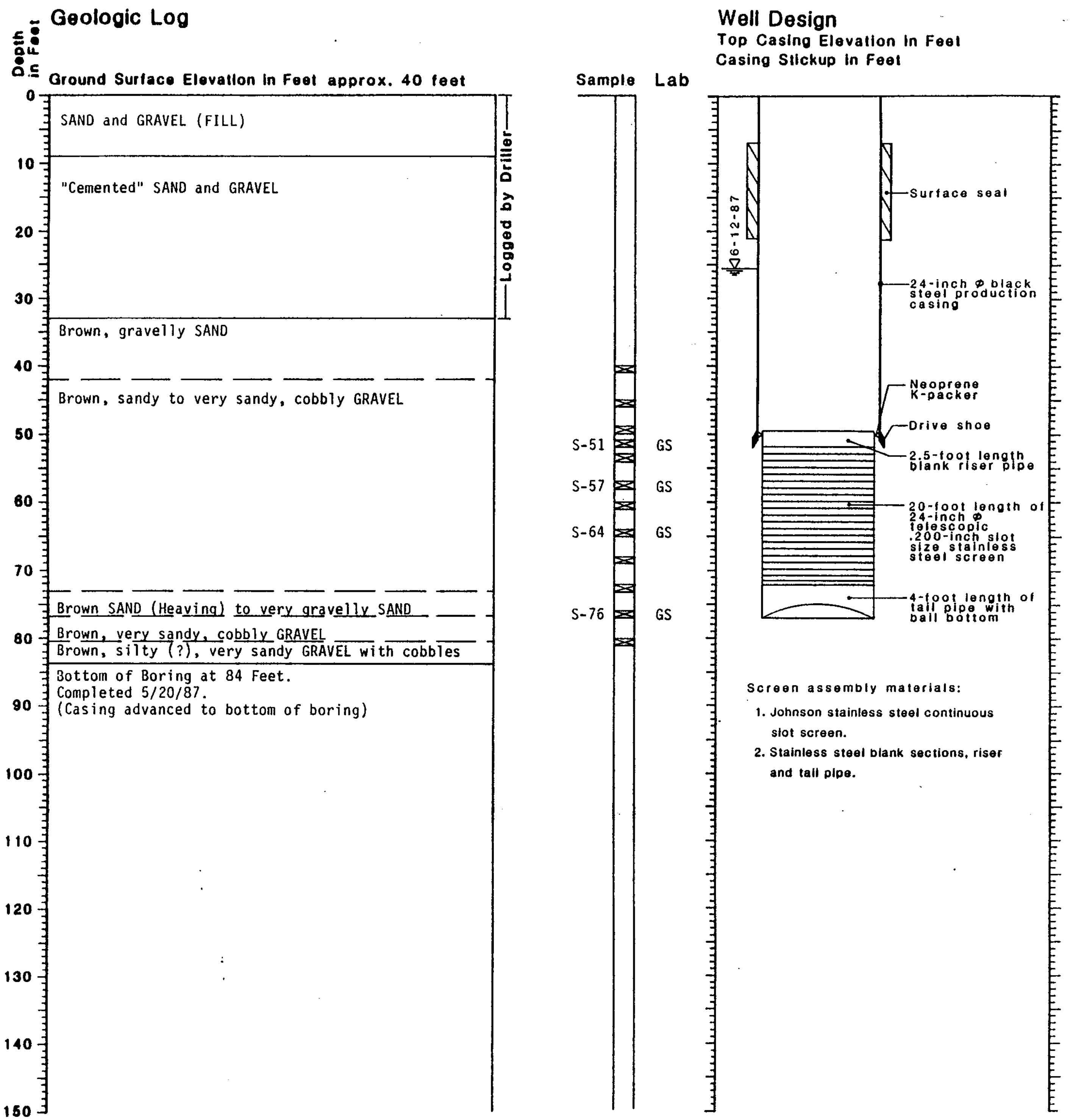
Screen assembly materials:

1. Johnson stainless steel continuous slot screen.
2. Stainless steel blank sections, riser and tail pipe.

NOTES: 1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level ∇ is for date indicated and may vary with time of year.
ATD: At Time of Drilling

Hart Crowser, Inc.
J-1667 7/87

Boring Log and Construction Data for Well RW-3



NOTES: 1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level -▽- is for date indicated and may vary with time of year.
ATD: At Time of Drilling

Hart Crowser, Inc.
J-1667 7/87

HARTCROWSER

Earth and Environmental Technologies

Remedial Investigation Report
PACCAR Site
Renton, Washington

Appendices E through I

Prepared for
PACCAR, Inc.

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J-1639-09

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This volume contains supporting Appendices E through I for the Remedial Investigation Report prepared for the PACCAR Site located in Renton, Washington. These appendices include:

- E Hydrologic Data
- F Data Validation Procedures and Results
- G Selected Soil Quality Data
- H Selected Groundwater Quality Data
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WATER LEVEL DATA
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Table E-1 - Water Level Data July 1986

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF PVC 7/28-29/86	WATER LEVEL ELEVATION 7/28-29/86
PACCAR SITE WELLS			
LW1S	25.99	2.96	23.03
LW2S	29.83	5.88	23.95
LW3S	31.20	6.43	24.77
LW4S	40.14	4.95	35.19
LW5VS	29.70	*4.16	25.54
LW5S	29.27	4.54	24.73
LW6S	30.19	*7.49	22.70
LW7S	34.04	6.59	27.45
LW8S	30.98	*4.47	26.51
LW9S	32.18	*9.49	22.69
LW10S	30.33	*2.98	27.35
LW11VS	29.43	4.18	25.25
LW11S	29.44	*5.26	24.18
LW12S	30.44	*7.30	23.14
LW13S	30.28	*3.09	27.19
LW14S	31.55	7.71	23.84
LW15S	32.29	5.16	27.13
**MW1S	27.93	*4.51	23.42
**MW2S	29.73	*5.66	24.07
**MW3S	34.99	Dry	---
MW4S	28.57	3.65	24.92
**MW1I	27.93	4.53	23.40
**MW2I	29.73	*6.41	23.32
**MW3I	34.99	10.23	24.76
HC-1I	31.67	NM	NM
HC-2I	35.05	NM	NM
HC-3I	35.04	NM	NM
HC-4I	34.61	NM	NM
HC-5I	30.28	NM	NM
HC-6I	28.73	NM	NM
LW1D	26.14	4.45	21.69
LW2D	30.17	5.85	24.32
LW3D	31.27	6.20	25.07
LW5D	30.45	*5.26	25.19
LW6D	29.87	*7.45	22.42
LW7D	33.86	*7.55	26.31
LW8D	33.27	*5.31	27.96
LW9D	32.00	11.57	20.43
LW10D	30.59	*4.80	25.79
LW11D	29.98	5.52	24.46
LW12D	30.32	*12.17	18.15
LW13D	30.29	*5.64	24.65
MW2D	29.73	*6.22	23.51
DM2D	27.17	*5.00	22.17
DM3D	28.57	3.68	24.89
DM5D	38.53	3.82	34.71

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF PVC 7/28-29/86	WATER LEVEL ELEVATION 7/28-29/86
RENTON WELLS			
PW1	39.40	34.70	4.70
PW2	39.79	35.60	4.19
PW3	31.00	13.60	17.40
PW8	45.70	37.70	8.00
PW9	45.13	27.45	17.68
MW1	40.91	24.16	16.75
MW2	53.32	29.90	23.42
MW3	35.50	17.70	17.80
MW4	36.44	18.82	17.62
MW5	38.32	19.40	18.92
MW6	38.83	21.50	17.33
MW7	47.16	24.35	22.81
**MW8	45.21	27.57	17.64
**MW9	46.26	28.40	17.86
MW10	34.12	16.10	18.02
MW11	32.24	14.35	17.89
RIVER GAGE			
SG1	32.60	7.51	25.09
SG2	***15.1	7.36	7.74
SG3	36.50	NM	NM
SG4	34.96	14.70	20.26

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-2 - Water Level Data November 1986

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF PVC 11/6/86	WATER LEVEL ELEVATION 11/6/86
PACCAR SITE WELLS			
LW1S	25.99	---	---
LW2S	29.83	5.27	24.56
LW3S	31.20	5.83	25.37
LW4S	40.14	---	---
LW5VS	29.70	*3.40	26.30
LW5S	29.27	3.14	26.13
LW6S	30.19	*5.77	24.42
LW7S	34.04	5.06	28.98
LW8S	30.98	*4.04	26.94
LW9S	32.18	*8.53	23.65
LW10S	30.33	*2.73	27.60
LW11VS	29.43	---	---
LW11S	29.44	*4.83	24.61
LW12S	30.44	*6.94	23.50
LW13S	30.28	*3.02	27.26
LW14S	31.55	---	---
LW15S	32.29	3.96	28.33
**MW1S	27.93	*3.90	24.03
**MW2S	29.73	*4.90	24.83
**MW3S	34.99	Dry	---
MW4S	28.57	2.63	25.94
**MW1I	27.93	3.98	23.95
**MW2I	29.73	*4.20	25.53
**MW3I	34.99	10.10	24.89
HC-1I	31.67	NM	NM
HC-2I	35.05	NM	NM
HC-3I	35.04	NM	NM
HC-4I	34.61	NM	NM
HC-5I	30.28	NM	NM
HC-6I	28.73	NM	NM
LW1D	26.14	---	---
LW2D	30.17	5.33	24.84
LW3D	31.27	5.59	25.68
LW5D	30.45	*4.52	25.93
LW6D	29.87	*6.48	23.39
LW7D	33.86	*6.81	27.05
LW8D	33.27	*4.40	28.87
LW9D	32.00	10.41	21.59
LW10D	30.59	*4.00	26.59
LW11D	29.98	4.83	25.15
LW12D	30.32	*10.67	19.65
LW13D	30.29	*4.63	25.66
MW2D	29.73	*5.93	23.80
DM2D	27.17	*4.67	22.50
DM3D	28.57	2.67	25.90
DM5D	38.53	---	---

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF PVC 11/6/86	WATER LEVEL ELEVATION 11/6/86
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	NM	NM
MW2	53.32	NM	NM
MW3	35.50	16.44	19.06
MW4	36.44	17.24	19.20
MW5	38.32	18.06	20.26
MW6	38.83	19.91	18.92
MW7	47.16	NM	NM
**MW8	45.21	NM	NM
**MW9	46.26	NM	NM
MW10	34.12	NM	NM
MW11	32.24	NM	NM
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	NM	NM
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-3 - Water Level Data April 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 4/27/87	WATER LEVEL ELEVATION 4/27/87
PACCAR SITE WELLS			
LW1S	25.99	*0.26	25.73
LW2S	29.83	4.98	24.85
LW3S	31.20	5.77	25.43
LW4S	40.14	*4.09	36.05
LW5VS	29.70	*3.68	26.02
LW5S	29.27	3.35	25.92
LW6S	30.19	*6.55	23.64
LW7S	34.04	5.27	28.77
LW8S	30.98	*3.79	27.19
LW9S	32.18	*8.56	23.62
LW10S	30.33	*2.62	27.71
LW11VS	29.43	*3.24	26.19
LW11S	29.44	OIL	---
LW12S	30.44	12.94	17.50
LW13S	30.28	2.46	27.82
LW14S	31.55	*6.61	24.94
LW15S	32.29	4.02	28.27
**MW1S	27.93	*3.46	24.47
**MW2S	29.73	*6.21	23.52
**MW3S	34.99	DRY	---
MW4S	28.57	2.87	25.70
**MW1I	27.93	3.86	24.07
**MW2I	29.73	*6.02	23.71
**MW3I	34.99	10.00	24.99
HC-1I	31.67	8.80	22.87
HC-2I	35.05	11.61	23.44
HC-3I	35.04	15.00	20.04
HC-4I	34.61	15.98	18.63
HC-5I	30.28	11.09	19.19
HC-6I	28.73	9.61	19.12
LW1D	26.14	*4.60	21.54
LW2D	30.17	4.81	25.36
LW3D	31.27	5.31	25.96
LW5D	30.45	*4.31	26.14
LW6D	29.87	*6.44	23.43
LW7D	33.86	*6.35	27.51
LW8D	33.27	*4.40	28.87
LW9D	32.00	10.30	21.70
LW10D	30.59	*3.70	26.89
LW11D	29.98	NM	NM
LW12D	30.32	*10.94	19.38
LW13D	30.29	*4.39	19.35
MW2D	29.73	*5.94	23.79
DM2D	27.17	*3.30	23.87
DM3D	28.57	2.76	25.81
DM5D	38.53	---	---

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 4/27/87	WATER LEVEL ELEVATION 4/27/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	NM	NM
MW2	53.32	NM	NM
MW3	35.50	16.42	19.08
MW4	36.44	18.09	18.35
MW5	38.32	18.97	19.35
MW6	38.83	20.50	18.33
MW7	47.16	NM	NM
**MW8	45.21	NM	NM
**MW9	46.26	NM	NM
MW10	34.12	NM	NM
MW11	32.24	NM	NM
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	NM	NM
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-4 - Water Level Data May 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 5/5/87	WATER LEVEL ELEVATION 5/5/87
PACCAR SITE WELLS			
LW1S	25.99	0.21	25.78
LW2S	29.83	5.01	24.82
LW3S	31.20	5.72	25.48
LW4S	40.14	4.20	35.94
LW5VS	29.70	3.52	26.18
LW5S	29.27	3.12	26.15
LW6S	30.19	6.27	23.92
LW7S	34.04	5.02	29.02
LW8S	30.98	3.49	27.49
LW9S	32.18	8.60	23.58
LW10S	30.33	2.65	27.68
LW11VS	29.43	2.31	27.12
LW11S	29.44	3.93	25.51
LW12S	30.44	6.07	24.37
LW13S	30.28	2.54	27.74
LW14S	31.55	6.77	24.78
LW15S	32.29	4.02	28.27
**MW1S	27.93	3.80	24.13
**MW2S	29.73	6.18	23.55
**MW3S	34.99	DRY	---
MW4S	28.57	2.67	25.90
**MW1I	27.93	4.01	23.92
**MW2I	29.73	6.28	23.45
**MW3I	34.99	10.07	24.92
HC-1I	31.67	8.43	23.24
HC-2I	35.05	11.20	23.85
HC-3I	35.04	14.27	20.77
HC-4I	34.61	15.15	19.46
HC-5I	30.28	10.59	19.69
HC-6I	28.73	9.09	19.64
LW1D	26.14	3.67	22.47
LW2D	30.17	5.11	25.06
LW3D	31.27	5.47	25.80
LW5D	30.45	4.49	25.96
LW6D	29.87	6.69	23.18
LW7D	33.86	6.61	27.25
LW8D	33.27	4.50	28.77
LW9D	32.00	10.47	21.53
LW10D	30.59	3.97	26.62
LW11D	29.98	6.62	23.36
LW12D	30.32	10.40	19.92
LW13D	30.29	4.58	25.71
MW2D	29.73	6.12	23.61
DM2D	27.17	3.40	23.77
DM3D	28.57	2.76	25.81
DM5D	38.53	3.52	35.01

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 5/5/87	WATER LEVEL ELEVATION 5/5/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	21.83	19.08
MW2	53.32	28.53	24.79
MW3	35.50	15.87	19.63
MW4	36.44	17.37	19.07
MW5	38.32	18.34	19.98
MW6	38.83	20.01	18.82
MW7	47.16	22.84	24.32
**MW8	45.21	28.37	16.84
**MW9	46.26	NM	NM
MW10	34.12	15.52	18.60
MW11	32.24	12.58	19.66
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	8.80	6.30
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-5 - Water Level Data June 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 6/15/87	WATER LEVEL ELEVATION 6/15/87
PACCAR SITE WELLS			
LW1S	25.99	2.59	23.40
LW2S	29.83	5.51	24.32
LW3S	31.20	6.15	25.05
LW4S	40.14	4.55	35.59
LW5VS	29.70	4.32	25.38
LW5S	29.27	3.92	25.35
LW6S	30.19	7.20	22.99
LW7S	34.04	6.23	27.81
LW8S	30.98	4.21	26.77
LW9S	32.18	9.23	22.95
LW10S	30.33	2.89	27.44
LW11VS	29.43	3.55	25.88
LW11S	29.44	NM	NM
LW12S	30.44	6.67	23.77
LW13S	30.28	2.92	27.36
LW14S	31.55	7.41	24.14
LW15S	32.29	4.67	27.62
**MW1S	27.93	4.64	23.29
**MW2S	29.73	6.54	23.19
**MW3S	34.99	DRY	---
MW4S	28.57	3.47	25.10
**MW1I	27.93	4.57	23.36
**MW2I	29.73	6.42	23.31
**MW3I	34.99	10.66	24.33
HC-1I	31.67	10.08	21.59
HC-2I	35.05	12.83	22.22
HC-3I	35.04	11.38	23.66
HC-4I	34.61	17.10	17.51
HC-5I	30.28	12.09	18.19
HC-6I	28.73	10.69	18.04
LW1D	26.14	3.89	22.25
LW2D	30.17	5.46	24.71
LW3D	31.27	5.90	25.37
LW5D	30.45	4.95	25.50
LW6D	29.87	7.16	22.71
LW7D	33.86	7.14	26.72
LW8D	33.27	5.06	28.21
LW9D	32.00	11.19	20.81
LW10D	30.59	4.36	26.23
LW11D	29.98	5.13	24.85
LW12D	30.32	12.09	18.23
LW13D	30.29	5.53	24.76
MW2D	29.73	6.34	23.39
DM2D	27.17	4.16	23.01
DM3D	28.57	3.37	25.20
DM5D	38.53	3.75	34.78

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 6/15/87	WATER LEVEL ELEVATION 6/15/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	23.81	17.10
MW2	53.32	29.65	23.67
MW3	35.50	17.44	18.06
MW4	36.44	19.55	16.89
MW5	38.32	20.46	17.86
MW6	38.83	22.08	16.75
MW7	47.16	29.24	17.92
**MW8	45.21	30.54	14.67
**MW9	46.26	30.30	15.96
MW10	34.12	16.16	17.96
MW11	32.24	14.22	18.02
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	8.19	6.91
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-6 - Water Level Data July 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 7/29/87	WATER LEVEL ELEVATION 7/29/87
PACCAR SITE WELLS			
LW1S	25.99	3.03	22.96
LW2S	29.83	6.14	23.69
LW3S	31.20	6.77	24.43
LW4S	40.14	5.18	34.96
LW5VS	29.70	5.06	24.64
LW5S	29.27	4.66	24.61
LW6S	30.19	7.84	22.35
LW7S	34.04	7.16	26.88
LW8S	30.98	4.85	26.13
LW9S	32.18	9.75	22.43
LW10S	30.33	2.95	27.38
LW11VS	29.43	4.20	25.23
LW11S	29.44	4.93	24.51
LW12S	30.44	7.01	23.43
LW13S	30.28	3.31	26.97
LW14S	31.55	7.66	23.89
LW15S	32.29	5.89	26.40
**MW1S	27.93	4.70	23.23
**MW2S	29.73	5.99	23.74
**MW3S	34.99	DRY	---
MW4S	28.57	DRY	---
**MW1I	27.93	4.75	23.18
**MW2I	29.73	6.86	22.87
**MW3I	34.99	10.89	24.10
HC-1I	31.67	10.75	20.92
HC-2I	35.05	13.63	21.42
HC-3I	35.04	NM	NM
HC-4I	34.61	17.64	16.97
HC-5I	30.28	12.72	17.56
HC-6I	28.73	11.28	17.45
LW1D	26.14	4.38	21.76
LW2D	30.17	6.19	23.98
LW3D	31.27	6.67	24.60
LW5D	30.45	5.68	24.77
LW6D	29.87	7.78	22.09
LW7D	33.86	8.04	25.82
LW8D	33.27	5.70	27.57
LW9D	32.00	11.88	20.12
LW10D	30.59	4.80	25.79
LW11D	29.98	5.49	24.49
LW12D	30.32	12.60	17.72
LW13D	30.29	6.42	23.87
MW2D	29.73	6.50	23.23
DM2D	27.17	4.59	22.58
DM3D	28.57	4.06	24.51
DM5D	38.53	4.00	34.53

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 7/29/87	WATER LEVEL ELEVATION 7/29/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	25.11	15.80
MW2	53.32	NM	NM
MW3	35.50	18.12	17.38
MW4	36.44	19.86	16.58
MW5	38.32	20.84	17.48
MW6	38.83	22.46	16.37
MW7	47.16	25.10	22.06
**MW8	45.21	31.07	14.14
**MW9	46.26	30.57	15.69
MW10	34.12	16.57	17.55
MW11	32.24	14.88	17.36
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	NM	NM
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.

Table E-7 - Water Level Data August 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 8/26/87	WATER LEVEL ELEVATION 8/26/87
PACCAR SITE WELLS			
LW1S	25.99	3.41	22.58
LW2S	29.83	6.36	23.47
LW3S	31.20	7.01	24.19
LW4S	40.14	5.42	34.72
LW5VS	29.70	5.27	24.43
LW5S	29.27	4.91	24.36
LW6S	30.19	8.03	22.16
LW7S	34.04	7.41	26.63
LW8S	30.98	4.76	26.22
LW9S	32.18	9.88	22.30
LW10S	30.33	3.03	27.30
LW11VS	29.43	NM	NM
LW11S	29.44	NM	NM
LW12S	30.44	7.03	23.41
LW13S	30.28	3.40	26.88
LW14S	31.55	7.63	23.92
LW15S	32.29	6.47	25.82
**MW1S	27.93	5.13	22.80
**MW2S	29.73	7.21	22.52
**MW3S	34.99	DRY	---
MW4S	28.57	DRY	---
**MW1I	27.93	5.12	22.81
**MW2I	29.73	7.23	22.50
**MW3I	34.99	10.88	24.11
HC-1I	31.67	11.04	20.63
HC-2I	35.05	13.88	21.17
HC-3I	35.04	17.10	17.94
HC-4I	34.61	17.94	16.67
HC-5I	30.28	12.95	17.33
HC-6I	28.73	11.50	17.23
LW1D	26.14	4.56	21.58
LW2D	30.17	6.42	23.75
LW3D	31.27	6.91	24.36
LW5D	30.45	5.92	24.53
LW6D	29.87	7.96	21.91
LW7D	33.86	8.26	25.60
LW8D	33.27	5.83	27.44
LW9D	32.00	12.05	19.95
LW10D	30.59	4.90	25.69
LW11D	29.98	NM	NM
LW12D	30.32	12.89	17.43
LW13D	30.29	6.60	23.69
**MW2D	29.73	7.18	22.55
DM2D	27.17	4.75	22.42
DM3D	28.57	4.28	24.29
DM5D	38.53	4.05	34.48

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 8/26/87	WATER LEVEL ELEVATION 8/26/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	24.96	15.95
MW2	53.32	31.01	22.31
MW3	35.50	18.39	17.11
MW4	36.44	20.13	16.31
MW5	38.32	21.08	17.24
MW6	38.83	22.79	16.04
MW7	47.16	25.29	21.87
**MW8	45.21	31.43	13.78
**MW9	46.26	NM	NM
MW10	34.12	16.82	17.30
MW11	32.24	15.05	17.19
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	7.53	7.57
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-8 - Water Level Data September 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	DEPTH BELOW TOP OF CASING 9/22/87	ELEVATION 9/22/87
PACCAR SITE WELLS			
LW1S	25.99	3.54	22.45
LW2S	29.83	6.44	23.39
LW3S	31.20	7.02	24.18
LW4S	40.14	5.39	34.75
LW5VS	29.70	5.12	24.58
LW5S	29.27	4.78	24.49
LW6S	30.19	8.02	22.17
LW7S	34.04	7.43	26.61
LW8S	30.98	4.69	26.29
LW9S	32.18	9.93	22.25
LW10S	30.33	3.18	27.15
LW11VS	29.43	NM	NM
LW11S	29.44	NM	NM
LW12S	30.44	7.31	23.13
LW13S	30.28	4.46	25.82
LW14S	31.55	7.87	23.68
LW15S	32.29	6.39	25.90
**MW1S	27.93	*5.21	22.72
**MW2S	29.73	*7.30	22.43
**MW3S	34.99	*DRY	---
MW4S	28.57	*4.06	24.51
**MW1I	27.93	*5.16	22.77
**MW2I	29.73	*7.33	22.40
**MW3I	34.99	11.14	23.85
HC-1I	31.67	10.59	21.08
HC-2I	35.05	13.51	21.54
HC-3I	35.04	6.55	28.49
HC-4I	34.61	17.44	17.17
HC-5I	30.28	12.67	17.61
HC-6I	28.73	11.19	17.54
LW1D	26.14	4.65	21.49
LW2D	30.17	6.45	23.72
LW3D	31.27	6.84	24.43
LW5D	30.45	5.84	24.61
LW6D	29.87	7.97	21.90
LW7D	33.86	8.29	25.57
LW8D	33.27	5.78	27.49
LW9D	32.00	11.87	20.13
LW10D	30.59	4.19	26.40
LW11D	29.98	NM	NM
LW12D	30.32	12.57	17.75
LW13D	30.29	6.42	23.87
**MW2D	29.73	*7.30	22.43
DM2D	27.17	*4.83	22.34
DM3D	28.57	*4.14	24.43
DM5D	38.53	*4.02	34.51

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 9/22/87	WATER LEVEL ELEVATION 9/22/87
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	NM
PW9	45.13	NM	NM
MW1	40.91	24.22	16.69
MW2	53.32	31.43	21.89
MW3	35.50	18.06	17.44
MW4	36.44	19.59	16.85
MW5	38.32	20.49	17.83
MW6	38.83	22.21	16.62
MW7	47.16	25.16	22.00
**MW8	45.21	28.90	16.31
**MW9	46.26	29.18	17.08
MW10	34.12	16.41	17.71
MW11	32.24	14.77	17.47
RIVER GAGE			
SG1	32.60	NM	NM
SG2	***15.1	7.50	22.60
SG3	36.50	NM	NM
SG4	34.96	NM	NM

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-9 - Water Level Data October 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 10/20/87	WATER LEVEL ELEVATION 10/20/87
PACCAR SITE WELLS			
LW1S	25.99	3.72	22.27
LW2S	29.83	6.58	23.25
LW3S	31.20	7.18	24.02
LW4S	40.14	4.44	35.70
LW5VS	29.70	6.47	23.23
LW5S	29.27	5.08	24.19
LW6S	30.19	8.22	21.97
LW7S	34.04	7.79	26.25
LW8S	30.98	4.96	26.02
LW9S	32.18	10.00	22.18
LW10S	30.33	3.33	27.00
LW11VS	29.43	---	---
LW11S	29.44	---	---
LW12S	30.44	7.32	23.12
LW13S	30.28	3.63	26.65
LW14S	31.55	7.81	23.74
LW15S	32.29	6.80	25.49
**MW1S	27.93	5.05	22.88
**MW2S	29.73	6.40	23.33
**MW3S	34.99	DRY	---
MW4S	28.57	DRY	---
**MW1I	27.93	5.08	22.85
**MW2I	29.73	6.97	22.76
**MW3I	34.99	10.44	24.55
HC-1I	31.67	10.80	20.87
HC-2I	35.05	13.82	21.23
HC-3I	35.04	16.70	18.34
HC-4I	34.61	17.80	16.81
HC-5I	30.28	13.00	17.28
HC-6I	28.73	11.41	17.32
LW1D	26.14	4.88	21.26
LW2D	30.17	6.61	23.56
LW3D	31.27	7.08	24.19
LW5D	30.45	6.08	24.37
LW6D	29.87	8.79	21.08
LW7D	33.86	8.47	25.39
LW8D	33.27	6.03	27.24
LW9D	32.00	NM	NM
LW10D	30.59	5.00	25.59
LW11D	29.98	---	---
LW12D	30.32	12.58	17.74
LW13D	30.29	6.60	23.69
**MW2D	29.73	7.32	22.41
DM2D	27.17	4.96	22.21
DM3D	28.57	4.67	23.90
DM5D	38.53	5.04	33.49

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 10/20/87	WATER LEVEL ELEVATION 10/20/87
RENTON WELLS			
PW1	39.40	---	---
PW2	39.79	---	---
PW3	31.00	---	---
PW8	45.70	---	---
PW9	45.13	---	---
MW1	40.91	24.61	16.30
MW2	53.32	32.22	21.10
MW3	35.50	18.53	16.97
MW4	36.44	19.98	16.46
MW5	38.32	20.53	17.79
MW6	38.83	22.35	16.48
MW7	47.16	25.81	21.35
**MW8	45.21	29.01	16.20
**MW9	46.26	29.15	17.11
MW10	34.12	16.81	17.31
MW11	32.24	15.18	17.06
RIVER GAGE			
SG1	32.60	---	---
SG2	***15.1	NM	NM
SG3	36.50	---	---
SG4	34.96	---	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-10 - Water Level Data November 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 11/23/87	WATER LEVEL ELEVATION 11/23/87
PACCAR SITE WELLS			
LW1S	25.99	3.51	22.48
LW2S	29.83	5.99	23.84
LW3S	31.20	6.51	24.69
LW4S	40.14	5.01	35.13
LW5VS	29.70	4.12	25.58
LW5S	29.27	3.74	25.53
LW6S	30.19	7.06	23.13
LW7S	34.04	6.15	27.89
LW8S	30.98	3.44	27.54
LW9S	32.18	9.24	22.94
LW10S	30.33	2.96	27.37
LW11VS	29.43	Destroyed	Destroyed
LW11S	29.44	Destroyed	Destroyed
LW12S	30.44	7.06	23.38
LW13S	30.28	3.28	27.00
LW14S	31.55	7.76	23.79
LW15S	32.29	4.96	27.33
**MW1S	27.93	3.73	24.20
**MW2S	29.73	7.14	22.59
**MW3S	34.99	DRY	---
MW4S	28.57	2.83	25.74
**MW1I	27.93	5.14	22.79
**MW2I	29.73	7.32	22.41
**MW3I	34.99	11.01	23.98
HC-1I	31.67	10.53	21.14
HC-2I	35.05	13.42	21.63
HC-3I	35.04	16.39	18.65
HC-4I	34.61	17.45	17.16
HC-5I	30.28	---	---
HC-6I	28.73	11.29	17.44
LW1D	26.14	4.89	21.25
LW2D	30.17	6.24	23.93
LW3D	31.27	6.62	24.65
LW5D	30.45	5.47	24.98
LW6D	29.87	7.68	22.19
LW7D	33.86	7.98	25.88
LW8D	33.27	5.32	27.95
LW9D	32.00	12.02	19.98
LW10D	30.59	4.70	25.89
LW11D	29.98	---	---
LW12D	30.32	12.57	17.75
LW13D	30.29	6.36	23.93
**MW2D	29.73	7.39	22.34
DM2D	27.17	4.72	22.45
DM3D	28.57	3.44	25.13
DM5D	38.53	3.82	34.71

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 11/23/87	WATER LEVEL ELEVATION 11/23/87
RENTON WELLS			
PW1	39.40	---	---
PW2	39.79	---	---
PW3	31.00	---	---
PW8	45.70	---	---
PW9	45.13	---	---
MW1	40.91	23.89	17.02
MW2	53.32	32.50	20.82
MW3	35.50	18.31	17.19
MW4	36.44	19.48	16.96
MW5	38.32	20.36	17.96
MW6	38.83	21.94	16.89
MW7	47.16	25.90	21.26
**MW8	45.21	30.75	14.46
**MW9	46.26	---	---
MW10	34.12	16.51	17.61
MW11	32.24	14.92	17.32
RIVER GAGE			
SG1	32.60	---	---
SG2	***15.1	7.65	7.45
SG3	36.50	---	---
SG4	34.96	---	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-11 - Water Level Data December 1987

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 12/21/87	WATER LEVEL ELEVATION 12/21/87
PACCAR SITE WELLS			
LW1S	25.99	2.42	23.57
LW2S	29.83	5.38	24.45
LW3S	31.20	5.93	25.27
LW4S	40.14	4.77	35.37
LW5VS	29.70	3.70	26.00
LW5S	29.27	3.26	26.01
LW6S	30.19	6.62	23.57
LW7S	34.04	5.23	28.81
LW8S	30.98	3.02	27.96
LW9S	32.18	8.51	23.67
LW10S	30.33	2.59	27.74
LW11VS	29.43	---	---
LW11S	29.44	---	---
LW12S	30.44	---	---
LW13S	30.28	2.80	27.48
LW14S	31.55	7.93	23.62
LW15S	32.29	4.07	28.22
**MW1S	27.93	3.83	24.10
**MW2S	29.73	6.49	23.24
**MW3S	34.99	DRY	---
MW4S	28.57	---	---
**MW1I	27.93	4.62	23.31
**MW2I	29.73	6.80	22.93
**MW3I	34.99	9.40	25.59
HC-1I	31.67	10.17	21.50
HC-2I	35.05	13.07	21.98
HC-3I	35.04	14.74	20.30
HC-4I	34.61	17.52	17.09
HC-5I	30.28	12.87	17.41
HC-6I	28.73	11.25	17.48
LW1D	26.14	4.67	21.47
LW2D	30.17	5.65	24.52
LW3D	31.27	6.00	25.27
LW5D	30.45	4.94	25.51
LW6D	29.87	6.90	22.97
LW7D	33.86	7.24	26.62
LW8D	33.27	4.75	28.52
LW9D	32.00	11.66	20.34
LW10D	30.59	4.20	26.39
LW11D	29.98	---	---
LW12D	30.32	12.50	17.82
LW13D	30.29	5.80	24.49
**MW2D	29.73	6.39	23.34
DM2D	27.17	4.94	22.23
DM3D	28.57	3.00	25.57
DM5D	38.53	3.74	34.79

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 12/21/87	WATER LEVEL ELEVATION 12/21/87
RENTON WELLS			
PW1	39.40	---	---
PW2	39.79	---	---
PW3	31.00	---	---
PW8	45.70	---	---
PW9	45.13	---	---
MW1	40.91	24.04	16.87
MW2	53.32	32.58	20.74
MW3	35.50	18.58	16.92
MW4	36.44	19.43	17.01
MW5	38.32	20.09	18.23
MW6	38.83	21.94	16.89
MW7	47.16	26.00	21.16
**MW8	45.21	28.86	16.35
**MW9	46.26	29.87	16.39
MW10	34.12	16.48	17.64
MW11	32.24	15.00	17.24
RIVER GAGE			
SG1	32.60	---	---
SG2	***15.1	---	---
SG3	36.50	---	---
SG4	34.96	---	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

1639-10

Table E-12 - Water Level Data February 1988

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 2/22/88	WATER LEVEL ELEVATION 2/22/88
PACCAR SITE WELLS			
LW1S	25.99	2.18	23.81
LW2S	29.83	5.43	24.40
LW3S	31.20	6.40	24.80
LW4S	40.14	5.00	35.14
LW5VS	29.70	5.76	23.94
LW5S	29.27	3.87	25.40
LW6S	30.19	6.96	23.23
LW7S	34.04	6.21	27.83
LW8S	30.98	4.37	26.61
LW9S	32.18	9.65	22.53
LW10S	30.33	2.95	27.38
LW11VS	29.43	NM	---
LW11S	29.44	NM	29.44
LW12S	30.44	6.92	23.52
LW13S	30.28	2.98	27.30
LW14S	31.55	7.35	24.20
LW15S	32.29	4.50	27.79
**MW1S	27.93	4.47	23.46
**MW2S	29.73	6.66	23.07
**MW3S	34.99	DRY	---
MW4S	28.57	3.12	25.45
**MW1I	27.93	4.74	23.19
**MW2I	29.73	7.10	22.63
**MW3I	34.99	10.55	24.44
HC-1I	31.67	13.96	17.71
HC-2I	35.05	16.84	18.21
HC-3I	35.04	27.26	7.78
HC-4I	34.61	22.09	12.52
HC-5I	30.28	16.58	13.70
HC-6I	28.73	15.04	13.69
LW1D	26.14	4.80	21.34
LW2D	30.17	6.05	24.12
LW3D	31.27	6.68	24.59
LW5D	30.45	5.67	24.78
LW6D	29.87	7.97	21.90
LW7D	33.86	8.17	25.69
LW8D	33.27	6.93	26.34
LW9D	32.00	14.71	17.29
LW10D	30.59	5.22	25.37
LW11D	29.98	NM	---
LW12D	30.32	16.38	13.94
LW13D	30.29	8.52	21.77
**MW2D	29.73	7.17	22.56
DM2D	27.17	4.15	23.02
DM3D	28.57	3.68	24.89
DM5D	38.53	4.09	34.44

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 2/22/88	WATER LEVEL ELEVATION 2/22/88
RENTON WELLS			
PW1	39.40	NM	---
PW2	39.79	NM	---
PW3	31.00	NM	---
PW8	45.70	NM	---
PW9	45.13	NM	---
MW1	40.91	28.50	12.41
MW2	53.32	36.28	17.04
MW3	35.50	22.61	12.89
MW4	36.44	24.76	11.68
MW5	38.32	25.33	12.99
MW6	38.83	26.92	11.91
MW7	47.16	29.62	17.54
**MW8	45.21	36.04	9.17
**MW9	46.26	35.37	10.89
MW10	34.12	20.47	13.65
MW11	32.24	19.12	13.12
RIVER GAGE			
SG1	32.60	NM	---
SG2	***15.1	NM	---
SG3	36.50	NM	---
SG4	34.96	NM	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-13 - Water Level Data April 1988

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL 4/26/88 & 4/27/88: DEPTH BELOW TOP OF CASING	ELEVATION
PACCAR SITE WELLS			
LW1S	25.99	2.35	23.64
LW2S	29.83	5.55	24.28
LW3S	31.20	6.22	24.98
LW4S	40.14	4.94	35.20
LW5VS	29.70	4.50	25.20
LW5S	29.27	4.09	25.18
LW6S	30.19	7.16	23.03
LW7S	34.04	6.80	27.24
LW8S	30.98	4.41	26.57
LW9S	32.18	9.31	22.87
LW10S	30.33	2.98	27.35
LW11VS	29.43	---	---
LW11S	29.44	---	---
LW12S	30.44	6.54	23.90
LW13S	30.28	3.25	27.03
LW14S	31.55	7.13	24.42
LW15S	32.29	4.78	27.51
**MW1S	27.93	4.67	23.26
**MW2S	29.73	6.62	23.11
**MW3S	34.99	DRY	---
MW4S	28.57	3.54	25.03
**MW1I	27.93	4.57	23.36
**MW2I	29.73	7.10	22.63
**MW3I	34.99	10.59	24.40
HC-1I	31.67	10.35	21.32
HC-2I	35.05	13.21	21.84
HC-3I	35.04	21.24	13.80
HC-4I	34.61	16.68	17.93
HC-5I	30.28	27.06	3.22
HC-6I	28.73	10.49	18.24
LW1D	26.14	4.35	21.79
LW2D	30.17	6.20	23.97
LW3D	31.27	6.59	24.68
LW5D	30.45	5.59	24.86
LW6D	29.87	7.74	22.13
LW7D	33.86	8.09	25.77
LW8D	33.27	5.54	27.73
LW9D	32.00	12.17	19.83
LW10D	30.59	4.83	25.76
LW11D	29.98	---	---
LW12D	30.32	11.80	18.52
LW13D	30.29	6.35	23.94
**MW2D	29.73	7.05	22.68
DM2D	27.17	4.45	22.72
DM3D	28.57	3.76	24.81
DM5D	38.53	4.95	33.58

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL 4/26/88 & 4/27/88: DEPTH BELOW TOP OF CASING	ELEVATION
RENTON WELLS			
PW1	39.40	---	---
PW2	39.79	---	---
PW3	31.00	---	---
PW8	45.70	---	---
PW9	45.13	---	---
MW1	40.91	22.70	18.21
MW2	53.32	28.81	24.51
MW3	35.50	16.94	18.56
MW4	36.44	18.95	17.49
MW5	38.32	20.00	18.32
MW6	38.83	21.13	17.70
MW7	47.16	23.26	23.90
**MW8	45.21	28.07	17.14
**MW9	46.26	27.80	18.46
MW10	34.12	15.86	18.26
MW11	32.24	13.73	18.51
RIVER GAGE			
SG1	32.60	---	---
SG2	***15.1	---	---
SG3	36.50	---	---
SG4	34.96	---	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
* Well not vented.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.

Table E-14 - Water Level Data June 1988

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 6/29/88	WATER LEVEL ELEVATION 6/29/88
PACCAR SITE WELLS			
LW1S	25.99	2.47	23.52
LW2S	29.83	5.46	24.37
LW3S	31.20	6.36	24.84
LW4S	40.14	4.81	35.33
LW5VS	29.70	4.51	25.19
LW5S	29.27	4.75	24.52
LW6S	30.19	7.22	22.97
LW7S	34.04	6.46	27.58
LW8S	30.98	4.50	26.48
LW9S	32.18	9.50	22.68
LW10S	30.33	3.19	27.14
LW11VS	29.43	---	---
LW11S	29.44	---	---
LW12S	30.44	6.80	23.64
LW13S	30.28	2.95	27.33
LW14S	31.55	7.37	24.18
LW15S	32.29	4.85	27.44
**MW1S	27.93	4.37	23.56
**MW2S	29.73	6.69	23.04
**MW3S	34.99	DRY	---
MW4S	28.57	3.78	24.79
**MW1I	27.93	4.56	23.37
**MW2I	29.73	6.63	23.10
**MW3I	34.99	10.77	24.22
HC-1I	31.67	10.90	20.77
HC-2I	35.05	13.84	21.21
HC-3I	35.04	17.47	17.57
HC-4I	34.61	18.03	16.58
HC-5I	30.28	12.86	17.42
HC-6I	28.73	11.53	17.20
LW1D	26.14	3.97	22.17
LW2D	30.17	5.58	24.59
LW3D	31.27	6.16	25.11
LW5D	30.45	5.16	25.29
LW6D	29.87	7.63	22.24
LW7D	33.86	7.54	26.32
LW8D	33.27	5.41	27.86
LW9D	32.00	12.13	19.87
LW10D	30.59	4.70	25.89
LW11D	29.98	---	---
LW12D	30.32	12.79	17.53
LW13D	30.29	6.38	23.91
**MW2D	29.73	6.65	23.08
@ DM2D	25.90	2.94	22.96
DM3D	28.57	3.43	25.14
DM5D	38.53	3.93	34.60

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL DEPTH BELOW TOP OF CASING 6/29/88	WATER LEVEL ELEVATION 6/29/88
RENTON WELLS			
PW1	39.40	---	---
PW2	39.79	---	---
PW3	31.00	---	---
PW8	45.70	---	---
PW9	45.13	---	---
MW1	40.91	24.85	16.06
MW2	53.32	31.02	22.30
MW3	35.50	18.16	17.34
MW4	36.44	20.45	15.99
MW5	38.32	21.59	16.73
MW6	38.83	23.00	15.83
MW7	47.16	25.08	22.08
**MW8	45.21	29.88	15.33
**MW9	46.26	31.88	14.38
MW10	34.12	16.85	17.27
MW11	32.24	15.00	17.24
RIVER GAGE			
SG1	32.60	---	---
SG2	***15.1	---	---
SG3	36.50	---	---
SG4	34.96	---	---

NOTES: All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
DM-2D: Well head elevation changed. 6/29/88 measurement was taken from ground surface because PVC riser was broken.
** Measurement from top of steel monument casing.
*** At SG2 water elevation = staff gage reading +15.10 feet.
(*) Measured from ground surface.
(@) DM-2D Well Head elevation changed. 6/29/88 measurement was taken from ground surface because pvc riser was broken

1639-10

Table E-15 - Water Level Data September 1988

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL 9/30/88 DEPTH BEL TOP OF CASING	ELEVATION
PACCAR SITE WELLS			
LW1S	25.99	3.54	22.45
LW2S	29.83	6.29	23.54
LW3S	31.20	7.11	24.09
@@LW4S	40.02	5.65	34.37
LW5VS	29.70	4.81	24.89
LW5S	29.27	4.41	24.86
LW6S	30.19	7.41	22.78
LW7S	34.04	7.27	26.77
LW8S	30.98	5.05	25.93
LW9S	32.18	10.03	22.15
LW10S	30.33	4.40	25.93
LW11VS	29.43		29.43
LW11S	29.44		29.44
LW12S	30.44	7.92	22.52
LW13S	30.28	3.65	26.63
LW14S	31.55	8.60	22.95
LW15S	32.29	5.78	26.51
@@@ MW1S	26.91	4.44	22.47
@@@ MW2S	29.04	6.40	22.64
@@@ MW3S	34.49	DRY	34.49
@@ MW4S	28.84	3.09	25.75
@@@ MW1I	27.02	5.25	21.77
@@@ MW2I	29.59	8.00	21.59
@@@ MW3I	34.50	1.27	33.23
HC-1I	31.67	13.92	17.75
HC-2I	35.05	16.84	18.21
HC-3I	35.04	20.21	14.83
HC-4I	34.61	21.51	13.10
HC-5I	30.28	16.45	13.83
HC-6I	28.73	14.90	13.83
LW1D	26.14	6.13	20.01
LW2D	30.17	7.20	22.97
LW3D	31.27	7.75	23.52
LW5D	30.45	6.53	23.92
LW6D	29.87	8.88	20.99
LW7D	33.86	9.20	24.66
LW8D	33.27	6.71	26.56
LW9D	32.00	15.11	16.89
LW10D	30.59	6.43	24.16
LW11D	29.98		
LW12D	30.32	16.44	13.88
LW13D	30.29	9.43	20.86
##MW2D	29.73	8.59	21.14
@ DM2D	27.63	5.16	22.47
@@ DM3D	28.61	4.25	24.36
@@ DM5D	39.05	4.40	34.65

WELL NUMBER	TOP OF 2" PVC ELEVATION IN FEET	WATER LEVEL 9/30/88 DEPTH BEL TOP OF CASING	ELEVATION
RENTON WELLS			
PW1	39.40	NW	NW
PW2	39.79	NW	NW
PW3	31.00	NW	NW
PW8	45.70	NW	NW
PW9	45.13	NW	NW
MW1	40.91	28.65	12.26
MW2	53.32	34.27	19.05
MW3	35.50	22.22	13.28
MW4	36.44	23.60	12.84
MW5	38.32	24.23	14.09
MW6	38.83	26.19	12.64
MW7	47.16	27.44	19.72
& ## MW8	45.76	32.62	13.14
# ##MW9	46.26	NM	NM
MW10	34.12	20.39	13.73
MW11	32.24	18.75	13.49
RIVER GAGE			
SG1	32.60	NM	NM
SG2	###15.1	NM	NM
SG3	36.50	NM	NM
SG4	34.96	NM	NM
HC WELLS INST. 8-9/88			
^ OW4S	30.23	6.73	23.50
^ OW4D	30.09	11.88	18.21
^ OW5S	29.68	5.33	24.35
^ OW5D	29.58	9.01	20.57
^ MW2DR	29.32	7.86	21.46
^ OSP1S	40.33	15.17	25.16
^ OSP1D	40.33	15.53	24.80
^ OSP2S	33.15	9.90	23.25
^ OSP2D	32.94	14.76	18.18
^ OSP3D	34.25	20.42	13.83
^ OSP4S	32.43	14.71	17.72
^ OSP4D	32.43	18.42	14.01
^ OSP5S	29.67	10.99	18.68
^ OSP5D	29.68	15.11	14.57
^ OSP6S	27.09	6.45	20.64
^ OSP6D	27.14	8.97	18.17
^ OSP7S	27.14	6.11	21.03
^ OSP7D	27.05	7.29	19.76

All dimensions in feet.
Measurements made by HART CROWSER, Inc. except 7/28-29/86.
NM Not Measured / NA Not Applicable
Well not vented.
Measurement from top of steel monument casing.
At SG2 water elevation = staff gage reading +15.10 feet.
@ Well head elevation changed. Repaired pvc riser and installed new monument 7/12/88
@@ Well head elevation changed. New monuments installed 8/26/88
@@@ Well head elevation changed. Surveyed pvc rizer 9/27/88. measurement now taken from top of pvc.
# Not measured; cap stuck
^ New wells installed
& Resurveyed 9/27/88, used corrected value.

Table E-16 – Water Level Data December 1988

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
PACCAR SITE WELLS			
LW1S	25.99	2.23	23.76
LW2S	29.83	NM	NM
LW3S	31.20	6.09	25.11
@@LW4S	40.02	4.16	35.86
LW5VS	29.70	3.67	26.03
LW5S	29.27	3.37	25.90
LW6S	30.19	6.18	24.01
LW7S	34.04	NM	NM
LW8S	30.98	4.10	26.88
LW9S	32.18	9.09	23.09
LW10S	30.33	3.09	27.24
LW11VS	29.43	NM	NM
LW11S	29.44	NM	NM
LW12S	30.44	6.33	24.11
LW13S	30.28	2.75	27.53
LW14S	31.55	6.96	24.59
LW15S	32.29	NM	NM
@@@ MW1S	26.91	3.74	23.17
@@@ MW2S	29.04	5.59	23.45
@@@ MW3S	34.49	DRY	34.49
@@ MW4S	28.84	2.14	26.70
@@@ MW1I	27.02	4.22	22.80
@@@ MW2I	29.59	6.44	23.15
@@@ MW3I	34.50	9.77	24.73
HC-1I	31.67	7.51	24.16
HC-2I	35.05	NM	NM
HC-3I	35.04	13.08	21.96
HC-4I	34.61	14.32	20.29
HC-5I	30.28	10.04	20.24
HC-6I	28.73	8.51	20.22
LW1D	26.14	4.68	21.46
LW2D	30.17	NM	NM
LW3D	31.27	5.66	25.61
LW5D	30.45	4.56	25.89
LW6D	29.87	6.62	23.25
LW7D	33.86	NM	NM
LW8D	33.27	4.60	28.67
LW9D	32.00	10.41	21.59
LW10D	30.59	3.88	26.71
LW11D	29.98	NM	NM
LW12D	30.32	9.89	20.43
LW13D	30.29	4.12	26.17
**MW2D	29.73	7.23	22.50
@ DM2D	27.63	4.21	23.42
@@ DM3D	28.61	2.66	25.95
@@ DM5D	39.05	3.43	35.62

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	24.28	21.42
PW9	45.13	NM	NM
MW1	40.91	21.47	19.44
MW2	53.32	28.38	24.94
MW3	35.50	15.52	19.98
MW4	36.44	16.15	20.29
MW5	38.32	16.70	21.62
MW6	38.83	18.66	20.17
MW7	47.16	22.13	25.03
& ** MW8	45.76	24.04	21.72
**MW9	46.26	22.96	23.30
MW10	34.12	13.64	20.48
MW11	32.24	12.20	20.04
MW12	39.56	NM	NM
MW13	39.00	18.66	20.34
MW14	38.80	NM	NM
MW15	37.60	NM	NM
MW16	39.17	NM	NM
MW17	43.17	NM	NM
MW18	40.84	NM	NM
MW19	41.45	NM	NM
MW20	41.64	NM	NM
MW21	38.96	18.87	20.09
MW22	39.03	NM	NM
MW23	37.28	NM	NM
MW24	37.45	NM	NM
MW25S	35.46	16.11	19.35
MW25D	35.54	16.22	19.32
MW26	33.74	15.47	18.27
MW27	30.83	11.81	19.02
RIVER GAGE			
SG1	32.60		32.60
SG2	***15.1		0.00
SG3	36.50		36.50
SG4	34.96		34.96

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
HC WELLS INST. 8–9/88			
OW4S	30.23	4.71	25.52
OW4D	30.09	7.16	22.93
0W5S	29.68	3.99	25.69
OW5D	29.58	4.79	24.79
MW2DR	29.32	5.82	23.50
# OSP1S	38.63	9.52	29.11
# OSP1D	38.36	8.55	29.81
OSP2S	33.15	8.16	24.99
OSP2D	32.94	8.22	24.72
OSP3D	34.25	13.47	20.78
OSP4S	32.43	11.01	21.42
OSP4D	32.43	11.71	20.72
OSP5S	29.67	9.28	20.39
OSP5D	29.68	8.97	20.71
OSP6S	27.09	NM	NM
OSP6D	27.14	NM	NM
OSP7S	27.14	NM	NM
OSP7D	27.05	5.90	21.15
^OSP – 8	38.21	9.94	28.27
^OSP–9	41.21	5.44	35.77
^OSP–10	37.54	9.71	27.83
^F OSP–11	37.08	–0.85	37.93
^F OSP–12	38.83	–0.25	39.08
^OSP–13	36.27	2.82	33.45

NOTES:
All dimensions in feet.
Measurements made by HART CROWSER, Inc. and CH2M Hill
NM Not Measured / NA Not Applicable
** Measurement from top of steel monument casing.
@ Well head elevation changed. Repaired pvc riser and installed new monument 7/12/88
@@ Well head elevation changed. New monuments installed 8/26/88
@@@ Well head elevation changed. Surveyed pvc rizer 9/27/88. measurement now taken from top of pvc.
^ New wells installed
& Resurveyed 9/27/88, used corrected value.
F Flowing
Well head elevation changed. Repaired monument after 9/30/88.

Table E-17 – Water Level Data March 1989

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
PACCAR SITE WELLS			
LW1S	25.99	1.57	24.42
LW2S	29.83	NM	NM
LW3S	31.20	5.42	25.78
@@LW4S	40.02	3.22	36.80
LW5VS	29.70	2.91	26.79
LW5S	29.27	2.53	26.74
LW6S	30.19	5.00	25.19
LW7S	34.04	4.29	NM
LW8S	30.98	2.50	28.48
LW9S	32.18	8.14	24.04
LW10S	30.33	2.20	28.13
LW11VS	29.43	NM	NM
LW11S	29.44	NM	NM
LW12S	30.44	4.82	25.62
LW13S	30.28	2.09	28.19
LW14S	31.55	5.49	26.06
LW15S	32.29	3.45	28.84
@@@ MW1S	26.91	2.55	24.36
@@@ MW2S	29.04	4.50	24.54
@@@ MW3S	34.49	DRY	DRY
@@ MW4S	28.84	1.28	27.56
@@@ MW1I	27.02	3.54	23.48
@@@ MW2I	29.59	5.42	24.17
@@@ MW3I	34.50	8.17	26.33
HC-1I	31.67	7.18	24.49
HC-2I	35.05	9.98	25.07
HC-3I	35.04	13.14	21.90
HC-4I	34.61	14.57	20.04
HC-5I	30.28	10.22	20.06
HC-6I	28.73	8.55	20.18
LW1D	26.14	3.43	22.71
LW2D	30.17	4.15	26.02
LW3D	31.27	4.94	26.33
LW5D	30.45	3.89	26.56
LW6D	29.87	5.76	24.11
LW7D	33.86	5.73	28.13
LW8D	33.27	3.77	29.50
LW9D	32.00	9.81	22.19
LW10D	30.59	3.12	27.47
LW11D	29.98	NM	NM
LW12D	30.32	9.89	20.43
LW13D	30.29	3.36	26.93
**MW2D	29.73	5.71	24.02
@ DM2D	27.63	3.51	24.12
@@ DM3D	28.61	1.93	26.68
@@ DM5D	39.05	3.61	35.44

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	45.70
PW9	45.13	NM	NM
MW1	40.91	22.34	18.57
MW2	53.32	28.12	25.20
MW3	35.50	15.80	19.70
MW4	36.44	16.47	19.97
MW5	38.32	16.78	21.54
MW6	38.83	19.30	19.53
MW7	47.16	22.08	25.08
& ** MW8	45.76	24.59	21.17
**MW9	46.26	23.63	22.63
MW10	34.12	13.83	20.29
MW11	32.24	12.27	19.97
MW12	39.56	NM	NM
MW13	39.00	NM	NM
MW14	38.80	18.98	19.82
MW15	37.60	NM	NM
MW16	39.17	18.99	20.18
MW17	43.17	23.14	20.03
MW18	40.84	21.02	19.82
MW19	41.45	NM	NM
MW20	41.64	NM	NM
MW21	38.96	NM	NM
MW22	39.03	NM	NM
MW23	37.28	17.68	19.60
MW24	37.45	NM	NM
MW25S	35.46	16.36	19.10
MW25D	35.54	16.46	19.08
MW26	33.74	NM	NM
MW27	30.83	NM	NM
RIVER GAGE			
SG1	32.60		
SG2	***15.1		
SG3	36.50		
SG4	34.96		

Well Number	Top of 2" PVC Elevation in Feet	Water Level: Depth Below Top of Casing 12/29/88	Water Level: Elevation
HC WELLS INST. 8-9/88			
OW4S	30.23	4.04	26.19
OW4D	30.09	6.67	23.42
0W5S	29.68	2.84	26.84
OW5D	29.58	3.90	25.68
MW2DR	29.32	4.63	24.69
# OSP1S	38.63	8.50	30.13
# OSP1D	38.36	7.53	30.83
OSP2S	33.15	6.75	26.40
OSP2D	32.94	7.94	25.00
OSP3D	34.25	13.66	20.59
OSP4S	32.43	10.14	22.29
OSP4D	32.43	11.82	20.61
OSP5S	29.67	8.96	20.71
OSP5D	29.68	8.05	21.63
OSP6S	27.09	3.55	23.54
OSP6D	27.14	4.99	22.15
OSP7S	27.14	4.57	22.57
OSP7D	27.05	4.81	22.24
^OSP – 8	38.21	8.71	29.50
^OSP-9	41.21	4.66	36.55
^OSP-10	37.54	8.77	28.77
^F OSP-11	37.08	-0.24	37.32
^F OSP-12	38.83	-0.05	38.88
^OSP-13	36.27	2.67	33.60

NOTES:

All dimensions in feet.

Measurements made by HART CROWSER, Inc. and CH2M Hill

NM Not Measured / NA Not Applicable

** Measurement from top of steel monument casing.

@ Well head elevation changed. Repaired pvc riser and installed new monument 7/12/88

@@ Well head elevation changed. New monuments installed 8/26/88

@@@ Well head elevation changed. Surveyed pvc rizer 9/27/88. measurement now taken from top of pvc.

^ New wells installed

& Resurveyed 9/27/88, used corrected value.

F Flowing

Well head elevation changed. Repaired monument after 9/30/88.

Table E-18 – Water Level Data June 1989

Well Number	Top of 2" PVC Elevation in Feet	Water Level Depth Below Top of Casing 6/27/89	Elevation
PACCAR SITE WELLS			
LW1S	25.99	2.61	23.38
LW2S	29.83	5.49	NM
LW3S	31.20	6.40	24.80
@@LW4S	40.02	4.34	35.68
LW5VS	29.70	4.42	25.28
LW5S	29.27	4.01	25.26
LW6S	30.19	7.08	23.11
LW7S	34.04	6.27	NM
LW8S	30.98	NM	ERR
LW9S	32.18	9.34	22.84
LW10S	30.33	3.56	26.77
LW11VS	29.43	NM	NM
LW11S	29.44	NM	NM
LW12S	30.44	6.65	23.79
LW13S	30.28	3.26	27.02
LW14S	31.55	7.32	24.23
LW15S	32.29	4.74	27.55
@@@ MW1S	26.91	4.27	22.64
@@@ MW2S	29.04	5.73	23.31
@@@ MW3S	34.49	DRY	DRY
@@ MW4S	28.84	3.47	25.37
@@@ MW1I	27.02	4.28	22.74
@@@ MW2I	29.59	5.94	23.65
@@@ MW3I	34.50	9.98	24.52
HC-1I	31.67	8.69	22.98
HC-2I	35.05	11.47	23.58
HC-3I	35.04	14.67	20.37
HC-4I	34.61	15.98	18.63
HC-5I	30.28	11.44	18.84
HC-6I	28.73	9.77	18.96
LW1D	26.14	3.81	22.33
LW2D	30.17	5.42	24.75
LW3D	31.27	5.84	25.43
LW5D	30.45	4.84	25.61
LW6D	29.87	6.93	22.94
LW7D	33.86	6.89	26.97
LW8D	33.27	NM	ERR
LW9D	32.00	10.83	21.17
LW10D	30.59	4.35	26.24
LW11D	29.98	NM	NM
LW12D	30.32	11.10	19.22
LW13D	30.29	4.72	25.57
**MW2D	29.73	6.34	23.39
@ DM2D	27.63	4.34	23.29
@@ DM3D	28.61	3.03	25.58
@@ DM5D	39.05	3.70	35.35

Well Number	Top of 2" PVC Elevation in Feet	Water Level Depth Below Top of Casing 6/27/89	Elevation
RENTON WELLS			
PW1	39.40	NM	NM
PW2	39.79	NM	NM
PW3	31.00	NM	NM
PW8	45.70	NM	ERR
PW9	45.13	NM	NM
MW1	40.91	23.50	17.41
MW2	53.32	29.14	24.18
MW3	35.50	16.81	18.69
MW4	36.44	17.88	18.56
MW5	38.32	18.29	20.03
MW6	38.83	20.54	18.29
MW7	47.16	23.23	23.93
& ** MW8	45.76	25.97	19.79
**MW9	46.26	25.17	21.09
MW10	34.12	15.15	18.97
MW11	32.24	13.46	18.78
MW12	39.56	NM	NM
MW13	39.00	20.58	NM
MW14	38.80	20.38	18.42
MW15	37.60	20.62	NM
MW16	39.17	20.49	18.68
MW17	43.17	24.57	18.60
MW18	40.84	22.38	18.46
MW19	41.45	NM	NM
MW20	41.64	NM	NM
MW21	38.96	NM	NM
MW22	39.03	NM	NM
MW23	37.28	18.81	18.47
MW24	37.45	NM	NM
MW25S	35.46	17.35	18.11
MW25D	35.54	17.48	18.06
MW26	33.74	16.57	NM
MW27	30.83	17.85	NM
RIVER GAGE			
SG1	32.60		
SG2	***15.1		
SG3	36.50		
SG4	34.96		

Well Number	Top of 2" PVC Elevation in Feet	Water Level Depth Below Top of Casing 6/27/89	Elevation
HC WELLS INST. 8–9/88			
OW4S	30.23	5.49	24.74
OW4D	30.09	7.77	22.32
0W5S	29.68	NM	ERR
OW5D	29.58	5.18	24.40
MW2DR	29.32	5.12	24.20
# OSP1S	38.63	9.34	29.29
# OSP1D	38.36	10.33	28.03
OSP2S	33.15	8.59	24.56
OSP2D	32.94	9.40	23.54
OSP3D	34.25	14.97	19.28
OSP4S	32.43	11.86	20.57
OSP4D	32.43	13.09	19.34
OSP5S	29.67	10.09	19.58
OSP5D	29.68	9.53	20.15
OSP6S	27.09	5.20	21.89
OSP6D	27.14	5.61	21.53
OSP7S	27.14	4.89	22.25
OSP7D	27.05	4.94	22.11
^OSP – 8	38.21	10.35	27.86
^OSP-9	41.21	7.28	33.93
^OSP-10	37.54	10.04	27.50
^F OSP-11	37.08	–1.05	38.13
^F OSP-12	38.83	–0.30	39.13
^OSP-13	36.27	3.01	33.26

NOTES:

All dimensions in feet.

Measurements made by HART CROWSER, Inc. and CH2M Hill

NM Not Measured / NA Not Applicable

** Measurement from top of steel monument casing.

@ Well head elevation changed. Repaired pvc riser and installed new monument 7/12/88

@@ Well head elevation changed. New monuments installed 8/26/88

@@@ Well head elevation changed. Surveyed pvc rizer 9/27/88. measurement now taken from top of pvc.

^ New wells installed

& Resurveyed 9/27/88, used corrected value.

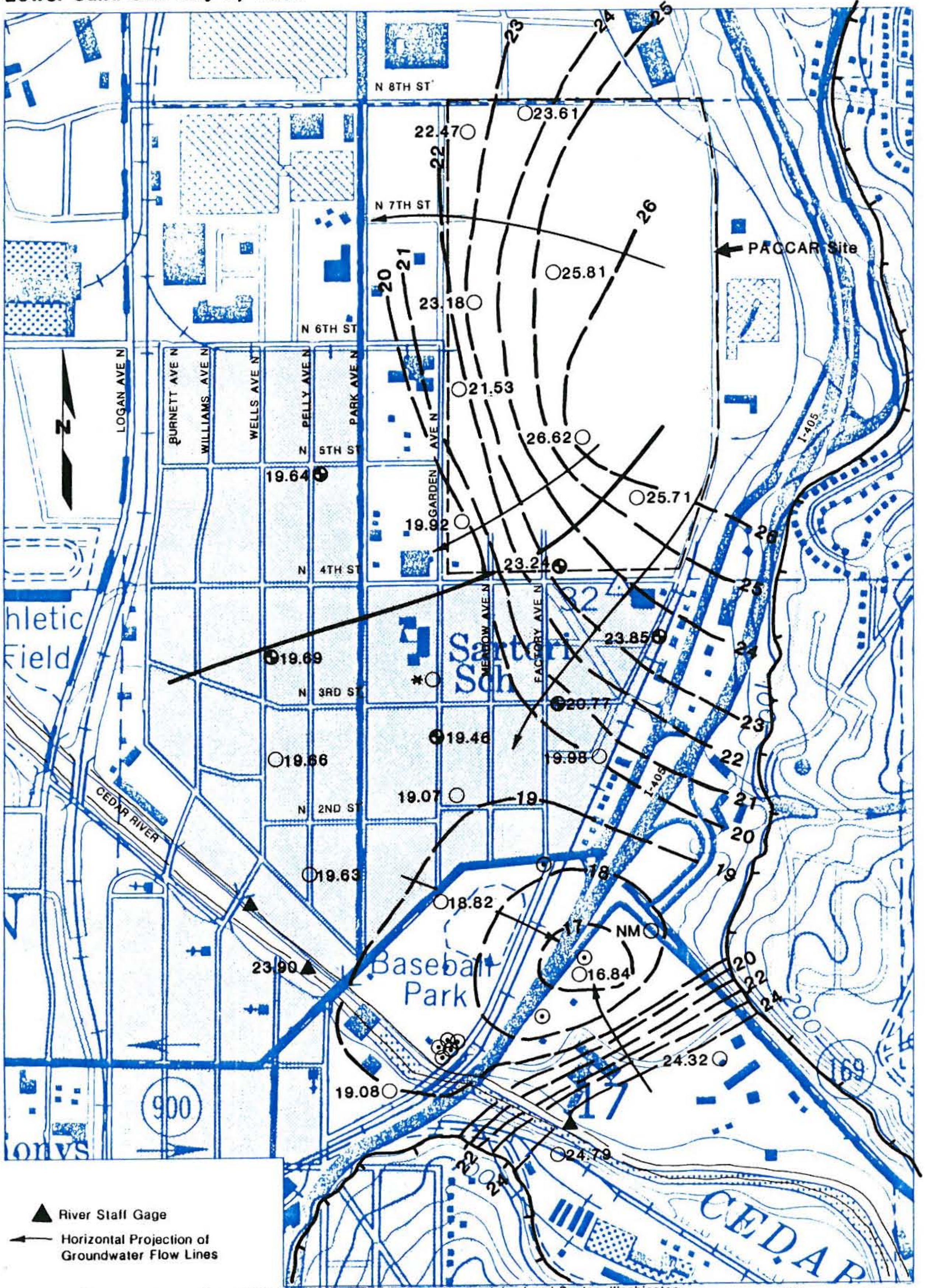
F Flowing

Well head elevation changed. Repaired monument after 9/30/88.

Hart Crowser
J-1639-09

FIGURES E-1 THROUGH E-18
GROUNDWATER ELEVATION CONTOUR MAPS
MAY 1987 THROUGH JUNE 1989

Groundwater Elevation Contour Map
Lower Sand Unit May 5, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

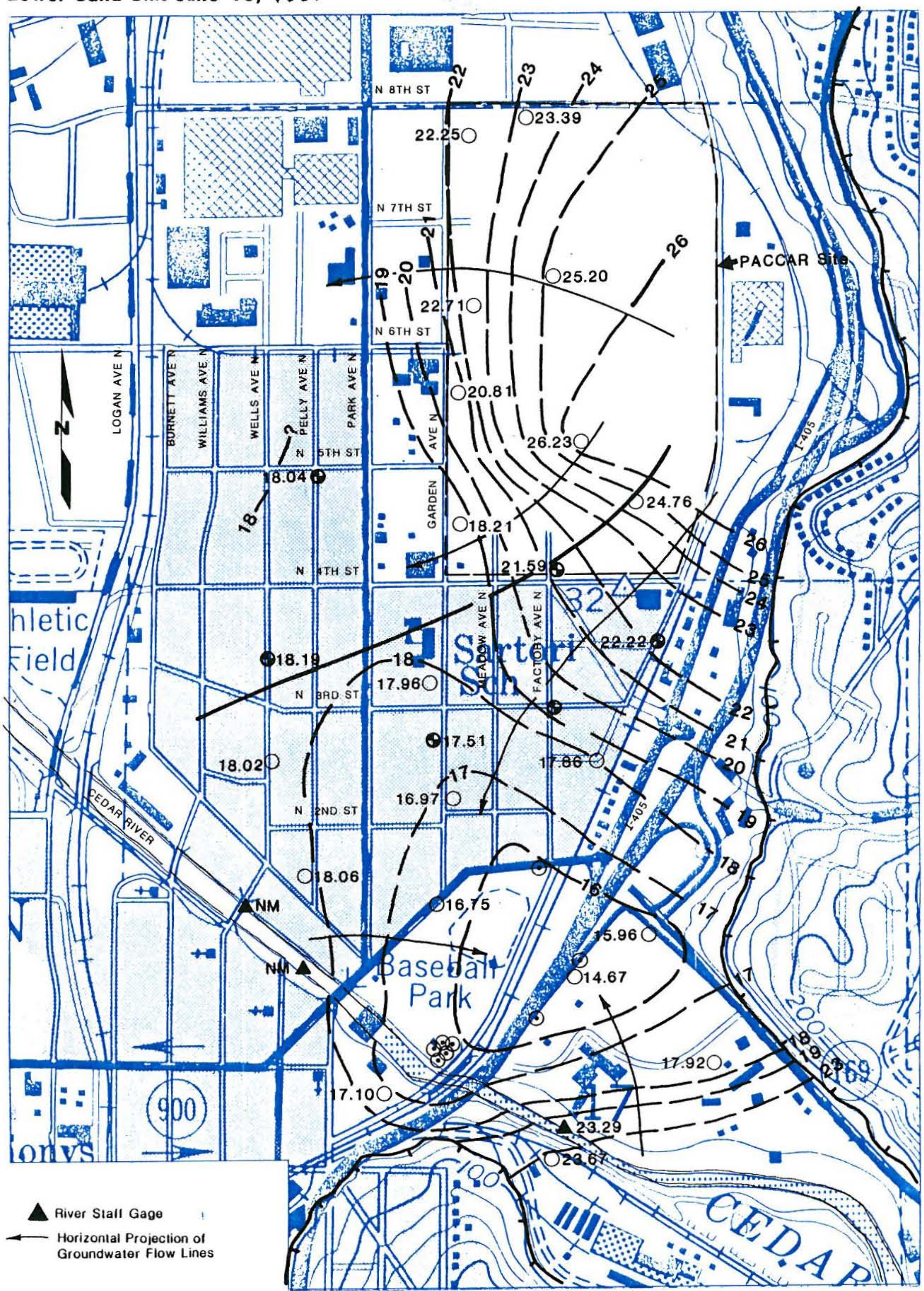
0 500 1000
Scale in Feet

○ Monitoring Well
⊕ Piezometer
⊙ City of Renton Production Well
19.64 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet
▬▬ Groundwater Divide Approximate Location
* Anomalous

HARTCROWSER
J-1639-09 1/89
Figure E-1

Groundwater Elevation Contour Map
Lower Sand Unit June 15, 1987



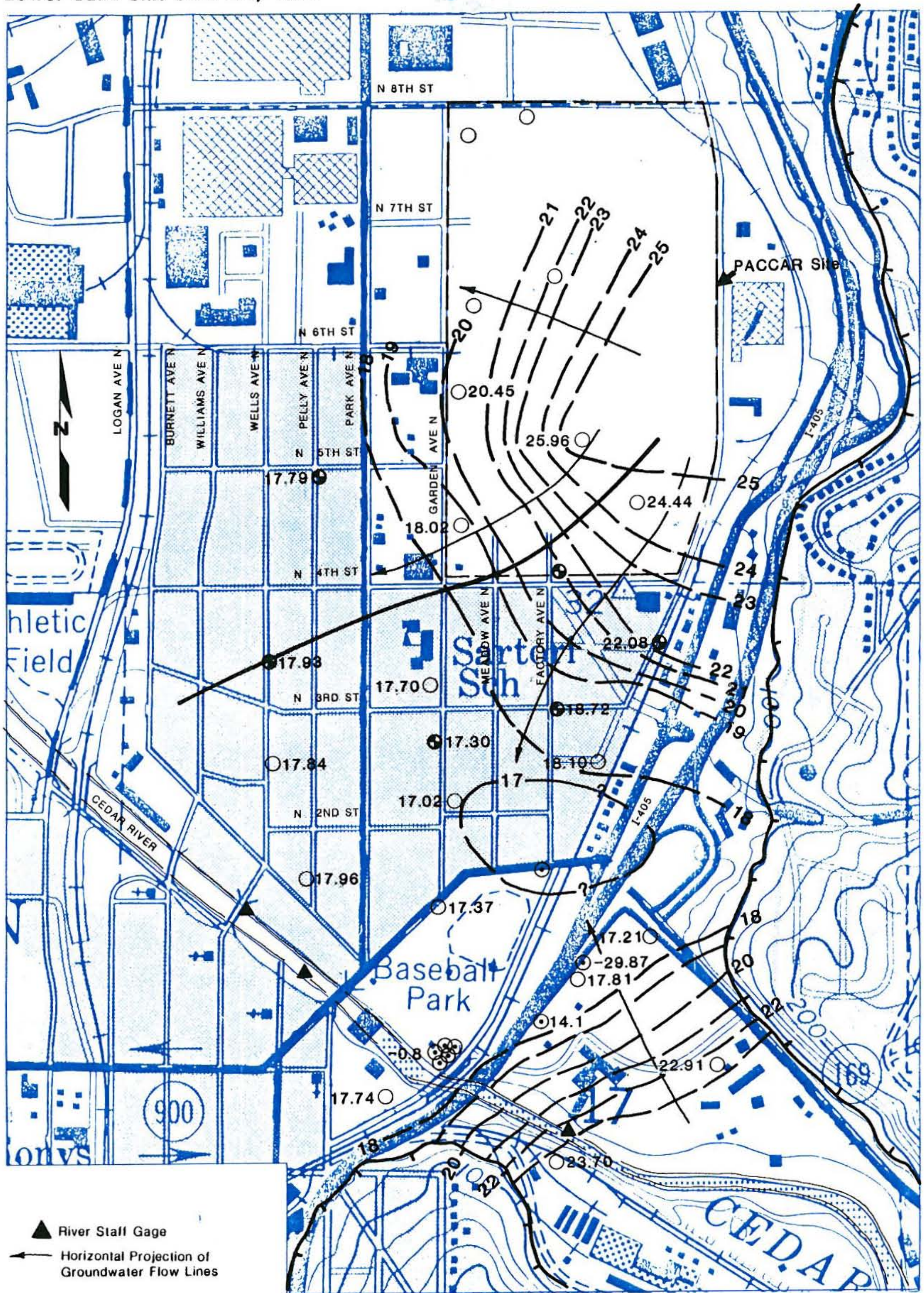
Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

- Monitoring Well
- Piezometer
- City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- Groundwater Divide Approximate Location

HARTCROWSER
J-1639-09 1/89
Figure E-2

Groundwater Elevation Contour Map
Lower Sand Unit June 24, 1987 *



River Staff Gage

Horizontal Projection of Groundwater Flow Lines

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

Monitoring Well
Piezometer
City of Renton Production Well
19.64 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet

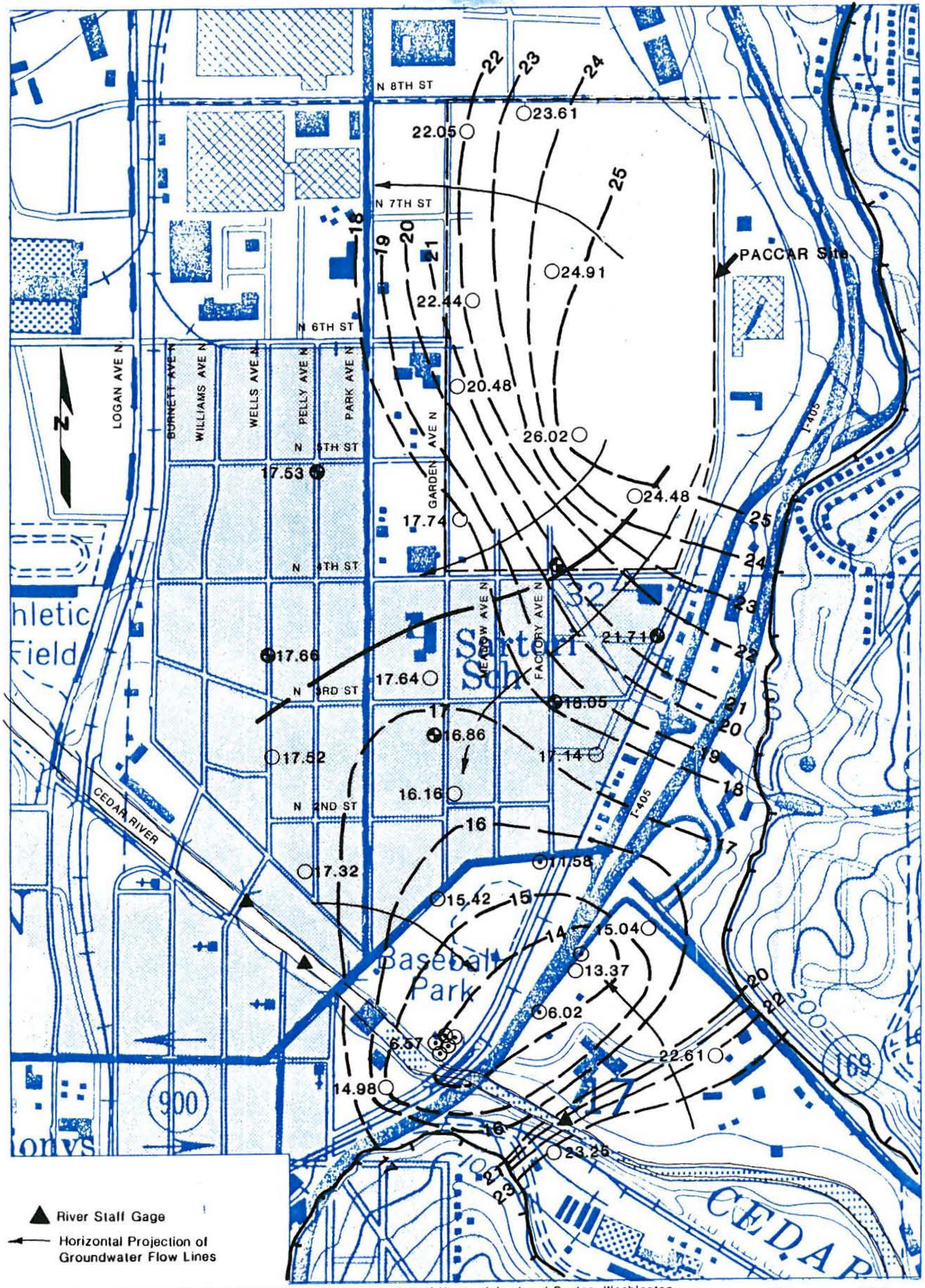
Groundwater Divide Approximate Location

* Measurements Taken Prior to Initiating Pumping.

HARTCROWSER
J-1639-09 1/89
Figure E-3

Groundwater Elevation Contour Map

Lower Sand Unit June 25, 1987 *



▲ River Stall Gage

← Horizontal Projection of Groundwater Flow Lines

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

○ Monitoring Well

Piezometer

City of Renton Production Well

19.64 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet

Groundwater Divide Approximate Location

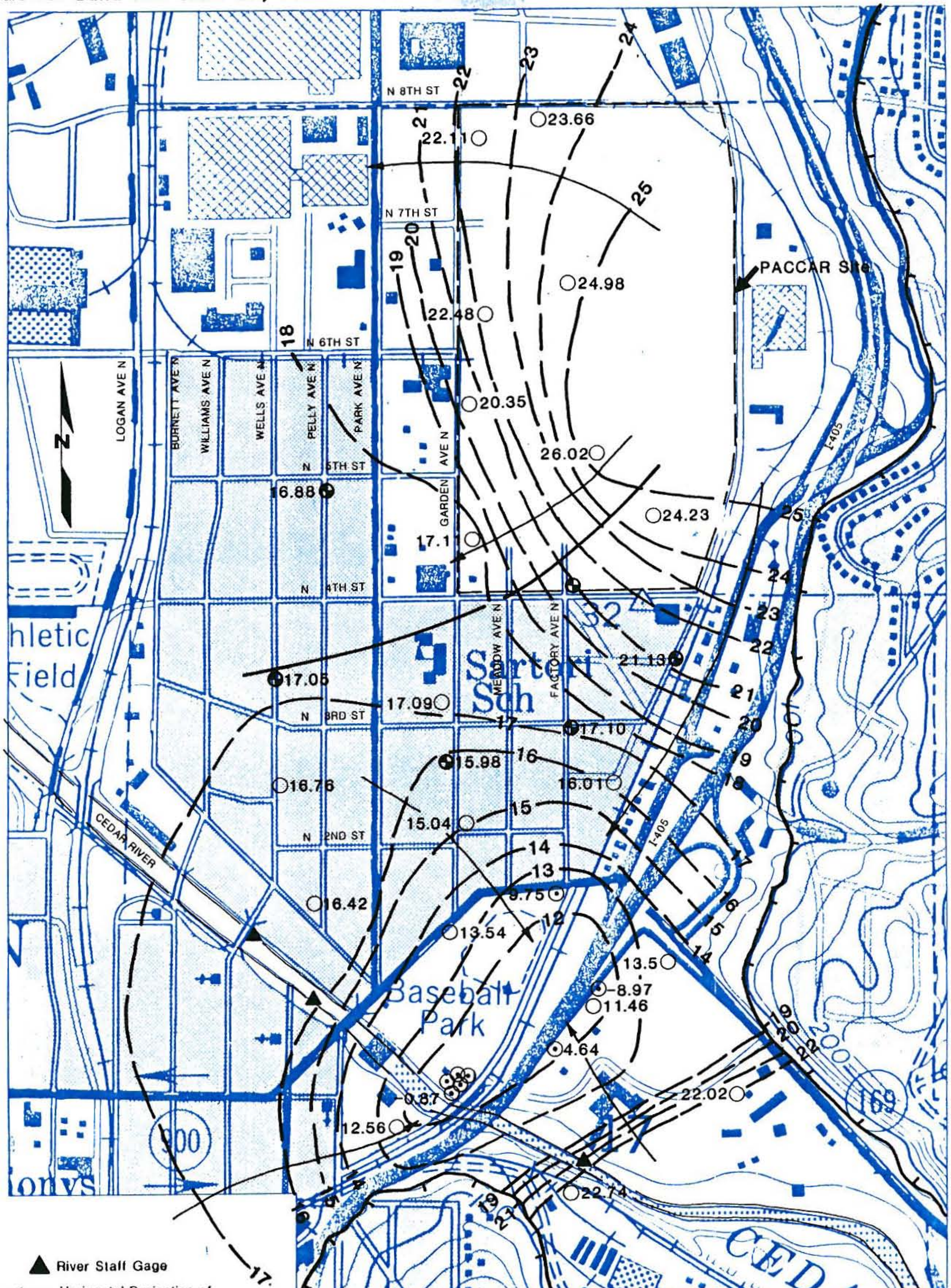
* Measurements Taken 24 Hours after Pumping Initiated. Pumping Rate: 11,500 gpm

HARTCROWSER

J-1639-09 1/89

Figure E-4

Groundwater Elevation Contour Map
Lower Sand Unit June 26, 1987 *



Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

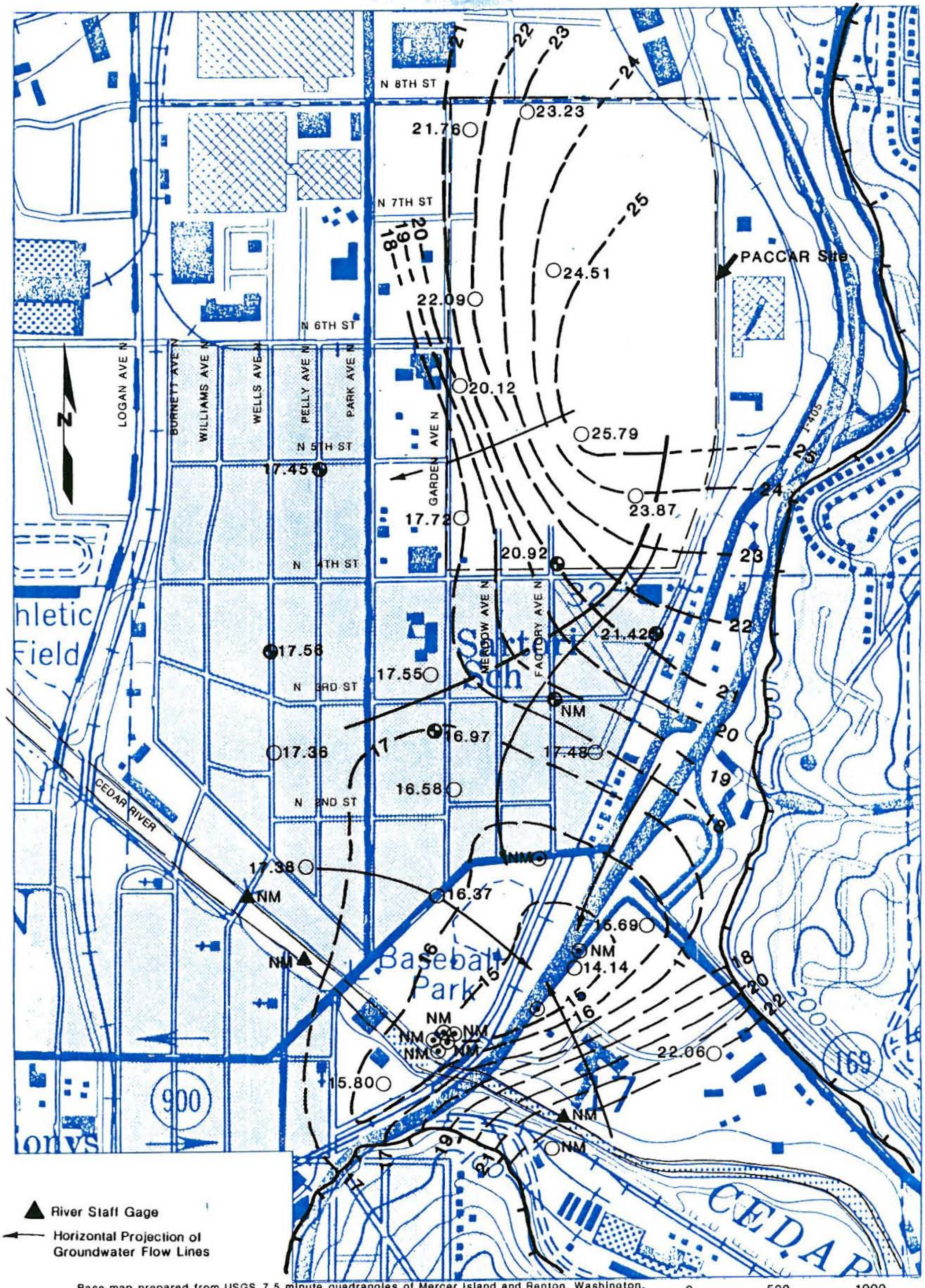
0 500 1000
Scale in Feet

Symbol	Explanation
○	Monitoring Well
⊕	Piezometer
⊙	City of Renton Production Well
19.64	Spot Groundwater Elevation in Feet
—20—	Groundwater Elevation Contour in Feet
———	Groundwater Divide Approximate Location

* Measurements taken 48 hours after pumping initiated. Pumping Rate: 11,500 gpm first 24 hours/15,000 second 24 hours.

HARTCROWSER
J-1639-09 1/89
Figure E-5

Groundwater Elevation Contour Map
Lower Sand Unit July 29, 1987



River Staff Gage

Horizontal Projection of Groundwater Flow Lines

Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000

Scale in Feet

Monitoring Well

Piezometer

City of Renton Production Well

19.64 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet

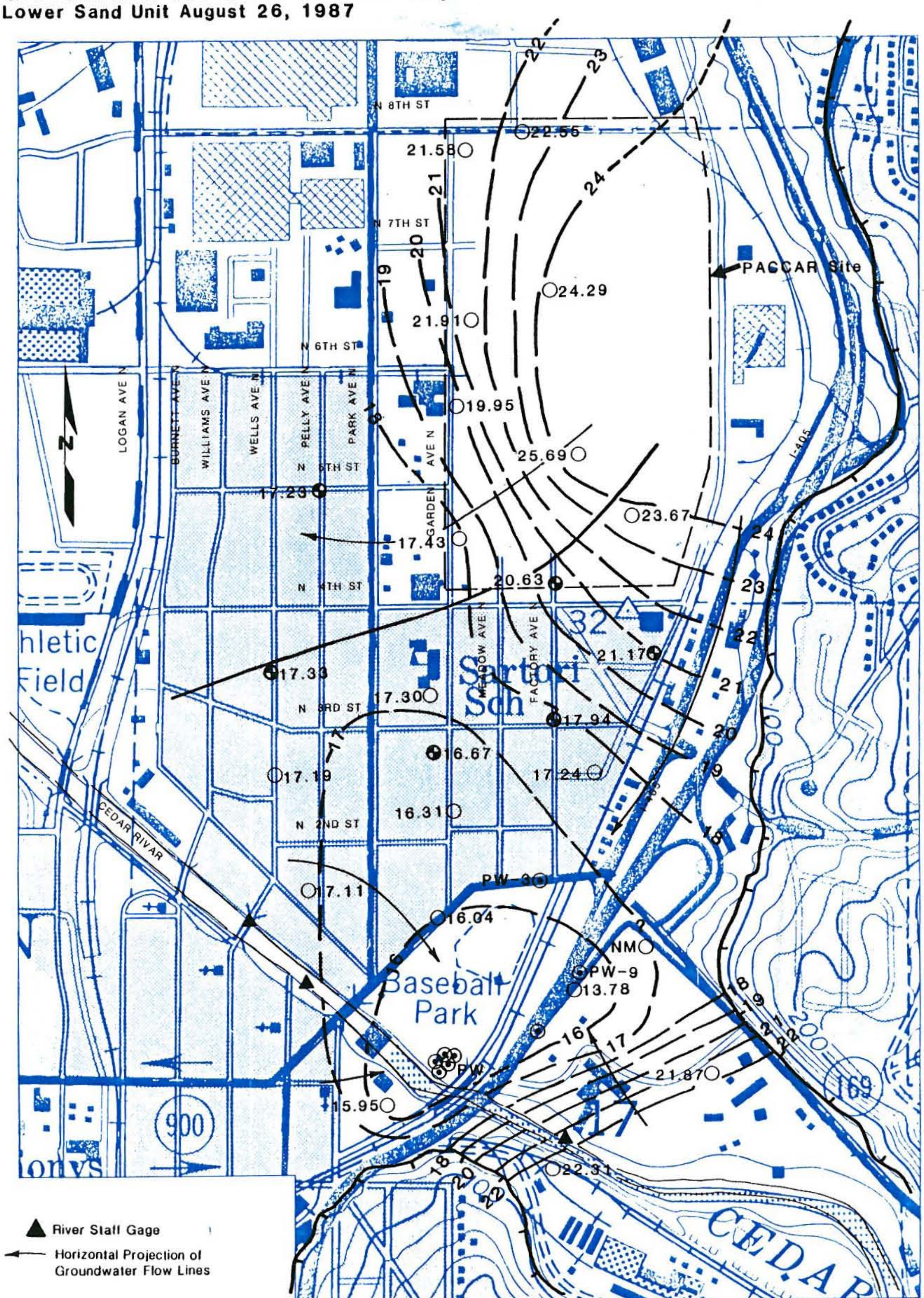
Groundwater Divide Approximate Location

HARTCROWSER

J-1639-09 1/89

Figure E-6

Groundwater Elevation Contour Map
Lower Sand Unit August 26, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

Scale in Feet: 0 500 1000

▲ River Staff Gage

← Horizontal Projection of Groundwater Flow Lines

○ Monitoring Well

Piezometer

City of Renton Production Well

16.67 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet

Groundwater Divide Approximate Location

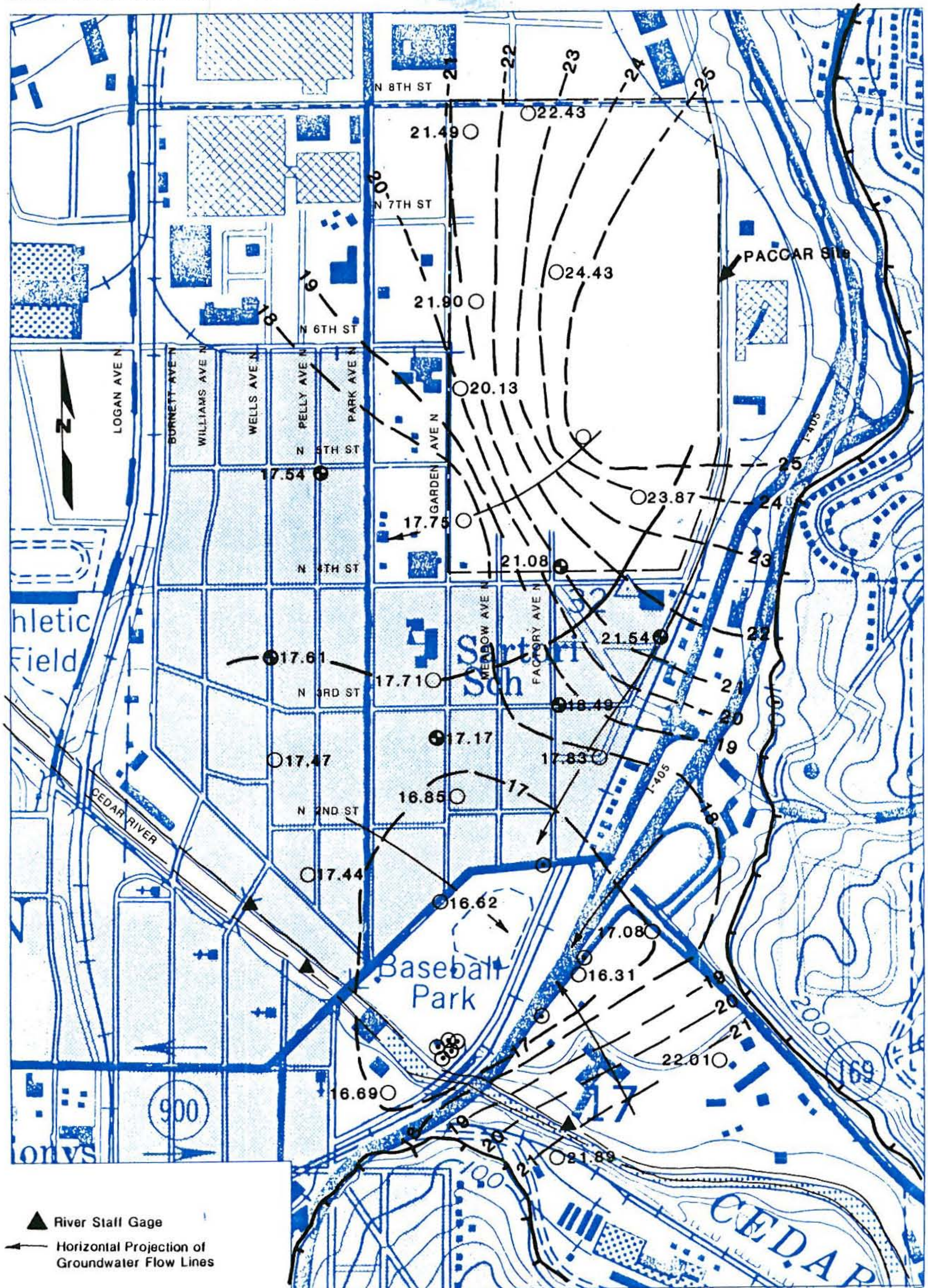
HARTCROWSER

J-1639-09 1/89

Figure E-7

Groundwater Elevation Contour Map

Lower Sand Unit September 22, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

- ○ Monitoring Well
- Piezometer
- ⊙ City of Renton Production Well
- **19.64** Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- —— Groundwater Divide Approximate Location

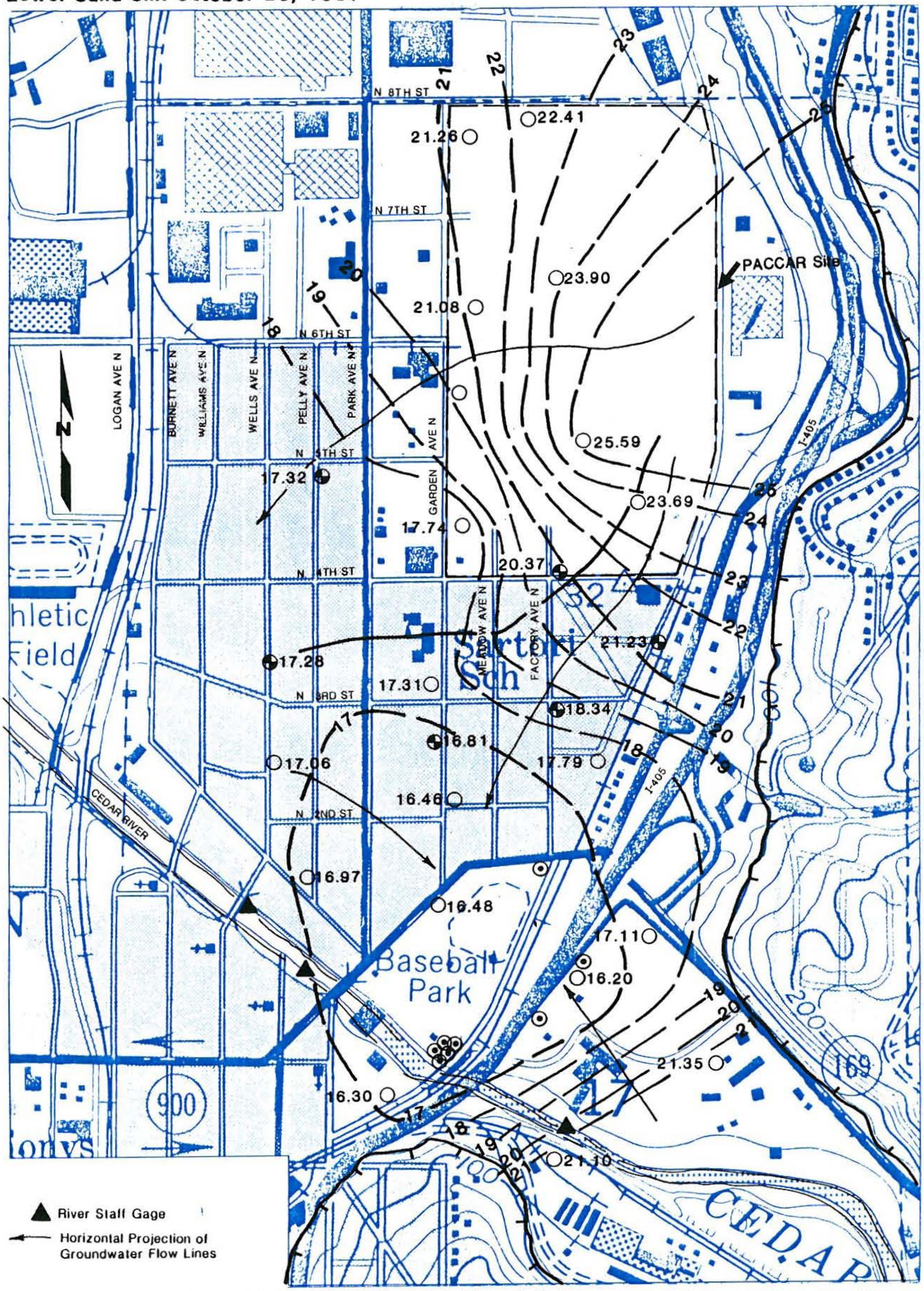
HARTCROWSER

J-1636-09 1/89

Figure E-8

Groundwater Elevation Contour Map

Lower Sand Unit October 20, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000

Scale in Feet

- ○ Monitoring Well
- ◐ Piezometer
- ⊙ City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- ——— Groundwater Divide Approximate Location

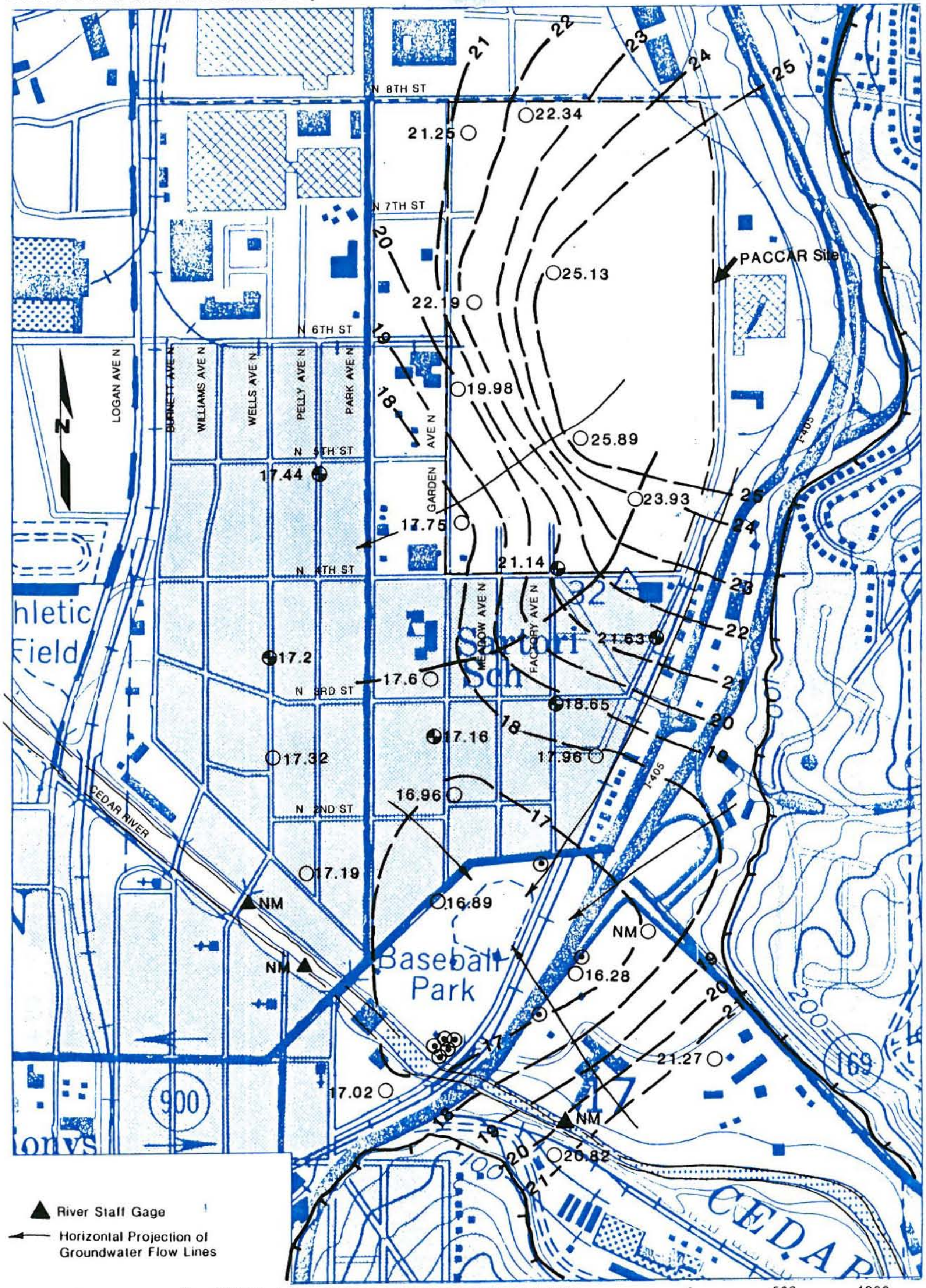
HARTCROWSER

J-1639-09 1/89

Figure E-9

Groundwater Elevation Contour Map

Lower Sand Unit November 23, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

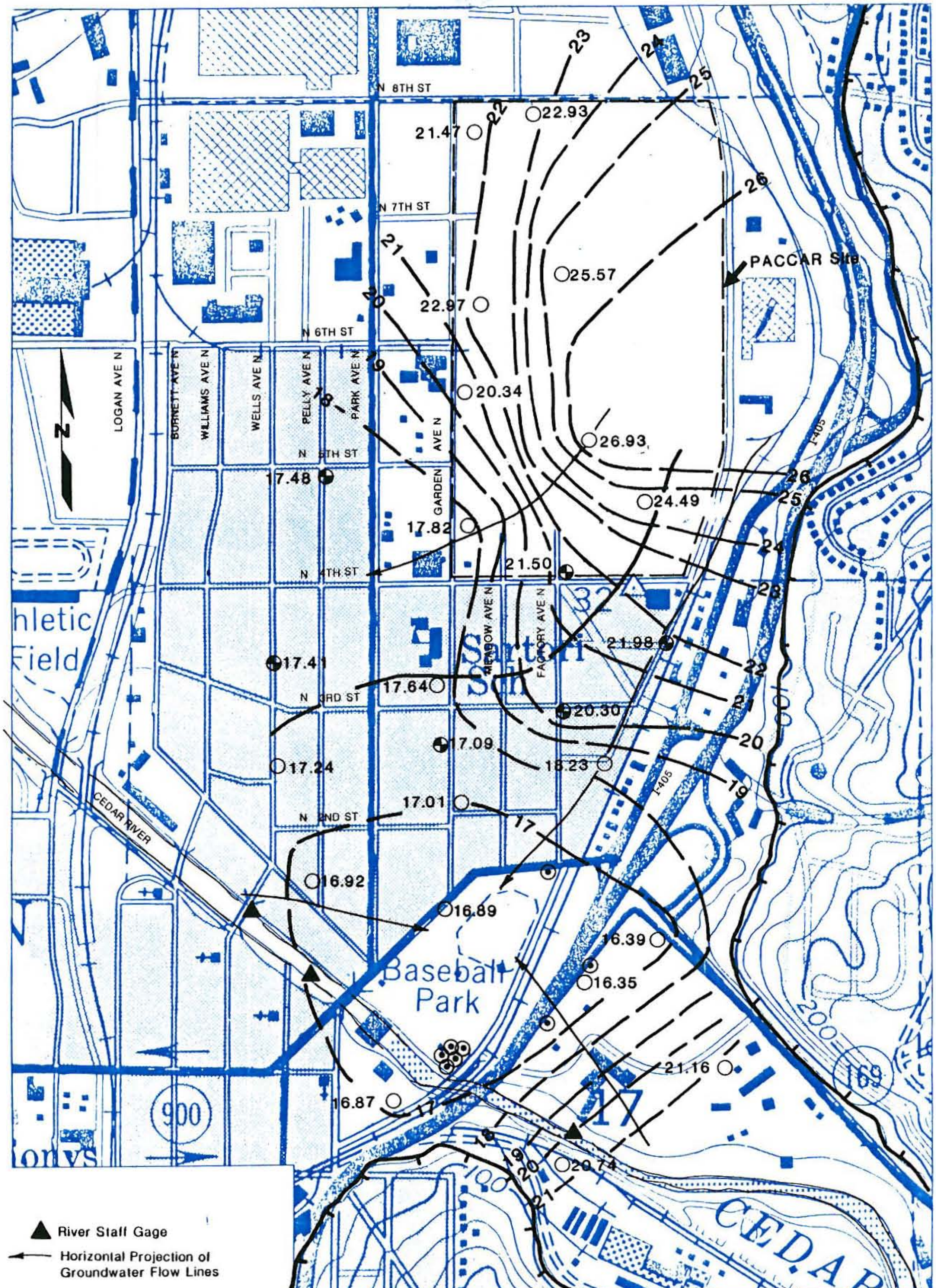
- Monitoring Well
- Piezometer
- City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- Groundwater Divide Approximate Location

0 500 1000
Scale in Feet

HARTCROWSER
J-1639-09 1/89
Figure E-10

Groundwater Elevation Contour Map

Lower Sand Unit December 21, 1987



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington

0 500 1000

Scale in Feet

- ○ Monitoring Well
- Piezometer
- City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- ——— Groundwater Divide Approximate Location

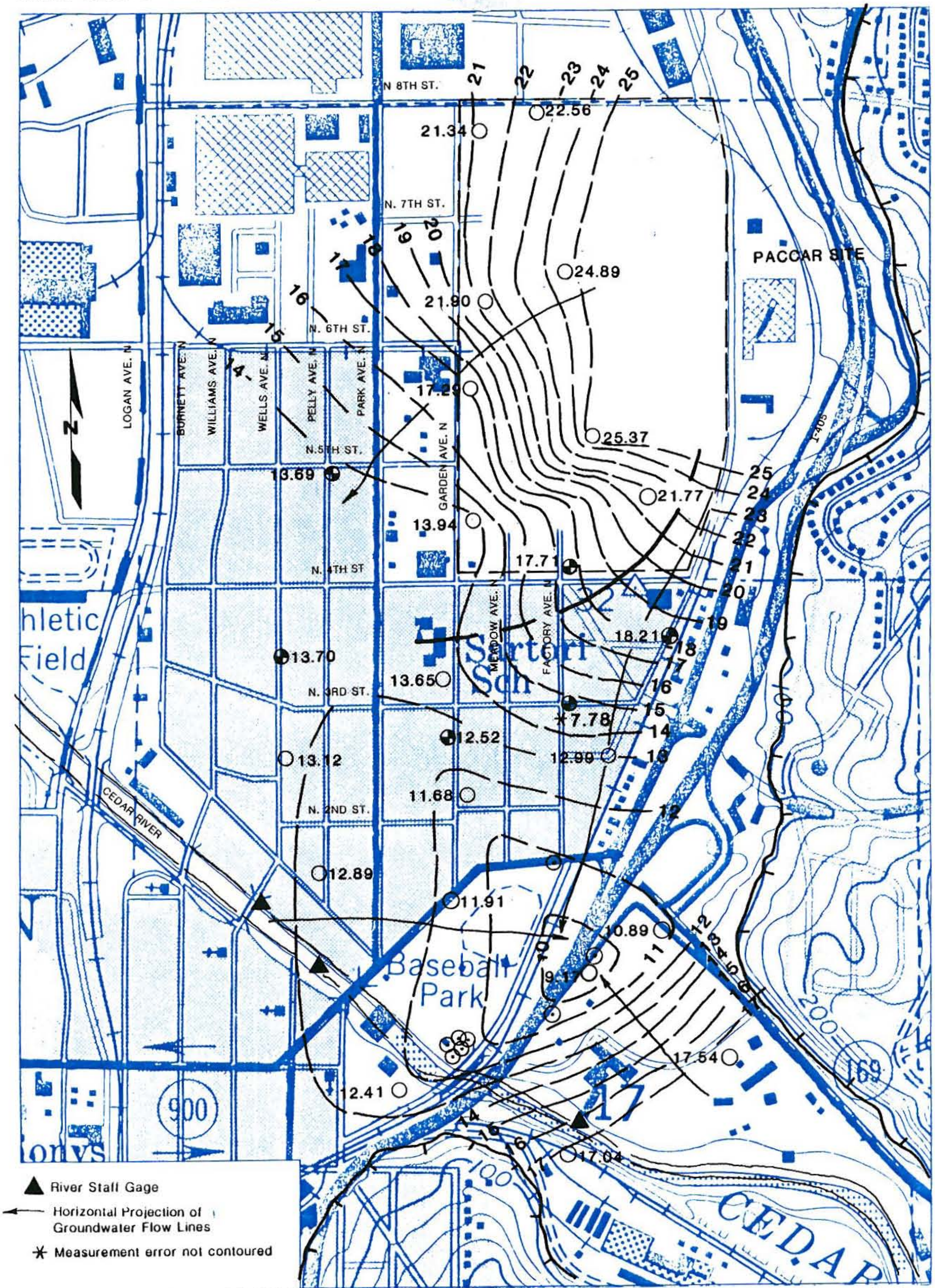
HARTCROWSER

J-1639-09 1/89

Figure E-11

Groundwater Elevation Contour Map

Lower Sand Unit February 22, 1988



▲ River Staff Gage

← Horizontal Projection of Groundwater Flow Lines

✳ Measurement error not contoured

Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000

Scale in Feet

○ Monitoring Well

◐ Piezometer

⊙ City of Renton Production Well

19.64 Spot Groundwater Elevation in Feet

— 20 — Groundwater Elevation Contour in Feet

——— Groundwater Divide Approximate Location

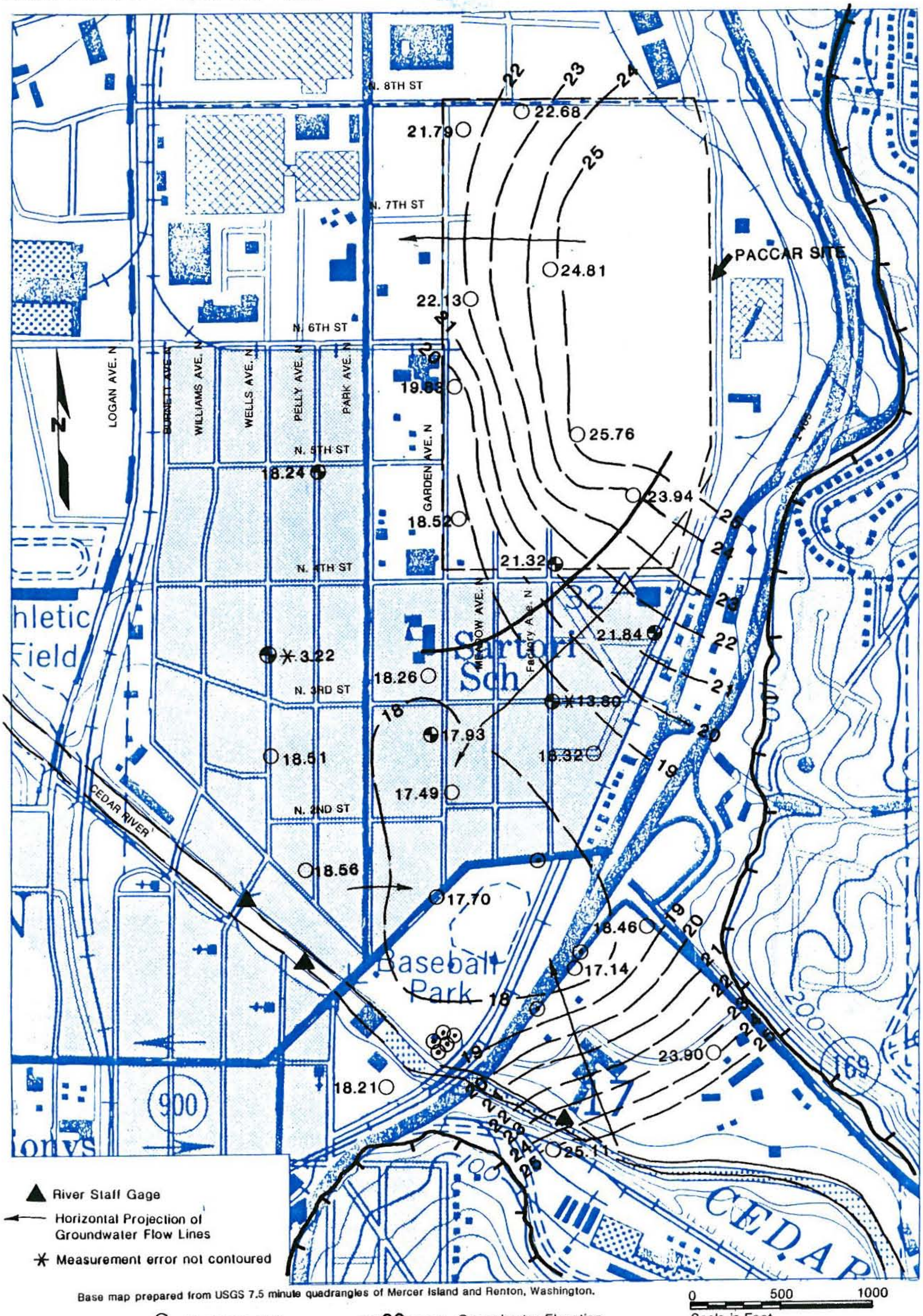
HARTCROWSER

J-1639-09 1/89

Figure E-12

Groundwater Elevation Contour Map

Lower Sand Unit April 27, 1988



▲ River Staff Gage

← Horizontal Projection of Groundwater Flow Lines

✳ Measurement error not contoured

Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

○ Monitoring Well

◐ Piezometer

⊙ City of Renton Production Well

19.64 Spot Groundwater Elevation in Feet

—20— Groundwater Elevation Contour in Feet

▬▬ Groundwater Divide Approximate Location

0 500 1000

Scale in Feet

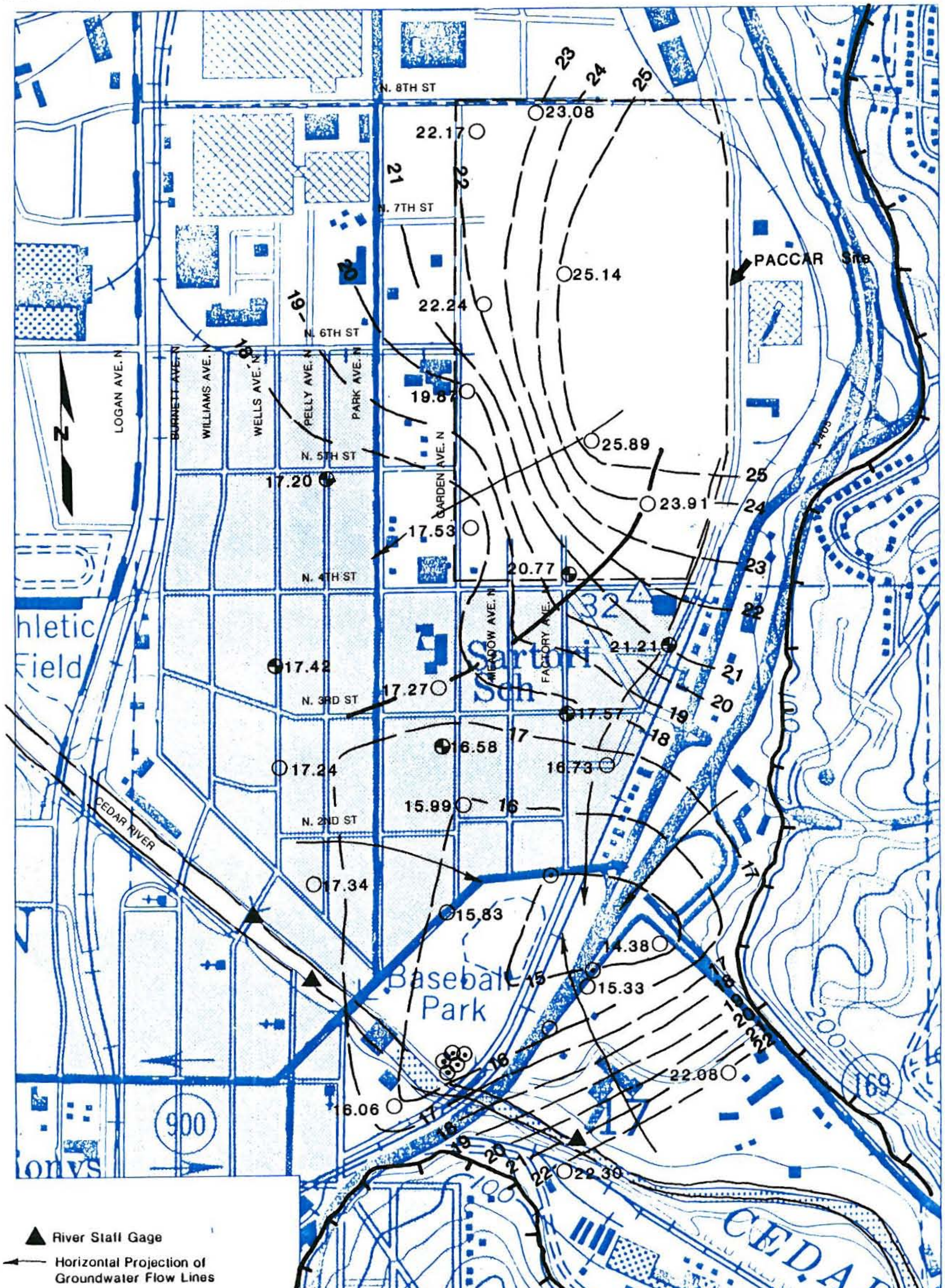
HARTCROWSER

J-1639-09 1/89

Figure E-13

Groundwater Elevation Contour Map

Lower Sand Unit June 29,1988



▲ River Staff Gage

←— Horizontal Projection of Groundwater Flow Lines

Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000

Scale in Feet

○ Monitoring Well

◒ Piezometer

⊙ City of Renton Production Well

19.64 Spot Groundwater Elevation in Feet

—**20**— Groundwater Elevation Contour in Feet

▬▬ Groundwater Divide Approximate Location

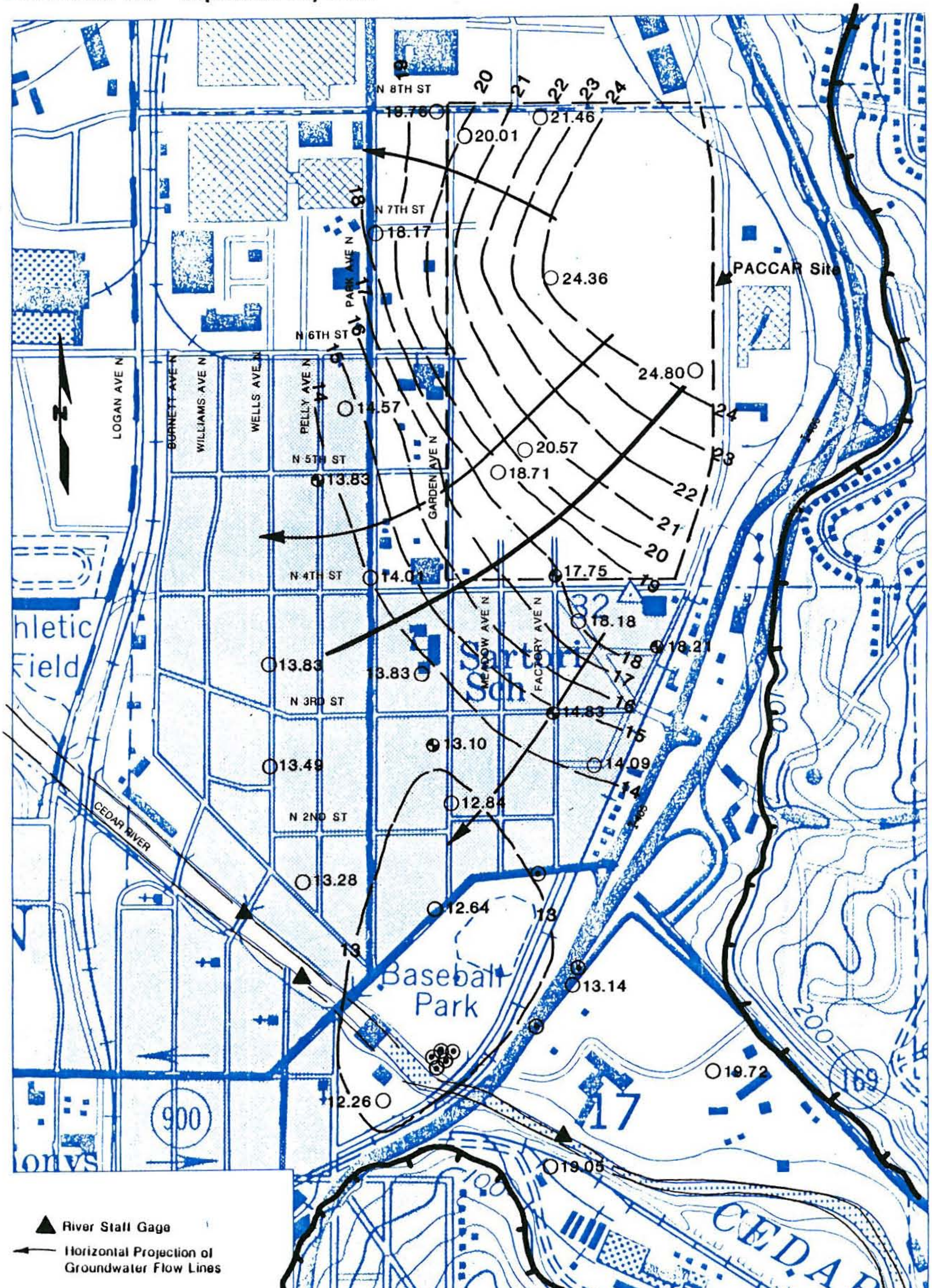
HARTCROWSER

J-1639-09 1/89

Figure E-14

Groundwater Elevation Contour Map

Lower Sand Unit September 30, 1988



Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

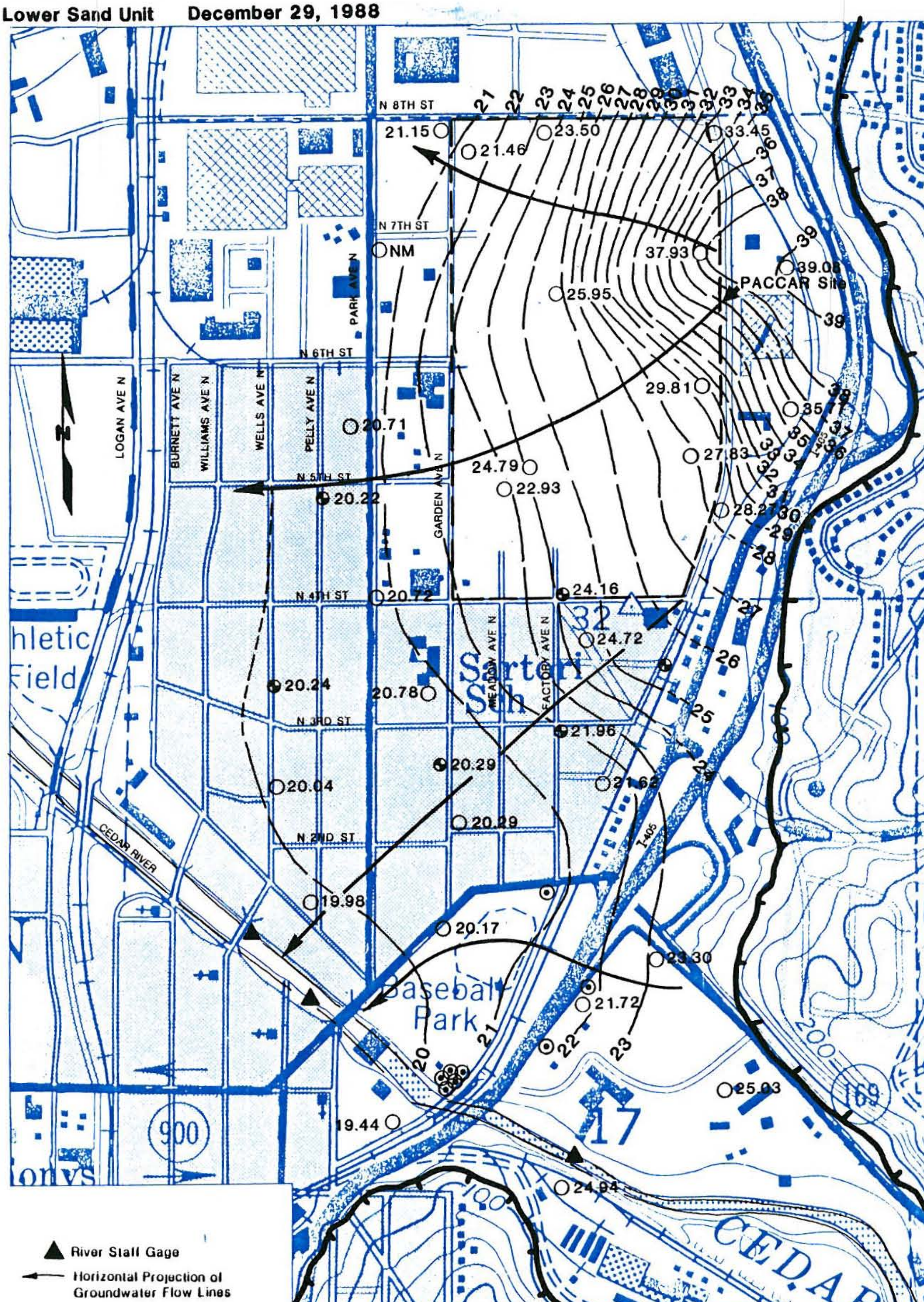
0 500 1000
Scale in Feet

- ○ Monitoring Well
- Piezometer
- City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- ——— Groundwater Divide Approximate Location

HARTCROWSER
J-1639-09 1/89
Figure E-15

Groundwater Elevation Contour Map

Lower Sand Unit December 29, 1988



- ▲ River Staff Gage
- ← Horizontal Projection of Groundwater Flow Lines

Base map prepared from USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000
Scale in Feet

- ○ Monitoring Well
- ⊕ Piezometer
- ⊙ City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- ——— Groundwater Divide Approximate Location

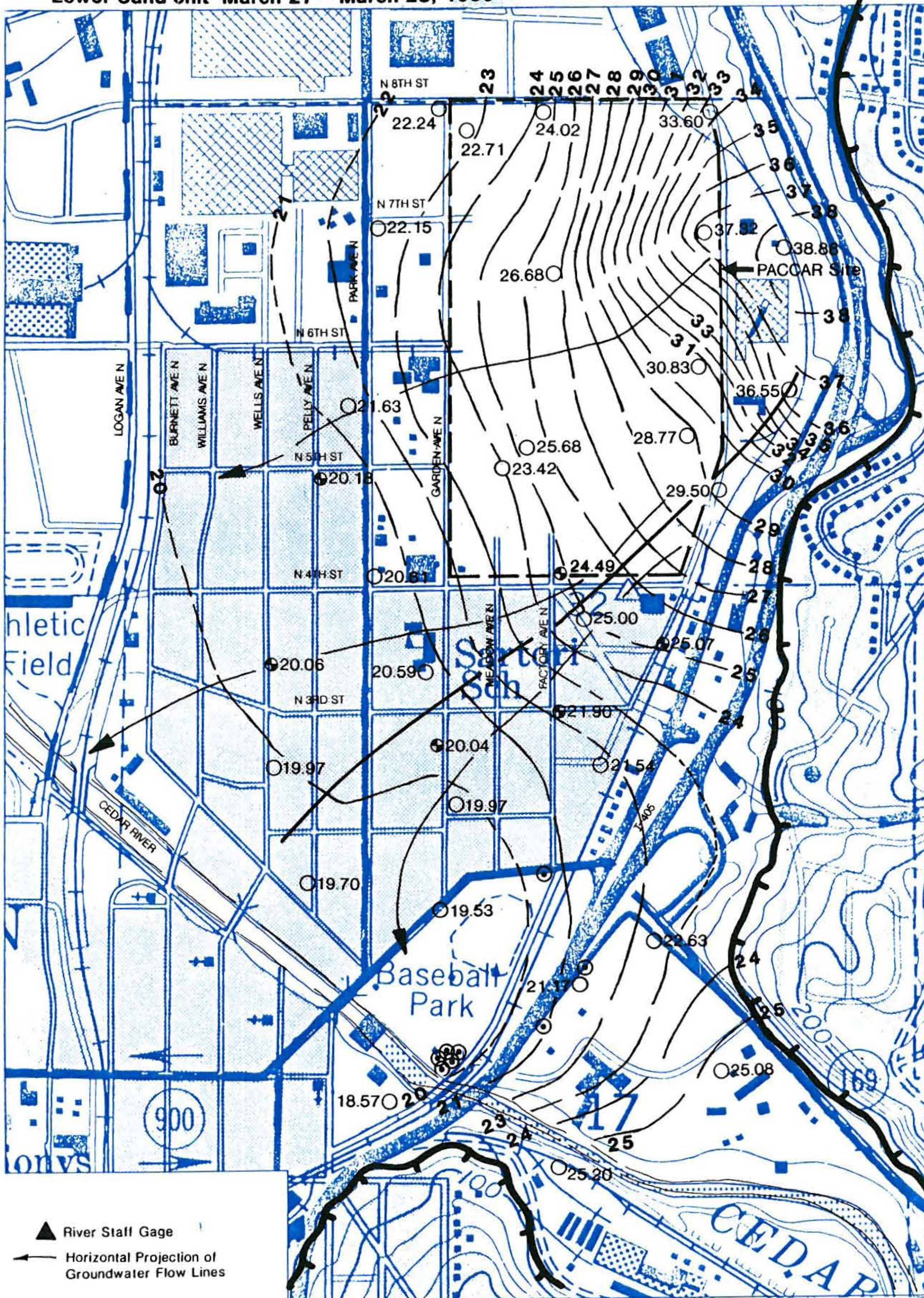
HARTCROWSER

J-1639-09 1/89

Figure E-16

Groundwater Elevation Contour Map

Lower Sand Unit March 27 - March 28, 1989



Base map prepared from USGS 7.5 minute quadrangles of Mercer Island and Renton, Washington.

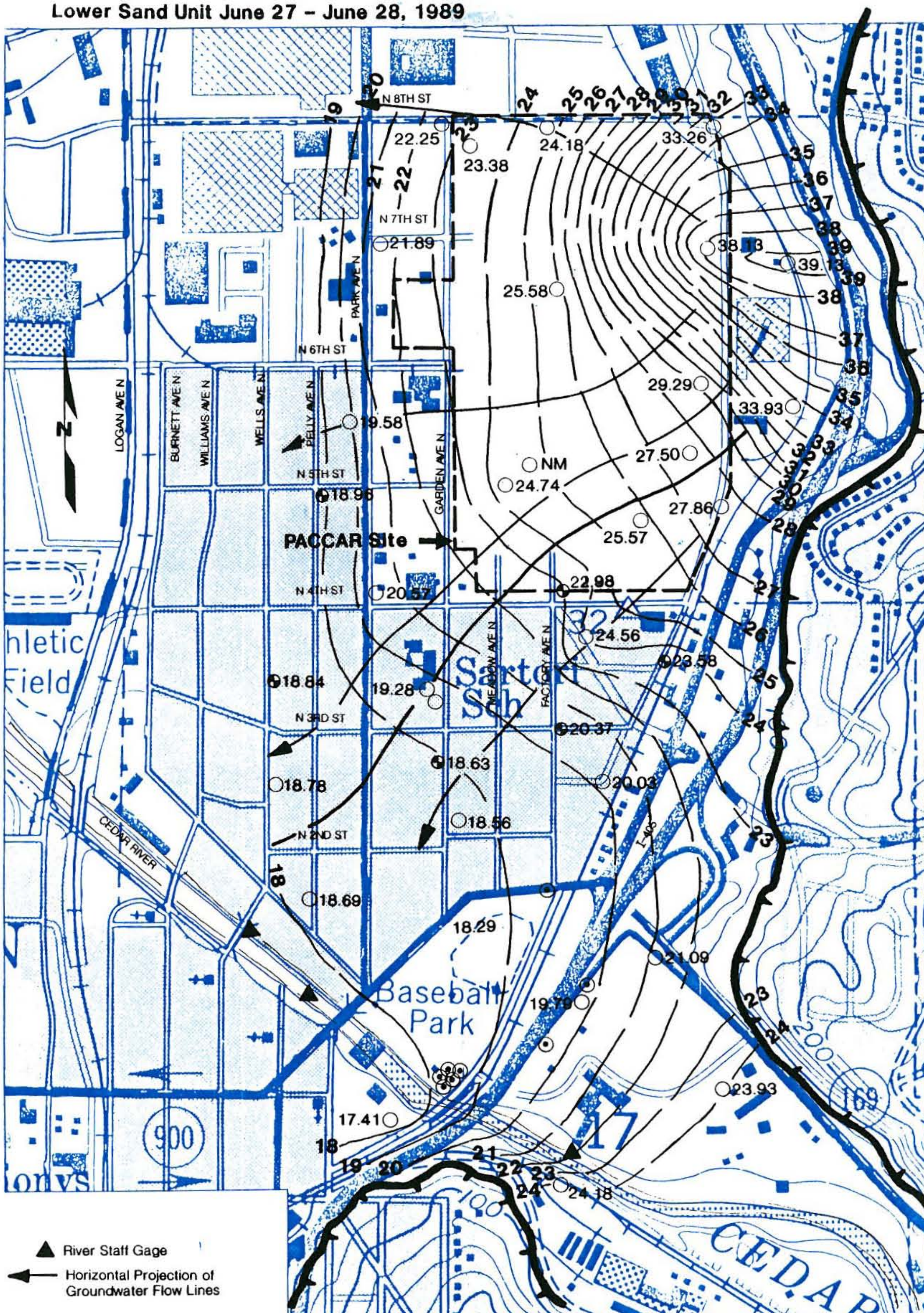
0 500 1000
Scale in Feet

- ○ Monitoring Well
- Piezometer
- City of Renton Production Well
- 19.64 Spot Groundwater Elevation in Feet
- —20— Groundwater Elevation Contour in Feet
- Groundwater Divide Approximate Location

HARTCROWSER
J-1639-09 1/89
Figure E-17

Groundwater Elevation Contour Map

Lower Sand Unit June 27 - June 28, 1989



River Staff Gage

Horizontal Projection of Groundwater Flow Lines

Base map prepared fromm USGS 7.5-minute quadrangles of Mercer Island and Renton, Washington.

0 500 1000

Scale in Feet

Monitoring Well

Piezometer

City of Renton Production Well

17.41 Spot Groundwater Elevation in Feet

20 Groundwater Elevation Contour in Feet

Groundwater Divide Approximate Location

HARTCROWSER

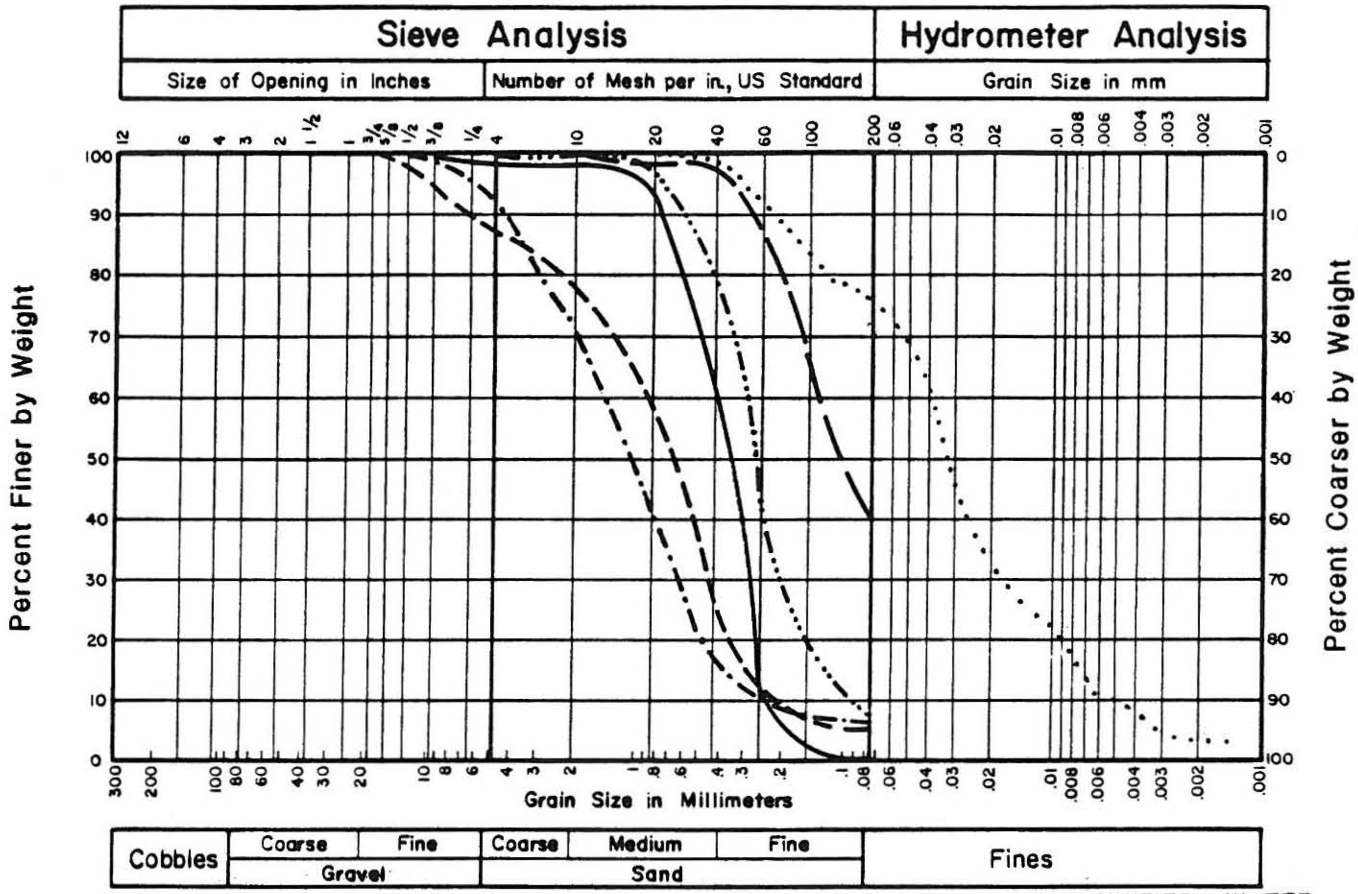
J-1639-09 1/89

Figure E-18

Hart Crowser
J-1639-09

FIGURE E-19
GRAIN SIZE ANALYSES

Grain Size Classification



LINE SYMBOL	BORING NUMBER	SAMPLE NUMBER	DEPTH IN FEET	CLASSIFICATION	UNIFIED SOIL CLASS.	WATER CONTENT PERCENT
———	OSP-1D	S-10	47.5 - 49.5	Medium to fine SAND.	SP	26
— —	OSP-2D	S-2	7.5 - 9.5	Very silty, fine SAND.	SM	27
- - - -	OSP-2D	S-10	47.5 - 49.0	Slightly silty, slightly gravelly SAND.	SP-SM	15
—·—·—	OSP-4D	S-9	42.5 - 44.5	Slightly gravelly, slightly silty SAND.	SP-SM	15
········	OW-5D	S-7	15.0 - 17.0	Sandy SILT.	ML	36
— ··· —	OW-5D	S-14	42.5 - 44.5	Slightly silty, medium to fine SAND.	SP-SM	27

HARTCROWSER
J-1639-09 12/88
Figure E-19

APPENDIX F
DATA VALIDATION
PROCEDURES AND RESULTS

CONTENTS

APPENDIX F
DATA VALIDATION PROCEDURES AND RESULTS
QUALITY ASSURANCE

Quality assurance (QA) refers to a system for ensuring that all information, data, and resulting decisions compiled under a specific task are technically sound, statistically valid, and properly documented. Quality control (QC) is the mechanism through which quality assurance achieves its goals.

Quality control for this project was in accordance with the Work Plan and the United States Environmental Protection Agency (U.S.E.P.A.) Laboratory Validation Functional Guidelines (E.P.A., 1985; 1988; undated). Validation of data obtained from organic, inorganic, and PCBs analyses were conducted separately. Advisory limits and requirements set by the E.P.A. were used to evaluate laboratory data quality.

Accuracy, precision, and completeness were used to quantify the quality of each particular measurement.

Accuracy is the direction and amount by which measurements tend to differ from the true value of the quantity of interest (i.e., a measure of systematic error). Sampling accuracy was evaluated by analysis of field blanks. Laboratory accuracy was evaluated by the recoveries of matrix spikes (MS), matrix spike duplicates (MSD), matrix spike triplicates (MST), analysis of standards, and evaluation of blanks. Acceptable ranges of recoveries were based on Contract Laboratory Program (CLP) and established in-house laboratory control limits, whichever was more conservative.

Precision is the degree of mutual agreement between independent measurements made under prescribed like conditions (i.e., a measure of random error). Sampling precision was evaluated by analysis of replicate field samples from a given location. Laboratory precision was evaluated by analysis of matrix spike (MS), matrix spike duplicates (MSD), and matrix spike triplicates (MST) relative percent differences (RPD).

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions (i.e., a measure of infrequency of total failures). Two approaches were utilized to assess the completeness of this laboratory data set.

The laboratory data validation requirements that were evaluated for each analysis are as follows:

- Sample Holding Time
- Calibration
- Method and Field Blanks
- Spike Recovery (MS, MSD, and MST)
- Surrogate Compounds
- Instrument and Laboratory Quality Control
- Field Replicates
- Rinse Blanks

Hart Crowser
J-1639-09

QUALITY ASSURANCE DATA FOR SOIL ANALYSES
OF SAMPLES COLLECTED IN 1988

Sample Receipt

Two hundred and twenty-nine (229) soil, three (3) water rinse blank and thirty-five (35) aqueous volatile field/trip blank samples were received between the dates of June 17 and August 24, 1988, for a total of two hundred and sixty-seven (267) samples. All samples were received intact and in good condition, with no exceptions.

Laboratory number 10400 was assigned to this project and each individual sample was given a discrete sub-sample number (i.e., 10400-1, 10400-2, etc). The attached Table I details the identification of each sample and the date on which it was received.

There were no discrepancies between sample identification and the chain-of-custody documents, with the following exceptions:

Lab No.	Identification	Comment
10400-29	Field Blank	The chain-of-custody indicated two sample containers, where one sample container was received.
10400-45	P13/HT01-11	This sample was not shown on the chain-of-custody for the date received. The sample was added to the chain-of-custody by the laboratory.
10400-103	S7/HT01-2.5	On the chain-of-custody, the sample column showed identification as S7/HT01-2.5 and the station column indicated identification as R7/HT01. The station column was changed to read S7/HT01 by the laboratory, after consultation with your office.
---	U5/HB01-2.5	This sample was received under chain-of-custody but was not analyzed and was returned to Hart Crowser at your request. No laboratory sample number was assigned.
---	Volatile Blank	This sample was shown on the chain-of-custody with N5/HB01-5, but was not received.

Four volatile organics (VOA) field blanks were not analyzed because either another field blank was received on the same date or there were no VOA analyses requested for the associated samples. The VOA blanks which were held without analysis were:

Lab No.	Identification	Comment
10400-29	Field Blank	Another VOA blank was received on the same date.
10400-33	Field Blank	No VOA analysis requested on associated samples.
10400-153	Volatile Blank	No VOA analysis requested on associated samples.
10400-161	Volatile Blank	No VOA analysis requested on associated samples.

The samples were held in cold storage at 4°C until removed for preparation and/or analysis.

Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
Interim Report #1									
10400	1	B9/HT01	2	soil	06/17/88	06/17/88	06/27/88	1.1	NA
10400	2	E7/HT01	2.5	soil	06/17/88	06/17/88	06/27/88	1.1	NA
10400	3	Q5/HT01	4	soil	06/17/88	06/17/88	06/27/88	1.1	NA
Interim Report #2									
10400	4	C1/HT01	9	soil	06/27/88	06/28/88	07/11/88	2	STOP
10400	5	C3/HT01	1	soil	06/27/88	06/28/88	07/11/88	2	2.1
10400	6	C5/HT01	4	soil	06/27/88	06/28/88	07/11/88	1.4	1.4.1
10400	7	C7/HT01	1.5	soil	06/27/88	06/28/88	07/11/88	2	STOP
10400	8	C9/HT01	8	soil	06/27/88	06/28/88	07/11/88	1.3	NA
10400	9	A11/HT01	4	soil	06/28/88	06/29/88	07/11/88	1.2	NA
10400	10	B11/HT01	8	soil	06/28/88	06/29/88	07/11/88	2	2.1
10400	11	C11/HT01	4	soil	06/28/88	06/29/88	07/11/88	1.4	1.4.1
10400	12	D11/HT01	1.5	soil	06/28/88	06/29/88	07/11/88	1.4	1.4.1
10400	13	E11/HT01	4	soil	06/28/88	06/29/88	07/11/88	1.1	NA
10400	14	B12/HT01	5	soil	06/28/88	06/29/88	07/11/88	2	STOP
10400	15			water		06/29/88	07/11/88	VOA FB	NA
10400	16	F11/HT01	5	soil	06/29/88	06/30/88	07/11/88	2	STOP
10400	17	G11/HT01	7	soil	06/29/88	06/30/88	07/11/88	2	STOP
10400	18	H11/HT01	5.5	soil	06/29/88	06/30/88	07/11/88	1.1	NA
10400	19	I11/HT01	2	soil	06/29/88	06/30/88	07/11/88	1.4	1.4.1
10400	20	J12/HT01	6.5	soil	06/29/88	06/30/88	07/11/88	1.3	NA
10400	21			water		06/30/88	07/11/88	VOA FB	NA
10400	22	C12/HT01	2	soil	06/30/88	07/01/88	07/11/88	2	2.1
10400	23	D12/HT01	7	soil	06/30/88	07/01/88	07/11/88	2	2.1
10400	24	C13/HT01	4	soil	06/30/88	07/01/88	07/11/88	2	STOP
10400	25	D13/HT01	3	soil	06/30/88	07/01/88	07/11/88	2	STOP
10400	26	F13/HT01	8	soil	06/30/88	07/01/88	07/11/88	1.3	NA
10400	27	Spoon	RinseB	water	06/30/88	07/01/88	07/11/88	1.1 mod	NA
10400	28	PACCAR	TB	water		07/01/88	07/11/88	VOA TB	NA
10400	29	PACCAR	FB	water		07/01/88	07/11/88	VOA FB	NA
Interim Report #3									
10400	30	H13/HT01	2	soil	07/01/88	07/05/88	07/18/88	2	STOP
10400	31	H12/HT01	4	soil	07/01/88	07/05/88	07/18/88	1.4	STOP
10400	32	F12/HT01	3	soil	07/01/88	07/05/88	07/18/88	2	STOP
10400	33	Field Blk	FB	water		07/05/88	07/18/88	VOA FB	NA
10400	34	J13/HT01	6	soil	07/05/88	07/06/88	07/18/88	1.4	STOP
10400	35	L12/HT01	2	soil	07/05/88	07/06/88	07/18/88	1.4	STOP
10400	36	L13/HT01	9	soil	07/05/88	07/06/88	07/18/88	2	STOP
10400	37	N12/HT01	4	soil	07/05/88	07/06/88	07/18/88	1.3	NA
10400	38	N13/HT01	3	soil	07/05/88	07/06/88	07/18/88	1.3	NA
10400	39	Field Blk	FB	water		07/06/88	07/18/88	VOA FB	NA
10400	40	R12/HT01	3	soil	07/06/88	07/07/88	07/18/88	2	2.1
10400	41	P12/HT01	7	soil	07/06/88	07/07/88	07/18/88	2	STOP
10400	42	P13/HT01	5	soil	07/06/88	07/07/88	07/18/88	1.3	NA
10400	43	T13/HT01	2	soil	07/06/88	07/07/88	07/18/88	1.4	STOP
10400	44	R13/HT01	6	soil	07/06/88	07/07/88	07/18/88	1.4	1.4.1
10400	45	P13/HT01	11	soil	07/06/88	07/07/88	07/18/88	1.3	NA

Table I: Sample Identification (page 1 of 6)

Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
10400	46	Field Blk	FB	water		07/07/88	07/18/88	VOA FB	NA
10400	47	D1/HT01	5	soil	07/07/88	07/08/88	07/18/88	2	2.1
10400	48	D3/HT01	3	soil	07/07/88	07/08/88	07/18/88	1.3	NA
10400	49	D5/HT01	4	soil	07/07/88	07/08/88	07/18/88	1.3	NA
10400	50	V13/HT01	6	soil	07/07/88	07/08/88	07/18/88	2	STOP
10400	51	V12/HT01	6	soil	07/07/88	07/08/88	07/18/88	2	STOP
10400	52	Vol. Blk	FB	water		07/08/88	07/18/88	VOA FB	NA
Interim Report #4									
10400	53	A9/HT01	7	soil	07/08/88	07/11/88	07/25/88	2	STOP
10400	54	A7/HT01	2	soil	07/08/88	07/11/88	07/25/88	2	STOP
10400	55	A5/HT01	4	soil	07/08/88	07/11/88	07/25/88	1.3	NA
10400	56	B7/HT01	7	soil	07/08/88	07/11/88	07/25/88	2	STOP
10400	57	B5/HT01	3	soil	07/08/88	07/11/88	07/25/88	1.3	NA
10400	58	Vol. Blk	FB	water		07/11/88	07/25/88	VOA FB	NA
10400	59	A1/HT01	9	soil	07/11/88	07/12/88	07/25/88	2	2.1
10400	60	A3/HT01	5	soil	07/11/88	07/12/88	07/25/88	1.1	NA
10400	61	A3/HT01	11	soil	07/11/88	07/12/88	07/25/88	1.1	NA
10400	62	D7/HT01	7	soil	07/11/88	07/12/88	07/25/88	2	STOP
10400	63	E5/HT01	8	soil	07/11/88	07/12/88	07/25/88	2	STOP
10400	64	E6/HT01	2	soil	07/11/88	07/12/88	07/25/88	1.1	NA
10400	65	E8/HT01	4	soil	07/11/88	07/12/88	07/25/88	2	STOP
10400	66	VOA Blank	FB	water		07/12/88	07/25/88	VOA FB	NA
10400	67	D9/HT01	5	soil	07/12/88	07/13/88	07/25/88	2	2.1
10400	68	D9/HT01	11	soil	07/12/88	07/13/88	07/25/88	2	STOP
10400	69	F3/HT01	4	soil	07/12/88	07/13/88	07/25/88	1.3	NA
10400	70	F4/HT01	8	soil	07/12/88	07/13/88	07/25/88	2	STOP
10400	71	F5/HT01	5	soil	07/12/88	07/13/88	07/25/88	1.2	NA
10400	72	G3/HT01	4	soil	07/12/88	07/13/88	07/25/88	1.3	NA
10400	73	Spoon	RinseB	water	07/12/88	07/13/88	07/25/88	1.1 mod	NA
10400	74	Vol. Blk	FB	water		07/13/88	07/25/88	VOA FB	NA
10400	75	H1/HT01	1	soil	07/13/88	07/14/88	07/25/88	1.3	NA
10400	76	H1/HT01	11	soil	07/13/88	07/14/88	07/25/88	1.3	NA
10400	77	H6/HT01	7	soil	07/13/88	07/14/88	07/25/88	2	STOP
10400	78	H7/HT01	1	soil	07/13/88	07/14/88	07/25/88	1.4	1.4.1
10400	79	F1/HT01	2	soil	07/13/88	07/14/88	07/25/88	1.4	1.4.1
10400	80	F8/HT01	2	soil	07/13/88	07/14/88	07/25/88	1.3	NA
10400	81	G7/HT01	4	soil	07/13/88	07/14/88	07/25/88	1.3	NA
10400	82	Field Blk	FB	water		07/14/88	07/25/88	VOA FB	NA
10400	83	E10/HT01	4	soil	07/14/88	07/15/88	07/25/88	1.3	NA
10400	84	F9/HT01	7	soil	07/14/88	07/15/88	07/25/88	1.3	NA
10400	85	G10/HT01	3	soil	07/14/88	07/15/88	07/25/88	1.4	1.4.1
10400	86	J11/HT01	7	soil	07/14/88	07/15/88	07/25/88	2	2.1
10400	87	K11/HT01	2	soil	07/14/88	07/15/88	07/25/88	1.1	NA
10400	88	H10/HT01	7	soil	07/14/88	07/15/88	07/25/88	2	STOP
10400	89	Field Blk	FB	water		07/15/88	07/25/88	VOA FB	NA
Interim Report #5									
10400	90	K3/HT01	4	soil	07/15/88	07/18/88	08/01/88	2	2.1
10400	91	L3/HT01	2	soil	07/15/88	07/18/88	08/01/88	1.4	1.4.1

Table I: Sample Identification (page 2 of 6)

Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
10400	92	M3/HT01	2	soil	07/15/88	07/18/88	08/01/88	1.4	1.4.1
10400	93	K4/HT01	7	soil	07/15/88	07/18/88	08/01/88	2	STOP
10400	94	J4/HT01	2	soil	07/18/88	07/19/88	08/01/88	1.4	1.4.1
10400	95	L4/HT01	3.5	soil	07/18/88	07/19/88	08/01/88	2	STOP
10400	96	M4/HT01	8	soil	07/18/88	07/19/88	08/01/88	2	STOP
10400	97	N4/HT01	5	soil	07/18/88	07/19/88	08/01/88	1.3	NA
10400	98	P11/HT01	2	soil	07/18/88	07/19/88	08/01/88	1.1	NA
10400	99	I5/HT01	8	soil	07/18/88	07/19/88	08/01/88	2	STOP
10400	100	Field Blk	FB	water		07/19/88	08/01/88	VOA FB	NA
10400	101	M11/HT01	7	soil	07/19/88	07/20/88	08/01/88	2	STOP
10400	102	R5/HT01	7	soil	07/19/88	07/20/88	08/01/88	1.1	NA
10400	103	S7/HT01	4	soil	07/19/88	07/20/88	08/01/88	2	2.1
10400	104	T7/HT01	7	soil	07/19/88	07/20/88	08/01/88	2	STOP
10400	105	U7/HT01	1	soil	07/19/88	07/20/88	08/01/88	1.4	1.4.1
10400	106	Field Blk	FB	water		07/20/88	08/01/88	VOA FB	NA
10400	107	G8/HB01	5	soil	07/21/88	07/22/88	08/01/88	2	STOP
10400	108	H8/HB01	0.9	soil	07/21/88	07/22/88	08/01/88	1.3	NA
10400	109	I8/HB01	5	soil	07/21/88	07/22/88	08/01/88	1.3	NA
10400	110	J8/HB01	0.7	soil	07/21/88	07/22/88	08/01/88	1.1	NA
10400	111	K8/HB01	5	soil	07/21/88	07/22/88	08/01/88	2	STOP
10400	112	K7/HB01	3.5	soil	07/21/88	07/22/88	08/01/88	1.4	STOP
10400	113	Trip Blk	FB	water		07/22/88	08/01/88	VOA TB	NA
Interim Report #6									
10400	114	G6/HB01	0.1	soil	07/22/88	07/25/88	08/08/88	1.4	1.4.1
10400	115	I6/HB01	5.0	soil	07/22/88	07/25/88	08/08/88	2	2.1
10400	116	F7/HB01	7.5	soil	07/22/88	07/25/88	08/08/88	2	STOP
10400	117	I4/HB01	2.5	soil	07/22/88	07/25/88	08/08/88	2	2.1
10400	118	J5/HB01	2.5	soil	07/22/88	07/25/88	08/08/88	1.1	NA
10400	119	G9/HB01	0.7	soil	07/22/88	07/25/88	08/08/88	2	STOP
10400	120	I7/HB01	2.5	soil	07/22/88	07/25/88	08/08/88	1.3	NA
10400	121	J7/HB01	5.0	soil	07/22/88	07/25/88	08/08/88	2	STOP
10400	122	Vol. Blk	FB	water		07/25/88	08/08/88	VOA FB	NA
10400	123	F10/HB01	0.7	soil	07/25/88	07/26/88	08/08/88	1.3	NA
10400	124	H9/HB01	5	soil	07/25/88	07/26/88	08/08/88	2	STOP
10400	125	J6/HB01	0.5	soil	07/25/88	07/26/88	08/08/88	1.4	1.4.1
10400	126	K6/HB01	7.5	soil	07/25/88	07/26/88	08/08/88	2	2.1
10400	127	M6/HB01	0.6	soil	07/25/88	07/26/88	08/08/88	2	2.1
10400	128	Vol. Blk	FB	water		07/26/88	08/08/88	VOA FB	NA
10400	129	J1/HB01	7.5	soil	07/26/88	07/27/88	08/08/88	1.3	NA
10400	130	L1/HB01	5.0	soil	07/26/88	07/27/88	08/08/88	1.2	NA
10400	131	L1/HB01	11.0	soil	07/26/88	07/27/88	08/08/88	1.2	NA
10400	132	K5/HB01	0.5	soil	07/26/88	07/27/88	08/08/88	1.4	1.4.1
10400	133	L5/HB01	5.0	soil	07/26/88	07/27/88	08/08/88	2	STOP
10400	134	M5/HB01	7.5	soil	07/26/88	07/27/88	08/08/88	1.3	NA
10400	135	Vol. Blk	FB	water		07/27/88	08/08/88	VOA FB	NA
10400	136	H5/HB01	0.3	soil	07/27/88	07/28/88	08/08/88	1.3	NA
10400	137	F6/HB01	5	soil	07/27/88	07/28/88	08/08/88	1.1	NA
10400	138	G5/HB01	7.5	soil	07/27/88	07/28/88	08/08/88	1.1	NA

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Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
10400	139	H4/HB01	7.5	soil	07/27/88	07/28/88	08/08/88	2	STOP
10400	140	I3/HB01	0.5	soil	07/27/88	07/28/88	08/08/88	1.3	NA
10400	141	J3/HB01	5	soil	07/27/88	07/28/88	08/08/88	1.2	NA
10400	142	06/HB01	0.5	soil	07/27/88	07/28/88	08/08/88	1.3	NA
10400	143	Spoon	RinseB	water	07/27/88	07/28/88	08/08/88	1.1 mod	NA
10400	144	Vol. Blk	FB	water		07/28/88	08/08/88	VOA FB	NA
10400	145	G4/HB01	0.3	soil	07/28/88	07/29/88	08/08/88	1.2	NA
10400	146	H3/HB01	5	soil	07/28/88	07/29/88	08/08/88	2	STOP
10400	147	W7/HB01	2.5	soil	07/28/88	07/29/88	08/08/88	1.2	NA
10400	148	V7/HB01	5	soil	07/28/88	07/29/88	08/08/88	2	2.1
10400	149	W5/HB01	7.5	soil	07/28/88	07/29/88	08/08/88	1.2	NA
10400	150	W3/HB01	0.2	soil	07/28/88	07/29/88	08/08/88	2	2.1
10400	151	V3/HB01	2.5	soil	07/28/88	07/29/88	08/08/88	1.2	NA
10400	152	V5/HB01	0.2	soil	07/28/88	07/29/88	08/08/88	2	2.1
10400	153	Vol. Blk	FB	water		07/29/88	08/08/88	VOA FB	NA
Interim Report #7									
10400	154	I9/HB01	0.4	soil	07/29/88	08/01/88	08/15/88	1.4	1.4.1
10400	155	J9/HB01	5	soil	07/29/88	08/01/88	08/15/88	2	2.1
10400	156	K9/HB01	7.5	soil	07/29/88	08/01/88	08/15/88	2	STOP
10400	157	L9/HB01	0.5	soil	07/29/88	08/01/88	08/15/88	1.2	NA
10400	158	L10/HB01	2.5	soil	07/29/88	08/01/88	08/15/88	2	2.1
10400	159	M9/HB01	5	soil	07/29/88	08/01/88	08/15/88	1.2	NA
10400	160	N9/HB01	2.5	soil	07/29/88	08/01/88	08/15/88	2	STOP
10400	161	Vol. Blk	FB	water		08/01/88	08/15/88	VOA FB	NA
10400	162	I10/HB01	2.5	soil	08/01/88	08/02/88	08/15/88	1.4	STOP
10400	163	M10/HB01	0.6	soil	08/01/88	08/02/88	08/15/88	1.1	NA
10400	164	N10/HB01	7.5	soil	08/01/88	08/02/88	08/15/88	2	STOP
10400	165	010/HB01	2.5	soil	08/01/88	08/02/88	08/15/88	2	2.1
10400	166	09/HB01	0.7	soil	08/01/88	08/02/88	08/15/88	2	2.1
10400	167	Vol. Blk	FB	water		08/02/88	08/15/88	VOA FB	NA
10400	168	Q9/HB01	2.5	soil	08/02/88	08/03/88	08/15/88	1.1	NA
10400	169	R9/HB01	0.4	soil	08/02/88	08/03/88	08/15/88	1.3	NA
10400	170	S9/HB01	7.5	soil	08/02/88	08/03/88	08/15/88	1.2	NA
10400	171	N8/HB01	0.6	soil	08/02/88	08/03/88	08/15/88	1.4	1.4.1
10400	172	08/HB01	5	soil	08/02/88	08/03/88	08/15/88	1.3	NA
10400	173	P8/HB01	7.5	soil	08/02/88	08/03/88	08/15/88	2	STOP
10400	174	Vol. Blk	FB	water		08/03/88	08/15/88	VOA FB	NA
10400	175	N1/HB01	0.6	soil	08/03/88	08/04/88	08/15/88	1.4	1.4.1
10400	176	P1/HB01	5	soil	08/03/88	08/04/88	08/15/88	2	2.1
10400	177	R1/HB01	2.5	soil	08/03/88	08/04/88	08/15/88	2	2.1
10400	178	R1/HB01	11	soil	08/03/88	08/04/88	08/15/88	2	2.1
10400	179	U1/HB01	7.5	soil	08/03/88	08/04/88	08/15/88	1.1	NA
10400	180	V1/HB01	0.3	soil	08/03/88	08/04/88	08/15/88	1.4	1.4.1
10400	181	03/HB01	7.5	soil	08/03/88	08/04/88	08/15/88	1.2	NA
10400	182	Vol. Blk	FB	water		08/04/88	08/15/88	VOA FB	NA
10400	183	N2/HB01	2.5	soil	08/04/88	08/05/88	08/15/88	1.4	1.4.1
10400	184	N3/HB01	7.5	soil	08/04/88	08/05/88	08/15/88	1.2	NA
10400	185	N3/HB01	11	soil	08/04/88	08/05/88	08/15/88	1.2	NA

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Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
10400	186	P3/HB01	5	soil	08/04/88	08/05/88	08/15/88	1.3	NA
10400	187	O4/HB01	1.5	soil	08/04/88	08/05/88	08/15/88	1.1	NA
10400	188	P4/HB01	2.5	soil	08/04/88	08/05/88	08/15/88	2	STOP
10400	189	S2/HB01	1.2	soil	08/04/88	08/05/88	08/15/88	1.4	1.4.1
10400	190	T2/HB01	2.5	soil	08/04/88	08/05/88	08/15/88	1.3	NA
10400	191	T3/HB01	7.5	soil	08/04/88	08/05/88	08/15/88	1.1	NA
10400	192	Vol. Blk	FB	water		08/05/88	08/15/88	VOA FB	NA
Interim Report #8									
10400	193	R4/HB01	0.5	soil	08/05/88	08/08/88	08/22/88	1.1	NA
10400	194	S4/HB01	2.5	soil	08/05/88	08/08/88	08/22/88	2	STOP
10400	195	T4/HB01	7.5	soil	08/05/88	08/08/88	08/22/88	2	STOP
10400	196	P5/HB01	5	soil	08/05/88	08/08/88	08/22/88	2	STOP
10400	197	S5/HB01	0.1	soil	08/05/88	08/08/88	08/22/88	1.4	1.4.1
10400	198	T5/HB01	0.4	soil	08/05/88	08/08/88	08/22/88	1.4	1.4.1
10400	199	R6/HB01	0.2	soil	08/05/88	08/08/88	08/22/88	1.4	1.4.1
10400	200	P6/HB01	0.5	soil	08/05/88	08/08/88	08/22/88	1.1	NA
10400	201	Vol. Blk	FB	water		08/08/88	08/22/88	VOA FB	NA
10400	202	Q4/HB01	7.5	soil	08/08/88	08/09/88	08/22/88	2	2.1
10400	203	Q6/HB01	3	soil	08/08/88	08/09/88	08/22/88	2	2.1
10400	204	Q7/HB01	5	soil	08/08/88	08/09/88	08/22/88	1.1	NA
10400	205	Q8/HB01	1	soil	08/08/88	08/09/88	08/22/88	1.1	NA
10400	206	Q10/HB01	7.5	soil	08/08/88	08/09/88	08/22/88	2	STOP
10400	207	Q11/HB01	5	soil	08/08/88	08/09/88	08/22/88	1.2	NA
10400	208	Vol. Blk	FB	water		08/09/88	08/22/88	VOA FB	NA
10400	209	L11/HB01	2.5	soil	08/09/88	08/10/88	08/22/88	1.1	NA
10400	210	N11/HB01	5	soil	08/09/88	08/10/88	08/22/88	2	STOP
10400	211	R11/HB01	7.5	soil	08/09/88	08/10/88	08/22/88	2	STOP
10400	212	T11/HB01	1	soil	08/09/88	08/10/88	08/22/88	1.4	1.4.1
10400	213	V11/HB01	7.5	soil	08/09/88	08/10/88	08/22/88	1.3	NA
10400	214	W11/HB01	2	soil	08/09/88	08/10/88	08/22/88	1.4	STOP
10400	215	T12/HB01	5	soil	08/09/88	08/10/88	08/22/88	2	STOP
10400	216	W12/HB01	7.5	soil	08/09/88	08/10/88	08/22/88	1.2	NA
10400	217	S8/HB01	2.5	soil	08/09/88	08/10/88	08/22/88	1.3	NA
10400	218	S8/HB01	11	soil	08/09/88	08/10/88	08/22/88	1.3	NA
10400	219	T8/HB01	1.2	soil	08/09/88	08/10/88	08/22/88	1.3	NA
10400	220	Q2/HB01	2	soil	08/09/88	08/10/88	08/22/88	1.4	1.4.1
10400	221	V9/HB01	0.6	soil	08/09/88	08/10/88	08/22/88	1.4	1.4.1
10400	222	W9/HB01	7.5	soil	08/09/88	08/10/88	08/22/88	2	STOP
10400	223	Vol. Blk	FB	water		08/10/88	08/22/88	VOA FB	NA
10400	224	P10/HB01	1	soil	08/10/88	08/11/88	08/22/88	1.1	NA
10400	225	P9/HB01	7.5	soil	08/10/88	08/11/88	08/22/88	1.2	NA
10400	226	P9/HB01	11	soil	08/10/88	08/11/88	08/22/88	1.2	NA
10400	227	O5/HB01	2.5	soil	08/10/88	08/11/88	08/22/88	1.3	NA
10400	228	P2/HB01	1.9	soil	08/10/88	08/11/88	08/22/88	1.4	1.4.1
10400	229	L7/HB01	0.6	soil	08/10/88	08/11/88	08/22/88	1.4	1.4.1
10400	230	M7/HB01	5	soil	08/10/88	08/11/88	08/22/88	2	STOP
10400	231	N7/HB01	2.5	soil	08/10/88	08/11/88	08/22/88	1.4	STOP
10400	232	O7/HB01	7.5	soil	08/10/88	08/11/88	08/22/88	2	STOP

Table I: Sample Identification (page 5 of 6)

Lab Number	Sample Number	HC Station	Depth	Matrix	Date Sampled	Date Rec'd	Interim Due Date	Initial Request	Follow-up Request
10400	233	Vol. Blk	FB	water		08/11/88	08/22/88	VOA FB	NA
10400	234	U2/HB01	5	soil	08/11/88	08/12/88	08/22/88	1.1	NA
10400	235	B1/HB01	0.2	soil	08/11/88	08/12/88	08/22/88	1.4	1.4.1
10400	236	B3/HB01	2.5	soil	08/11/88	08/12/88	08/22/88	1.1	NA
10400	237	A12/HB01	0.2	soil	08/11/88	08/12/88	08/22/88	2	STOP
10400	238	A13/HB01	7.5	soil	08/11/88	08/12/88	08/22/88	1.2	NA
10400	239	B13/HB01	0.2	soil	08/11/88	08/12/88	08/22/88	2	2.1
10400	240	Vol. Blk	FB	water		08/12/88	08/22/88	VOA FB	NA
Interim Report #9									
10400	241	L6/HB01	2.5	soil	08/12/88	08/15/88	08/29/88	2	STOP
10400	242	N6/HB01	7.5	soil	08/12/88	08/15/88	08/29/88	2	2.1
10400	243	M8/HB01	0.7	soil	08/12/88	08/15/88	08/29/88	1.1	NA
10400	244	L8/HB01	7.5	soil	08/12/88	08/15/88	08/29/88	2	STOP
10400	245	L8/HB01	11	soil	08/12/88	08/15/88	08/29/88	2	STOP
10400	246	E9/HB01	1.1	soil	08/12/88	08/15/88	08/29/88	1.4	1.4.1
10400	247	Vol. Blk	FB	water		08/15/88	08/29/88	VOA FB	NA
10400	248	R2/HB01	7.5	soil	08/15/88	08/16/88	08/29/88	2	2.1
10400	249	Q3/HB01	0.5	soil	08/15/88	08/16/88	08/29/88	1.4	1.4.1
10400	250	R3/HB01	2.5	soil	08/15/88	08/16/88	08/29/88	1.3	NA
10400	251	S3/HB01	7.5	soil	08/15/88	08/16/88	08/29/88	2	STOP
10400	252	O2/HB01	5	soil	08/15/88	08/16/88	08/29/88	2	STOP
10400	253	R10/HB01	5	soil	08/15/88	08/16/88	08/29/88	1.3	NA
10400	254	T9/HB01	5	soil	08/15/88	08/16/88	08/29/88	2	STOP
10400	255	Vol. Blk	FB	water		08/16/88	08/29/88	VOA FB	NA
10400	256	O11/HB01	7.5	soil	08/16/88	08/17/88	08/29/88	2	STOP
10400	257	R8/HB01	5	soil	08/16/88	08/17/88	08/29/88	1.3	NA
10400	258	R8/HB01	11	soil	08/16/88	08/17/88	08/29/88	1.3	NA
10400	259	S6/HB01	7.5	soil	08/16/88	08/17/88	08/29/88	2	STOP
10400	260	T6/HB01	5	soil	08/16/88	08/17/88	08/29/88	1.4	STOP
10400	261	Vol. Blk	FB	water		08/17/88	08/29/88	VOA FB	NA
10400	262	U3/HB01	0.0	soil	08/17/88	08/18/88	08/29/88	2	2.1
10400	263	P7/HB01	0.7	soil	08/17/88	08/18/88	08/29/88	1.4	1.4.1
10400	264	R7/HB01	0.6	soil	08/17/88	08/18/88	08/29/88	1.1	NA
10400	265	M1/HB01	2.5	soil	08/17/88	08/18/88	08/29/88	2	2.1
10400	266	Vol. Blk	FB	water		08/18/88	08/29/88	VOA FB	NA
10400	267	N5/HB01	5	soil	08/24/88	08/24/88	08/31/88	1.3	NA

Table I: Sample Identification (page 6 of 6)

Methods of Analysis

Samples were analyzed as specified in the Laboratory Work Order of June 15, 1988.

Specific methods of analysis employed are shown on each sample result page. Two letter codes are used to indicate the volumes from which test methods are drawn. These codes are defined as shown below:

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986.

EP = Methods for Chemical Analysis of Water and Wastes, U.S.E.P.A., March, 1983.

LX = A Laucks Testing Laboratories in-house method or modification of a previously published method. LX methods are described below.

Laucks Testing Laboratories Methods

SM1: A modification of SW 3550. Sample which has been dried at 105°C is used, rather than as-received sample; some of the volumes of reagents vary; and digestion times vary.

SM3: A modification of SW 7061. The dried sample is digested directly, rather than digesting an aliquot of a previous digestion.

EP-3 A modification of SW 3010. The volume is reduced only once during digestion. Both are HNO_3 and HCl digestions.

WM1: A modification of SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM3-A: Modification of Standard Methods 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI and Laucks uses preserved, not digested, sample.

GC/FID: Screens are a method of analysis intended to give a generally qualitative view of what can be extracted from a sample using an organic solvent.

Extraction for this screen analysis is performed employing methods SW 3510 (water) or SW 3550 (soil), Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986. If there is a possiblity that further analysis will be performed on the residue (for example, confirmation by gas chromatography/mass spectrometry), the appropriate surrogate compounds are added to the extract.

The residue produced from the extraction is injected into a gas chromatograph fitted with a flame ionization detector. The column type and temperature program used are sufficient to elute each of the compounds of interest, usually within forty-five minutes. This is adequate time for all acid/base/neutral organic priority pollutant compounds to elute from the GC system.

The resulting chromatograph is then quantified by summing the response, usually from eight to forty-eight minutes. The response contributed by each of the surrogate compounds, if any were added, is subtracted. The summed response is then calculated against the response of a chosen standard, in this case phenanthrene, and reported as phenanthrene response. Chromatograms are printed on similar scales for comparison purposes.

Reporting Conventions

The following abbreviations appear in these reports:

MDL = Method Detection Limit

SDL = Sample Detection Limit This figure can vary from sample to sample, dependent on sample size, matrix interferences, dry weight, etc.

CRDL = Contract Recommended Detection Limit.

RE = Reported values are the results for a re-extracted and/or re-analyzed sample.

Sample results may be flagged with a one-letter code designed to provide additional information about the analysis or the value reported. The flags employed are defined below. Where no flag is present, the analyte was detected and the value reported is the measured concentration.

U = The analyte was not detected. The value reported is the greater of the SDL or the CRDL, if any.

B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. (If the sample result is U flagged, no B flag is applied.)

D = The value reported is based on analysis of a diluted sample or extract. The dilution was made to bring another compound of interest within linear range or because of matrix effect.

X = The value reported has been blank corrected. If blank correction yields a value which is U flagged, no X flag is shown.

J = The analyte was detected at a concentration below the Method Detection Limit (MDL), but at a level deemed of sufficient analytical significance to warrent its use for blank correction purposes. For this project, this effect is specific to the Total Petroleum Hydrocarbon (TPH) method blank analysis.

E = The reported value is qualified and should be considered an estimate. Comments on reasons for this qualification appear in the Quality Control Report accompanying these test results. (This is equivalent to the Functional Guidelines "J" flag.)

R = The flagged data point is not useable, for reasons discussed in the Quality Control Report.

By convention, if an analyte is not detected and if the SDL is less than the CRDL, the CRDL value is reported with a U flag. The implication is that no analyte was detected at the SDL level either. If the SDL is larger than the CRDL, it becomes the value which is U flagged.

Analytical History

Dates of analysis for every preparation and analytical procedure are shown on the data sheets provided for each sample. In addition, this information is summarized in attached Table II for all samples.

Any preparation or analytical procedure performed outside of holding times is marked (*) and appropriate comments appear in the Quality Control narrative included with this report.

Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Total Petroleum Hydrocarbons Prep.	Total Petroleum Hydrocarbons Anal.	Total Arsenic Prep.	Total Arsenic Anal.
Interim Report #1									
10400	1	B9/HT01	2	06/17/88	06/20/88	06/24/88	06/27/88	06/21/88	06/27/88
10400	2	E7/HT01	2.5	06/17/88	06/20/88	06/24/88	06/27/88	06/21/88	06/27/88
10400	3	Q5/HT01	4	06/17/88	06/20/88	06/24/88	06/27/88	06/21/88	06/27/88
Interim Report #2									
10400	4	C1/HT01	9	06/27/88	06/30/88	06/29/88	06/30/88	07/04/88	07/06/88
10400	5	C3/HT01	1	06/27/88	06/30/88	06/29/88	06/30/88	07/04/88	07/06/88
10400	6	C5/HT01	4	06/27/88	06/30/88	06/29/88	06/30/88	07/04/88	07/06/88
10400	7	C7/HT01	1.5	06/27/88	06/30/88	06/29/88	06/30/88	07/04/88	07/06/88
10400	8	C9/HT01	8	06/27/88	06/30/88	06/29/88	06/30/88	07/04/88	07/06/88
10400	9	A11/HT01	4	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	10	B11/HT01	8	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	11	C11/HT01	4	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	12	D11/HT01	1.5	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	13	E11/HT01	4	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	14	B12/HT01	5	06/28/88	07/01/88	06/30/88	07/01/88	07/04/88	07/06/88
10400	15				NA	NA	NA	NA	NA
10400	16	F11/HT01	5	06/29/88	07/02/88	07/01/88	07/02/88	07/04/88	07/06/88
10400	17	G11/HT01	7	06/29/88	07/02/88	07/01/88	07/02/88	07/04/88	07/06/88
10400	18	H11/HT01	5.5	06/29/88	07/02/88	07/01/88	07/02/88	07/04/88	07/06/88
10400	19	I11/HT01	2	06/29/88	07/02/88	07/01/88	07/02/88	07/04/88	07/06/88
10400	20	J12/HT01	6.5	06/29/88	07/02/88	07/01/88	07/02/88	07/04/88	07/06/88
10400	21				NA	NA	NA	NA	NA
10400	22	C12/HT01	2	06/30/88	07/02/88	07/01/88	07/02/88	07/06/88	07/07/88
10400	23	D12/HT01	7	06/30/88	07/02/88	07/01/88	07/02/88	07/06/88	07/07/88
10400	24	C13/HT01	4	06/30/88	07/02/88	07/01/88	07/02/88	07/06/88	07/07/88
10400	25	D13/HT01	3	06/30/88	07/02/88	07/01/88	07/02/88	07/06/88	07/07/88
10400	26	F13/HT01	8	06/30/88	07/02/88	07/01/88	07/02/88	07/06/88	07/07/88
10400	27	Spoon	RinseB	06/30/88	NA	NA	07/08/88	07/06/88	07/06/88
10400	28	PACCAR	TB		NA	NA	NA	NA	NA
10400	29	PACCAR	FB		NA	NA	NA	NA	NA
Interim Report #3									
10400	30	H13/HT01	2	07/01/88	07/05/88	07/06/88	07/07/88	07/06/88	07/07/88
10400	31	H12/HT01	4	07/01/88	07/05/88	07/06/88	07/07/88	07/06/88	07/07/88
10400	32	F12/HT01	3	07/01/88	07/05/88	07/06/88	07/07/88	07/06/88	07/07/88
10400	33	Field Blk	FB		NA	NA	NA	NA	NA
10400	34	J13/HT01	6	07/05/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	35	L12/HT01	2	07/05/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	36	L13/HT01	9	07/05/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	37	N12/HT01	4	07/05/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	38	N13/HT01	3	07/05/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	39	Field Blk	FB		NA	NA	NA	NA	NA
10400	40	R12/HT01	3	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	41	P12/HT01	7	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	42	P13/HT01	5	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	43	T13/HT01	2	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	44	R13/HT01	6	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88
10400	45	P13/HT01	11	07/06/88	07/07/88	07/07/88	07/08/88	07/11/88	07/14/88

Table II: Analytical History (page 1 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Total Petroleum Hydrocarbons Prep.	Total Petroleum Hydrocarbons Anal.	Total Arsenic Prep.	Total Arsenic Anal.
10400	46	Field Blk	FB		NA	NA	NA	NA	NA
10400	47	D1/HT01	5	07/07/88	07/09/88	07/08/88	07/08/88	07/11/88	07/14/88
10400	48	D3/HT01	3	07/07/88	07/09/88	07/08/88	07/08/88	07/11/88	07/14/88
10400	49	D5/HT01	4	07/07/88	07/09/88	07/08/88	07/08/88	07/11/88	07/14/88
10400	50	V13/HT01	6	07/07/88	07/09/88	07/08/88	07/08/88	07/11/88	07/14/88
10400	51	V12/HT01	6	07/07/88	07/09/88	07/08/88	07/08/88	07/11/88	07/14/88
10400	52	Vol. Blk	FB		NA	NA	NA	NA	NA
Interim Report #4									
10400	53	A9/HT01	7	07/08/88	07/11/88	07/12/88	07/12/88	07/14/88	07/20/88
10400	54	A7/HT01	2	07/08/88	07/11/88	07/12/88	07/12/88	07/14/88	07/20/88
10400	55	A5/HT01	4	07/08/88	07/11/88	07/12/88	07/12/88	07/14/88	07/20/88
10400	56	B7/HT01	7	07/08/88	07/11/88	07/12/88	07/12/88	07/14/88	07/20/88
10400	57	B5/HT01	3	07/08/88	07/11/88	07/12/88	07/12/88	07/14/88	07/20/88
10400	58	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	59	A1/HT01	9	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	60	A3/HT01	5	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	61	A3/HT01	11	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	62	D7/HT01	7	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	63	E5/HT01	8	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	64	E6/HT01	2	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	65	E8/HT01	4	07/11/88	07/12/88	07/13/88	07/14/88	07/14/88	07/20/88
10400	66	VOA Blank	FB		NA	NA	NA	NA	NA
10400	67	D9/HT01	5	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	68	D9/HT01	11	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	69	F3/HT01	4	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	70	F4/HT01	8	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	71	F5/HT01	5	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	72	G3/HT01	4	07/12/88	07/13/88	07/14/88	07/15/88	07/14/88	07/20/88
10400	73	Spoon	RinseB	07/12/88	NA	07/22/88	07/25/88	07/25/88	07/25/88
10400	74	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	75	H1/HT01	1	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	76	H1/HT01	11	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	77	H6/HT01	7	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	78	H7/HT01	1	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	79	F1/HT01	2	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	80	F8/HT01	2	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	81	G7/HT01	4	07/13/88	07/14/88	07/15/88	07/16/88	07/19/88	07/20/88
10400	82	Field Blk	FB		NA	NA	NA	NA	NA
10400	83	E10/HT01	4	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	84	F9/HT01	7	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	85	G10/HT01	3	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	86	J11/HT01	7	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	87	K11/HT01	2	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	88	H10/HT01	7	07/14/88	07/15/88	07/16/88	07/18/88	07/19/88	07/20/88
10400	89	Field Blk	FB		NA	NA	NA	NA	NA
Interim Report #5									
10400	90	K3/HT01	4	07/15/88	07/18/88	07/19/88	07/20/88	07/25/88	07/28/88
10400	91	L3/HT01	2	07/15/88	07/18/88	07/19/88	07/20/88	07/25/88	07/28/88

Table II: Analytical History (page 2 of 30)

						Total Petroleum Hydrocarbons		Total Arsenic	
Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Prep.	Anal.	Prep.	Anal.
10400	92	M3/HT01	2	07/15/88	07/18/88	07/19/88	07/20/88	07/25/88	07/28/88
10400	93	K4/HT01	7	07/15/88	07/18/88	07/19/88	07/20/88	07/25/88	07/28/88
10400	94	J4/HT01	2	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	95	L4/HT01	3.5	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	96	M4/HT01	8	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	97	N4/HT01	5	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	98	P11/HT01	2	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	99	I5/HT01	8	07/18/88	07/19/88	07/20/88	07/21/88	07/25/88	07/28/88
10400	100	Field Blk	FB		NA	NA	NA	NA	NA
10400	101	M11/HT01	7	07/19/88	07/20/88	07/21/88	07/22/88	07/25/88	07/28/88
10400	102	R5/HT01	7	07/19/88	07/20/88	07/21/88	07/22/88	07/25/88	07/28/88
10400	103	S7/HT01	4	07/19/88	07/20/88	07/21/88	07/22/88	07/25/88	07/28/88
10400	104	T7/HT01	7	07/19/88	07/20/88	07/21/88	07/22/88	07/25/88	07/28/88
10400	105	U7/HT01	1	07/19/88	07/20/88	07/21/88	07/22/88	07/25/88	07/28/88
10400	106	Field Blk	FB		NA	NA	NA	NA	NA
10400	107	G8/HB01	5	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	108	H8/HB01	0.9	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	109	I8/HB01	5	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	110	J8/HB01	0.7	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	111	K8/HB01	5	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	112	K7/HB01	3.5	07/21/88	07/22/88	07/22/88	07/25/88	07/25/88	07/28/88
10400	113	Trip Blk	FB		NA	NA	NA	NA	NA
Interim Report #6									
10400	114	G6/HB01	0.1	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	115	I6/HB01	5.0	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	116	F7/HB01	7.5	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	117	I4/HB01	2.5	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	118	J5/HB01	2.5	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	119	G9/HB01	0.7	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	120	I7/HB01	2.5	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	121	J7/HB01	5.0	07/22/88	07/25/88	07/26/88	07/27/88	08/01/88	08/05/88
10400	122	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	123	F10/HB01	0.7	07/25/88	07/26/88	07/27/88	07/28/88	08/01/88	08/05/88
10400	124	H9/HB01	5	07/25/88	07/26/88	07/27/88	07/28/88	08/01/88	08/05/88
10400	125	J6/HB01	0.5	07/25/88	07/26/88	07/27/88	07/28/88	08/01/88	08/05/88
10400	126	K6/HB01	7.5	07/25/88	07/26/88	07/27/88	07/28/88	08/01/88	08/05/88
10400	127	M6/HB01	0.6	07/25/88	07/26/88	07/27/88	07/28/88	08/01/88	08/05/88
10400	128	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	129	J1/HB01	7.5	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	130	L1/HB01	5.0	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	131	L1/HB01	11.0	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	132	K5/HB01	0.5	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	133	L5/HB01	5.0	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	134	M5/HB01	7.5	07/26/88	07/27/88	07/28/88	07/29/88	08/01/88	08/05/88
10400	135	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	136	H5/HB01	0.3	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	137	F6/HB01	5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	138	G5/HB01	7.5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88

Table II: Analytical History (page 3 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Total Petroleum Hydrocarbons Prep.	Total Petroleum Hydrocarbons Anal.	Total Arsenic Prep.	Total Arsenic Anal.
10400	139	H4/HB01	7.5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	140	I3/HB01	0.5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	141	J3/HB01	5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	142	06/HB01	0.5	07/27/88	07/28/88	07/29/88	07/30/88	08/01/88	08/05/88
10400	143	Spoon	RinseB	07/27/88	NA	08/04/88	08/04/88	08/04/88	08/05/88
10400	144	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	145	G4/HB01	0.3	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	146	H3/HB01	5	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	147	W7/HB01	2.5	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	148	V7/HB01	5	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	149	W5/HB01	7.5	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	150	W3/HB01	0.2	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	151	V3/HB01	2.5	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	152	V5/HB01	0.2	07/28/88	07/29/88	07/30/88	08/01/88	08/01/88	08/05/88
10400	153	Vol. Blk	FB		NA	NA	NA	NA	NA
Interim Report #7									
10400	154	I9/HB01	0.4	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	155	J9/HB01	5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	156	K9/HB01	7.5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	157	L9/HB01	0.5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	158	L10/HB01	2.5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	159	M9/HB01	5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	160	N9/HB01	2.5	07/29/88	08/01/88	08/02/88	08/03/88	08/08/88	08/11/88
10400	161	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	162	I10/HB01	2.5	08/01/88	08/02/88	08/03/88	08/04/88	08/08/88	08/11/88
10400	163	M10/HB01	0.6	08/01/88	08/02/88	08/03/88	08/04/88	08/08/88	08/11/88
10400	164	N10/HB01	7.5	08/01/88	08/02/88	08/03/88	08/04/88	08/08/88	08/11/88
10400	165	010/HB01	2.5	08/01/88	08/02/88	08/03/88	08/04/88	08/08/88	08/11/88
10400	166	09/HB01	0.7	08/01/88	08/02/88	08/03/88	08/04/88	08/08/88	08/11/88
10400	167	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	168	Q9/HB01	2.5	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	169	R9/HB01	0.4	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	170	S9/HB01	7.5	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	171	N8/HB01	0.6	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	172	08/HB01	5	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	173	P8/HB01	7.5	08/02/88	08/03/88	08/04/88	08/05/88	08/08/88	08/11/88
10400	174	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	175	N1/HB01	0.6	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	176	P1/HB01	5	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	177	R1/HB01	2.5	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	178	R1/HB01	11	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	179	U1/HB01	7.5	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	180	V1/HB01	0.3	08/03/88	06/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	181	03/HB01	7.5	08/03/88	08/04/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	182	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	183	N2/HB01	2.5	08/04/88	08/08/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	184	N3/HB01	7.5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	185	N3/HB01	11	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88

Table II: Analytical History (page 4 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Total Petroleum Hydrocarbons Prep.	Total Petroleum Hydrocarbons Anal.	Total Arsenic Prep.	Total Arsenic Anal.
10400	186	P3/HB01	5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	187	04/HB01	1.5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	188	P4/HB01	2.5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	189	S2/HB01	1.2	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	190	T2/HB01	2.5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	191	T3/HB01	7.5	08/04/88	08/05/88	08/05/88	08/08/88	08/08/88	08/11/88
10400	192	Vol. Blk	FB		NA	NA	NA	NA	NA
Interim Report #8									
10400	193	R4/HB01	0.5	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	194	S4/HB01	2.5	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	195	T4/HB01	7.5	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	196	P5/HB01	5	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	197	S5/HB01	0.1	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	198	T5/HB01	0.4	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	199	R6/HB01	0.2	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	200	P6/HB01	0.5	08/05/88	08/08/88	08/09/88	08/10/88	08/15/88	08/17/88
10400	201	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	202	Q4/HB01	7.5	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	203	Q6/HB01	3	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	204	Q7/HB01	5	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	205	Q8/HB01	1	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	206	Q10/HB01	7.5	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	207	Q11/HB01	5	08/08/88	08/09/88	08/10/88	08/11/88	08/15/88	08/17/88
10400	208	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	209	L11/HB01	2.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	210	N11/HB01	5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	211	R11/HB01	7.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	212	T11/HB01	1	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	213	V11/HB01	7.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	214	W11/HB01	2	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	215	T12/HB01	5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	216	W12/HB01	7.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	217	S8/HB01	2.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	218	S8/HB01	11	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	219	T8/HB01	1.2	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	220	Q2/HB01	2	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	221	V9/HB01	0.6	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	222	W9/HB01	7.5	08/09/88	08/11/88	08/11/88	08/12/88	08/15/88	08/17/88
10400	223	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	224	P10/HB01	1	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	225	P9/HB01	7.5	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	226	P9/HB01	11	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	227	05/HB01	2.5	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	228	P2/HB01	1.9	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	229	L7/HB01	0.6	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	230	M7/HB01	5	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	231	N7/HB01	2.5	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	232	07/HB01	7.5	08/10/88	08/11/88	08/12/88	08/15/88	08/15/88	08/17/88

Table II: Analytical History (page 5 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	TS Anal.	Total Petroleum Hydrocarbons Prep.	Total Petroleum Hydrocarbons Anal.	Total Arsenic Prep.	Total Arsenic Anal.
10400	233	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	234	U2/HB01	5	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	235	B1/HB01	0.2	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	236	B3/HB01	2.5	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	237	A12/HB01	0.2	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	238	A13/HB01	7.5	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	239	B13/HB01	0.2	08/11/88	08/12/88	08/12/88	08/15/88	08/15/88	08/17/88
10400	240	Vol. Blk	FB		NA	NA	NA	NA	NA
Interim Report #9									
10400	241	L6/HB01	2.5	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	242	N6/HB01	7.5	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	243	M8/HB01	0.7	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	244	L8/HB01	7.5	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	245	L8/HB01	11	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	246	E9/HB01	1.1	08/12/88	08/15/88	08/16/88	08/17/88	08/22/88	08/26/88
10400	247	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	248	R2/HB01	7.5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	249	Q3/HB01	0.5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	250	R3/HB01	2.5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	251	S3/HB01	7.5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	252	O2/HB01	5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	253	R10/HB01	5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	254	T9/HB01	5	08/15/88	08/16/88	08/17/88	08/18/88	08/22/88	08/26/88
10400	255	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	256	O11/HB01	7.5	08/16/88	08/17/88	08/18/88	08/19/88	08/22/88	08/26/88
10400	257	R8/HB01	5	08/16/88	08/17/88	08/18/88	08/19/88	08/22/88	08/26/88
10400	258	R8/HB01	11	08/16/88	08/17/88	08/18/88	08/19/88	08/22/88	08/26/88
10400	259	S6/HB01	7.5	08/16/88	08/17/88	08/18/88	08/19/88	08/22/88	08/26/88
10400	260	T6/HB01	5	08/16/88	08/17/88	08/18/88	08/19/88	08/22/88	08/26/88
10400	261	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	262	U3/HB01	0.0	08/17/88	08/18/88	08/19/88	08/22/88	08/22/88	08/26/88
10400	263	P7/HB01	0.7	08/17/88	08/18/88	08/19/88	08/22/88	08/22/88	08/26/88
10400	264	R7/HB01	0.6	08/17/88	08/18/88	08/19/88	08/22/88	08/22/88	08/26/88
10400	265	M1/HB01	2.5	08/17/88	08/19/88	08/19/88	08/22/88	08/22/88	08/26/88
10400	266	Vol. Blk	FB		NA	NA	NA	NA	NA
10400	267	N5/HB01	5	08/24/88	08/25/88	08/25/88	08/25/88	08/29/88	08/30/88

Table II: Analytical History (page 6 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
Interim Report #1							
10400	1	B9/HT01	2	06/17/88	06/23/88	06/23/88	
10400	2	E7/HT01	2.5	06/17/88	06/23/88	06/23/88	Cu,Pb,Zn anal. 06/24/88
10400	3	Q5/HT01	4	06/17/88	06/23/88	06/23/88	Cu,Zn anal. 06/27/88
Interim Report #2							
10400	4	C1/HT01	9	06/27/88	07/01/88	07/05/88	
10400	5	C3/HT01	1	06/27/88	07/01/88	07/05/88	
10400	6	C5/HT01	4	06/27/88	07/01/88	07/05/88	
10400	7	C7/HT01	1.5	06/27/88	07/01/88	07/05/88	
10400	8	C9/HT01	8	06/27/88	07/01/88	07/05/88	
10400	9	A11/HT01	4	06/28/88	07/01/88	07/05/88	
10400	10	B11/HT01	8	06/28/88	07/01/88	07/05/88	
10400	11	C11/HT01	4	06/28/88	07/01/88	07/05/88	
10400	12	D11/HT01	1.5	06/28/88	07/01/88	07/05/88	
10400	13	E11/HT01	4	06/28/88	07/01/88	07/05/88	
10400	14	B12/HT01	5	06/28/88	07/01/88	07/05/88	
10400	15				NA	NA	
10400	16	F11/HT01	5	06/29/88	07/04/88	07/06/88	
10400	17	G11/HT01	7	06/29/88	07/04/88	07/06/88	
10400	18	H11/HT01	5.5	06/29/88	07/04/88	07/06/88	
10400	19	I11/HT01	2	06/29/88	07/04/88	07/06/88	
10400	20	J12/HT01	6.5	06/29/88	07/04/88	07/06/88	
10400	21				NA	NA	
10400	22	C12/HT01	2	06/30/88	07/06/88	07/07/88	
10400	23	D12/HT01	7	06/30/88	07/06/88	07/07/88	
10400	24	C13/HT01	4	06/30/88	07/06/88	07/07/88	
10400	25	D13/HT01	3	06/30/88	07/06/88	07/07/88	
10400	26	F13/HT01	8	06/30/88	07/06/88	07/07/88	
10400	27	Spoon	RinseB	06/30/88	07/05/88	07/06/88	
10400	28	PACCAR	TB		NA	NA	
10400	29	PACCAR	FB		NA	NA	
Interim Report #3							
10400	30	H13/HT01	2	07/01/88	07/06/88	07/12/88	
10400	31	H12/HT01	4	07/01/88	07/06/88	07/12/88	
10400	32	F12/HT01	3	07/01/88	07/06/88	07/12/88	
10400	33	Field Blk	FB		NA	NA	
10400	34	J13/HT01	6	07/05/88	07/11/88	07/12/88	
10400	35	L12/HT01	2	07/05/88	07/11/88	07/12/88	
10400	36	L13/HT01	9	07/05/88	07/11/88	07/12/88	
10400	37	N12/HT01	4	07/05/88	07/11/88	07/12/88	
10400	38	N13/HT01	3	07/05/88	07/11/88	07/12/88	
10400	39	Field Blk	FB		NA	NA	
10400	40	R12/HT01	3	07/06/88	07/11/88	07/12/88	
10400	41	P12/HT01	7	07/06/88	07/11/88	07/12/88	
10400	42	P13/HT01	5	07/06/88	07/11/88	07/12/88	
10400	43	T13/HT01	2	07/06/88	07/11/88	07/12/88	
10400	44	R13/HT01	6	07/06/88	07/11/88	07/12/88	
10400	45	P13/HT01	11	07/06/88	07/11/88	07/12/88	

Table II: Analytical History (page 7 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
10400	46	Field Blk	FB		NA	NA	
10400	47	D1/HT01	5	07/07/88	07/11/88	07/12/88	
10400	48	D3/HT01	3	07/07/88	07/11/88	07/12/88	
10400	49	D5/HT01	4	07/07/88	07/11/88	07/12/88	
10400	50	V13/HT01	6	07/07/88	07/11/88	07/12/88	
10400	51	V12/HT01	6	07/07/88	07/11/88	07/12/88	
10400	52	Vol. Blk	FB		NA	NA	
Interim Report #4							
10400	53	A9/HT01	7	07/08/88	07/21/88	07/22/88	
10400	54	A7/HT01	2	07/08/88	07/21/88	07/22/88	
10400	55	A5/HT01	4	07/08/88	07/21/88	07/22/88	
10400	56	B7/HT01	7	07/08/88	07/21/88	07/22/88	
10400	57	B5/HT01	3	07/08/88	07/21/88	07/22/88	
10400	58	Vol. Blk	FB		NA	NA	
10400	59	A1/HT01	9	07/11/88	07/21/88	07/22/88	
10400	60	A3/HT01	5	07/11/88	07/21/88	07/22/88	
10400	61	A3/HT01	11	07/11/88	07/21/88	07/22/88	
10400	62	D7/HT01	7	07/11/88	07/21/88	07/22/88	
10400	63	E5/HT01	8	07/11/88	07/21/88	07/22/88	
10400	64	E6/HT01	2	07/11/88	07/21/88	07/22/88	
10400	65	E8/HT01	4	07/11/88	07/21/88	07/22/88	
10400	66	VOA Blank	FB		NA	NA	
10400	67	D9/HT01	5	07/12/88	07/21/88	07/22/88	
10400	68	D9/HT01	11	07/12/88	07/21/88	07/22/88	
10400	69	F3/HT01	4	07/12/88	07/21/88	07/22/88	
10400	70	F4/HT01	8	07/12/88	07/21/88	07/22/88	
10400	71	F5/HT01	5	07/12/88	07/21/88	07/22/88	
10400	72	G3/HT01	4	07/12/88	07/21/88	07/22/88	
10400	73	Spoon	RinseB	07/12/88	07/25/88	07/27/88	
10400	74	Vol. Blk	FB		NA	NA	
10400	75	H1/HT01	1	07/13/88	07/21/88	07/22/88	
10400	76	H1/HT01	11	07/13/88	07/21/88	07/22/88	
10400	77	H6/HT01	7	07/13/88	07/21/88	07/22/88	
10400	78	H7/HT01	1	07/13/88	07/21/88	07/22/88	
10400	79	F1/HT01	2	07/13/88	07/21/88	07/22/88	
10400	80	F8/HT01	2	07/13/88	07/21/88	07/22/88	
10400	81	G7/HT01	4	07/13/88	07/21/88	07/22/88	
10400	82	Field Blk	FB		NA	NA	
10400	83	E10/HT01	4	07/14/88	07/21/88	07/22/88	
10400	84	F9/HT01	7	07/14/88	07/21/88	07/22/88	
10400	85	G10/HT01	3	07/14/88	07/21/88	07/22/88	
10400	86	J11/HT01	7	07/14/88	07/21/88	07/22/88	
10400	87	K11/HT01	2	07/14/88	07/21/88	07/22/88	
10400	88	H10/HT01	7	07/14/88	07/21/88	07/22/88	
10400	89	Field Blk	FB		NA	NA	
Interim Report #5							
10400	90	K3/HT01	4	07/15/88	07/25/88	07/27/88	Pb anal. 07/29/88
10400	91	L3/HT01	2	07/15/88	07/25/88	07/27/88	

Table II: Analytical History (page 8 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
10400	92	M3/HT01	2	07/15/88	07/25/88	07/27/88	
10400	93	K4/HT01	7	07/15/88	07/25/88	07/27/88	
10400	94	J4/HT01	2	07/18/88	07/25/88	07/27/88	Cd anal. 07/29/88
10400	95	L4/HT01	3.5	07/18/88	07/25/88	07/27/88	
10400	96	M4/HT01	8	07/18/88	07/25/88	07/27/88	Pb anal. 07/29/88
10400	97	N4/HT01	5	07/18/88	07/25/88	07/27/88	
10400	98	P11/HT01	2	07/18/88	07/25/88	07/27/88	Cd anal. 07/29/88
10400	99	I5/HT01	8	07/18/88	07/25/88	07/27/88	
10400	100	Field Blk	FB		NA	NA	
10400	101	M11/HT01	7	07/19/88	07/25/88	07/27/88	
10400	102	R5/HT01	7	07/19/88	07/25/88	07/27/88	
10400	103	S7/HT01	4	07/19/88	07/25/88	07/27/88	
10400	104	T7/HT01	7	07/19/88	07/25/88	07/27/88	
10400	105	U7/HT01	1	07/19/88	07/25/88	07/27/88	
10400	106	Field Blk	FB		NA	NA	
10400	107	G8/HB01	5	07/21/88	07/25/88	07/27/88	
10400	108	H8/HB01	0.9	07/21/88	07/25/88	07/27/88	Cd anal. 07/29/88
10400	109	I8/HB01	5	07/21/88	07/25/88	07/27/88	
10400	110	J8/HB01	0.7	07/21/88	07/25/88	07/27/88	Cd anal. 07/29/88
10400	111	K8/HB01	5	07/21/88	07/25/88	07/27/88	
10400	112	K7/HB01	3.5	07/21/88	07/25/88	07/27/88	
10400	113	Trip Blk	FB		NA	NA	
Interim Report #6							
10400	114	G6/HB01	0.1	07/22/88	08/01/88	08/03/88	
10400	115	I6/HB01	5.0	07/22/88	08/01/88	08/03/88	
10400	116	F7/HB01	7.5	07/22/88	08/01/88	08/03/88	
10400	117	I4/HB01	2.5	07/22/88	08/01/88	08/03/88	
10400	118	J5/HB01	2.5	07/22/88	08/01/88	08/03/88	
10400	119	G9/HB01	0.7	07/22/88	08/01/88	08/03/88	
10400	120	I7/HB01	2.5	07/22/88	08/01/88	08/03/88	
10400	121	J7/HB01	5.0	07/22/88	08/01/88	08/03/88	
10400	122	Vol. Blk	FB		NA	NA	
10400	123	F10/HB01	0.7	07/25/88	08/01/88	08/03/88	
10400	124	H9/HB01	5	07/25/88	08/01/88	08/03/88	
10400	125	J6/HB01	0.5	07/25/88	08/01/88	08/03/88	
10400	126	K6/HB01	7.5	07/25/88	08/01/88	08/03/88	
10400	127	M6/HB01	0.6	07/25/88	08/01/88	08/03/88	
10400	128	Vol. Blk	FB		NA	NA	
10400	129	J1/HB01	7.5	07/26/88	08/01/88	08/03/88	
10400	130	L1/HB01	5.0	07/26/88	08/01/88	08/03/88	
10400	131	L1/HB01	11.0	07/26/88	08/01/88	08/03/88	
10400	132	K5/HB01	0.5	07/26/88	08/01/88	08/03/88	
10400	133	L5/HB01	5.0	07/26/88	08/01/88	08/03/88	
10400	134	M5/HB01	7.5	07/26/88	08/01/88	08/04/88	
10400	135	Vol. Blk	FB		NA	NA	
10400	136	H5/HB01	0.3	07/27/88	08/01/88	08/03/88	
10400	137	F6/HB01	5	07/27/88	08/01/88	08/03/88	
10400	138	G5/HB01	7.5	07/27/88	08/01/88	08/03/88	

Table II: Analytical History (page 9 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
10400	139	H4/HB01	7.5	07/27/88	08/01/88	08/03/88	
10400	140	I3/HB01	0.5	07/27/88	08/01/88	08/03/88	
10400	141	J3/HB01	5	07/27/88	08/01/88	08/03/88	
10400	142	O6/HB01	0.5	07/27/88	08/03/88	08/03/88	
10400	143	Spoon	RinseB	07/27/88	08/05/88	08/05/88	
10400	144	Vol. Blk	FB		NA	NA	
10400	145	G4/HB01	0.3	07/28/88	08/01/88	08/03/88	
10400	146	H3/HB01	5	07/28/88	08/01/88	08/03/88	
10400	147	W7/HB01	2.5	07/28/88	08/01/88	08/03/88	
10400	148	V7/HB01	5	07/28/88	08/01/88	08/03/88	
10400	149	W5/HB01	7.5	07/28/88	08/01/88	08/03/88	
10400	150	W3/HB01	0.2	07/28/88	08/01/88	08/03/88	
10400	151	V3/HB01	2.5	07/28/88	08/01/88	08/03/88	
10400	152	V5/HB01	0.2	07/28/88	08/01/88	08/03/88	
10400	153	Vol. Blk	FB		NA	NA	
Interim Report #7							
10400	154	I9/HB01	0.4	07/29/88	08/08/88	08/10/88	
10400	155	J9/HB01	5	07/29/88	08/08/88	08/10/88	
10400	156	K9/HB01	7.5	07/29/88	08/08/88	08/10/88	
10400	157	L9/HB01	0.5	07/29/88	08/08/88	08/10/88	
10400	158	L10/HB01	2.5	07/29/88	08/08/88	08/10/88	
10400	159	M9/HB01	5	07/29/88	08/08/88	08/10/88	
10400	160	N9/HB01	2.5	07/29/88	08/08/88	08/10/88	
10400	161	Vol. Blk	FB		NA	NA	
10400	162	I10/HB01	2.5	08/01/88	08/08/88	08/10/88	
10400	163	M10/HB01	0.6	08/01/88	08/08/88	08/10/88	
10400	164	N10/HB01	7.5	08/01/88	08/08/88	08/10/88	
10400	165	O10/HB01	2.5	08/01/88	08/08/88	08/10/88	
10400	166	O9/HB01	0.7	08/01/88	08/08/88	08/10/88	
10400	167	Vol. Blk	FB		NA	NA	
10400	168	Q9/HB01	2.5	08/02/88	08/08/88	08/10/88	
10400	169	R9/HB01	0.4	08/02/88	08/08/88	08/10/88	
10400	170	S9/HB01	7.5	08/02/88	08/08/88	08/10/88	
10400	171	N8/HB01	0.6	08/02/88	08/08/88	08/10/88	
10400	172	O8/HB01	5	08/02/88	08/08/88	08/10/88	
10400	173	P8/HB01	7.5	08/02/88	08/08/88	08/10/88	
10400	174	Vol. Blk	FB		NA	NA	
10400	175	N1/HB01	0.6	08/03/88	08/08/88	08/10/88	
10400	176	P1/HB01	5	08/03/88	08/08/88	08/10/88	
10400	177	R1/HB01	2.5	08/03/88	08/08/88	08/10/88	
10400	178	R1/HB01	11	08/03/88	08/08/88	08/10/88	
10400	179	U1/HB01	7.5	08/03/88	08/08/88	08/10/88	
10400	180	V1/HB01	0.3	08/03/88	08/08/88	08/10/88	
10400	181	O3/HB01	7.5	08/03/88	08/08/88	08/10/88	
10400	182	Vol. Blk	FB		NA	NA	
10400	183	N2/HB01	2.5	08/04/88	08/08/88	08/10/88	
10400	184	N3/HB01	7.5	08/04/88	08/08/88	08/10/88	
10400	185	N3/HB01	11	08/04/88	08/08/88	08/10/88	

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Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
10400	186	P3/HB01	5	08/04/88	08/08/88	08/10/88	
10400	187	O4/HB01	1.5	08/04/88	08/08/88	08/10/88	
10400	188	P4/HB01	2.5	08/04/88	08/08/88	08/10/88	
10400	189	S2/HB01	1.2	08/04/88	08/08/88	08/10/88	
10400	190	T2/HB01	2.5	08/04/88	08/08/88	08/10/88	
10400	191	T3/HB01	7.5	08/04/88	08/08/88	08/10/88	
10400	192	Vol. Blk	FB		NA	NA	
Interim Report #8							
10400	193	R4/HB01	0.5	08/05/88	08/15/88	08/17/88	
10400	194	S4/HB01	2.5	08/05/88	08/15/88	08/17/88	
10400	195	T4/HB01	7.5	08/05/88	08/15/88	08/17/88	
10400	196	P5/HB01	5	08/05/88	08/15/88	08/17/88	
10400	197	S5/HB01	0.1	08/05/88	08/15/88	08/17/88	
10400	198	T5/HB01	0.4	08/05/88	08/15/88	08/17/88	
10400	199	R6/HB01	0.2	08/05/88	08/15/88	08/17/88	
10400	200	P6/HB01	0.5	08/05/88	08/15/88	08/17/88	
10400	201	Vol. Blk	FB		NA	NA	
10400	202	Q4/HB01	7.5	08/08/88	08/15/88	08/17/88	
10400	203	Q6/HB01	3	08/08/88	08/15/88	08/17/88	
10400	204	Q7/HB01	5	08/08/88	08/15/88	08/17/88	
10400	205	Q8/HB01	1	08/08/88	08/15/88	08/17/88	
10400	206	Q10/HB01	7.5	08/08/88	08/15/88	08/17/88	
10400	207	Q11/HB01	5	08/08/88	08/15/88	08/17/88	
10400	208	Vol. Blk	FB		NA	NA	
10400	209	L11/HB01	2.5	08/09/88	08/15/88	08/17/88	
10400	210	N11/HB01	5	08/09/88	08/15/88	08/17/88	
10400	211	R11/HB01	7.5	08/09/88	08/15/88	08/17/88	
10400	212	T11/HB01	1	08/09/88	08/15/88	08/17/88	
10400	213	V11/HB01	7.5	08/09/88	08/15/88	08/17/88	
10400	214	W11/HB01	2	08/09/88	08/15/88	08/17/88	
10400	215	T12/HB01	5	08/09/88	08/15/88	08/17/88	
10400	216	W12/HB01	7.5	08/09/88	08/15/88	08/17/88	
10400	217	S8/HB01	2.5	08/09/88	08/15/88	08/17/88	
10400	218	S8/HB01	11	08/09/88	08/15/88	08/17/88	
10400	219	T8/HB01	1.2	08/09/88	08/15/88	08/17/88	
10400	220	Q2/HB01	2	08/09/88	08/15/88	08/17/88	
10400	221	V9/HB01	0.6	08/09/88	08/15/88	08/17/88	
10400	222	W9/HB01	7.5	08/09/88	08/15/88	08/17/88	
10400	223	Vol. Blk	FB		NA	NA	
10400	224	P10/HB01	1	08/10/88	08/15/88	08/17/88	
10400	225	P9/HB01	7.5	08/10/88	08/15/88	08/17/88	
10400	226	P9/HB01	11	08/10/88	08/15/88	08/17/88	
10400	227	O5/HB01	2.5	08/10/88	08/15/88	08/17/88	
10400	228	P2/HB01	1.9	08/10/88	08/15/88	08/17/88	
10400	229	L7/HB01	0.6	08/10/88	08/15/88	08/17/88	
10400	230	M7/HB01	5	08/10/88	08/15/88	08/17/88	
10400	231	N7/HB01	2.5	08/10/88	08/15/88	08/17/88	
10400	232	O7/HB01	7.5	08/10/88	08/15/88	08/17/88	

Table II: Analytical History (page 11 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	Total ICAP Prep.	Total ICAP Anal.	Exceptions to Total ICAP Prep./Anal. Dates
10400	233	Vol. Blk	FB		NA	NA	
10400	234	U2/HB01	5	08/11/88	08/15/88	08/17/88	
10400	235	B1/HB01	0.2	08/11/88	08/15/88	08/17/88	
10400	236	B3/HB01	2.5	08/11/88	08/15/88	08/17/88	
10400	237	A12/HB01	0.2	08/11/88	08/15/88	08/17/88	
10400	238	A13/HB01	7.5	08/11/88	08/15/88	08/17/88	
10400	239	B13/HB01	0.2	08/11/88	08/15/88	08/17/88	
10400	240	Vol. Blk	FB		NA	NA	
Interim Report #9							
10400	241	L6/HB01	2.5	08/12/88	08/22/88	08/24/88	
10400	242	N6/HB01	7.5	08/12/88	08/22/88	08/24/88	
10400	243	M8/HB01	0.7	08/12/88	08/22/88	08/24/88	
10400	244	L8/HB01	7.5	08/12/88	08/22/88	08/24/88	
10400	245	L8/HB01	11	08/12/88	08/22/88	08/24/88	
10400	246	E9/HB01	1.1	08/12/88	08/22/88	08/24/88	
10400	247	Vol. Blk	FB		NA	NA	
10400	248	R2/HB01	7.5	08/15/88	08/22/88	08/24/88	
10400	249	Q3/HB01	0.5	08/15/88	08/22/88	08/24/88	
10400	250	R3/HB01	2.5	08/15/88	08/22/88	08/24/88	
10400	251	S3/HB01	7.5	08/15/88	08/22/88	08/24/88	
10400	252	O2/HB01	5	08/15/88	08/22/88	08/24/88	
10400	253	R10/HB01	5	08/15/88	08/22/88	08/24/88	
10400	254	T9/HB01	5	08/15/88	08/22/88	08/24/88	
10400	255	Vol. Blk	FB		NA	NA	
10400	256	O11/HB01	7.5	08/16/88	08/22/88	08/24/88	
10400	257	R8/HB01	5	08/16/88	08/22/88	08/24/88	
10400	258	R8/HB01	11	08/16/88	08/22/88	08/24/88	
10400	259	S6/HB01	7.5	08/16/88	08/22/88	08/24/88	
10400	260	T6/HB01	5	08/16/88	08/22/88	08/24/88	
10400	261	Vol. Blk	FB		NA	NA	
10400	262	U3/HB01	0.0	08/17/88	08/22/88	08/24/88	
10400	263	P7/HB01	0.7	08/17/88	08/22/88	08/24/88	
10400	264	R7/HB01	0.6	08/17/88	08/22/88	08/24/88	
10400	265	M1/HB01	2.5	08/17/88	08/22/88	08/24/88	
10400	266	Vol. Blk	FB		NA	NA	
10400	267	N5/HB01	5	08/24/88	08/29/88	08/31/88	

Table II: Analytical History (page 12 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX Ext.	EP TOX ICAP Prep.	EP TOX Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
Interim Report #1								
10400	1	B9/HT01	2	06/17/88	06/20/88	06/24/88	06/26/88	Cr anal. 06/27/88
10400	2	E7/HT01	2.5	06/17/88	06/20/88	06/24/88	06/26/88	Cr anal. 06/27/88
10400	3	Q5/HT01	4	06/17/88	06/20/88	06/24/88	06/26/88	Cr anal. 06/27/88
Interim Report #2								
10400	4	C1/HT01	9	06/27/88	06/30/88	07/06/88	07/07/88	
10400	5	C3/HT01	1	06/27/88	06/29/88	07/06/88	07/07/88	
10400	6	C5/HT01	4	06/27/88	06/29/88	07/06/88	07/07/88	
10400	7	C7/HT01	1.5	06/27/88	06/30/88	07/06/88	07/07/88	
10400	8	C9/HT01	8	06/27/88	06/29/88	07/06/88	07/07/88	
10400	9	A11/HT01	4	06/28/88	06/30/88	07/06/88	07/07/88	
10400	10	B11/HT01	8	06/28/88	06/30/88	07/06/88	07/07/88	
10400	11	C11/HT01	4	06/28/88	06/30/88	07/06/88	07/07/88	
10400	12	D11/HT01	1.5	06/28/88	06/30/88	07/06/88	07/07/88	
10400	13	E11/HT01	4	06/28/88	06/30/88	07/06/88	07/07/88	
10400	14	B12/HT01	5	06/28/88	06/30/88	07/06/88	07/07/88	
10400	15				NA	NA	NA	
10400	16	F11/HT01	5	06/29/88	07/04/88	07/06/88	07/07/88	
10400	17	G11/HT01	7	06/29/88	07/04/88	07/06/88	07/07/88	
10400	18	H11/HT01	5.5	06/29/88	07/04/88	07/06/88	07/07/88	
10400	19	I11/HT01	2	06/29/88	07/04/88	07/06/88	07/07/88	
10400	20	J12/HT01	6.5	06/29/88	07/04/88	07/06/88	07/07/88	
10400	21				NA	NA	NA	
10400	22	C12/HT01	2	06/30/88	07/04/88	07/06/88	07/07/88	
10400	23	D12/HT01	7	06/30/88	07/04/88	07/06/88	07/07/88	
10400	24	C13/HT01	4	06/30/88	07/04/88	07/06/88	07/07/88	
10400	25	D13/HT01	3	06/30/88	07/04/88	07/06/88	07/07/88	
10400	26	F13/HT01	8	06/30/88	07/04/88	07/06/88	07/07/88	
10400	27	Spoon	RinseB	06/30/88	NA	NA	NA	
10400	28	PACCAR	TB		NA	NA	NA	
10400	29	PACCAR	FB		NA	NA	NA	
Interim Report #3								
10400	30	H13/HT01	2	07/01/88	07/06/88	07/14/88	07/14/88	
10400	31	H12/HT01	4	07/01/88	07/07/88	07/14/88	07/14/88	
10400	32	F12/HT01	3	07/01/88	07/06/88	07/14/88	07/14/88	
10400	33	Field Blk	FB		NA	NA	NA	
10400	34	J13/HT01	6	07/05/88	07/07/88	07/14/88	07/14/88	
10400	35	L12/HT01	2	07/05/88	07/07/88	07/14/88	07/14/88	
10400	36	L13/HT01	9	07/05/88	07/11/88	07/14/88	07/14/88	
10400	37	N12/HT01	4	07/05/88	07/07/88	07/14/88	07/14/88	
10400	38	N13/HT01	3	07/05/88	07/07/88	07/14/88	07/14/88	
10400	39	Field Blk	FB		NA	NA	NA	
10400	40	R12/HT01	3	07/06/88	07/11/88	07/14/88	07/14/88	
10400	41	P12/HT01	7	07/06/88	07/12/88	07/14/88	07/14/88	
10400	42	P13/HT01	5	07/06/88	07/12/88	07/14/88	07/14/88	
10400	43	T13/HT01	2	07/06/88	07/10/88	07/14/88	07/14/88	
10400	44	R13/HT01	6	07/06/88	07/11/88	07/14/88	07/14/88	
10400	45	P13/HT01	11	07/06/88	07/11/88	07/14/88	07/14/88	

Table II: Analytical History (page 13 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX ICAP Ext.	EP TOX ICAP Prep.	EP TOX ICAP Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
10400	46	Field Blk	FB		NA	NA	NA	
10400	47	D1/HT01	5	07/07/88	07/11/88	07/14/88	07/14/88	
10400	48	D3/HT01	3	07/07/88	07/11/88	07/14/88	07/14/88	
10400	49	D5/HT01	4	07/07/88	07/11/88	07/14/88	07/14/88	
10400	50	V13/HT01	6	07/07/88	07/11/88	07/14/88	07/14/88	
10400	51	V12/HT01	6	07/07/88	07/12/88	07/14/88	07/14/88	
10400	52	Vol. Blk	FB		NA	NA	NA	
Interim Report #4								
10400	53	A9/HT01	7	07/08/88	07/12/88	07/15/88	07/15/88	
10400	54	A7/HT01	2	07/08/88	07/12/88	07/15/88	07/15/88	
10400	55	A5/HT01	4	07/08/88	07/12/88	07/15/88	07/15/88	
10400	56	B7/HT01	7	07/08/88	07/12/88	07/15/88	07/15/88	
10400	57	B5/HT01	3	07/08/88	07/12/88	07/15/88	07/15/88	
10400	58	Vol. Blk	FB		NA	NA	NA	
10400	59	A1/HT01	9	07/11/88	07/13/88	07/15/88	07/15/88	
10400	60	A3/HT01	5	07/11/88	07/13/88	07/15/88	07/15/88	
10400	61	A3/HT01	11	07/11/88	07/13/88	07/15/88	07/15/88	
10400	62	D7/HT01	7	07/11/88	07/18/88	07/20/88	07/21/88	
10400	63	E5/HT01	8	07/11/88	07/13/88	07/15/88	07/15/88	
10400	64	E6/HT01	2	07/11/88	07/13/88	07/15/88	07/15/88	
10400	65	E8/HT01	4	07/11/88	07/13/88	07/15/88	07/15/88	
10400	66	VOA Blank	FB		NA	NA	NA	
10400	67	D9/HT01	5	07/12/88	07/14/88	07/20/88	07/21/88	
10400	68	D9/HT01	11	07/12/88	07/14/88	07/20/88	07/21/88	
10400	69	F3/HT01	4	07/12/88	07/14/88	07/20/88	07/21/88	
10400	70	F4/HT01	8	07/12/88	07/18/88	07/20/88	07/21/88	
10400	71	F5/HT01	5	07/12/88	07/14/88	07/20/88	07/21/88	
10400	72	G3/HT01	4	07/12/88	07/14/88	07/20/88	07/21/88	
10400	73	Spoon	RinseB	07/12/88	NA	NA	NA	
10400	74	Vol. Blk	FB		NA	NA	NA	
10400	75	H1/HT01	1	07/13/88	07/18/88	07/20/88	07/21/88	
10400	76	H1/HT01	11	07/13/88	07/18/88	07/20/88	07/21/88	
10400	77	H6/HT01	7	07/13/88	07/18/88	07/20/88	07/21/88	
10400	78	H7/HT01	1	07/13/88	07/18/88	07/20/88	07/21/88	
10400	79	F1/HT01	2	07/13/88	07/18/88	07/20/88	07/21/88	
10400	80	F8/HT01	2	07/13/88	07/18/88	07/20/88	07/21/88	
10400	81	G7/HT01	4	07/13/88	07/18/88	07/20/88	07/21/88	
10400	82	Field Blk	FB		NA	NA	NA	
10400	83	E10/HT01	4	07/14/88	07/18/88	07/20/88	07/21/88	
10400	84	F9/HT01	7	07/14/88	07/18/88	07/20/88	07/21/88	
10400	85	G10/HT01	3	07/14/88	07/18/88	07/20/88	07/21/88	
10400	86	J11/HT01	7	07/14/88	07/18/88	07/20/88	07/21/88	
10400	87	K11/HT01	2	07/14/88	07/18/88	07/20/88	07/21/88	
10400	88	H10/HT01	7	07/14/88	07/18/88	07/20/88	07/21/88	
10400	89	Field Blk	FB		NA	NA	NA	
Interim Report #5								
10400	90	K3/HT01	4	07/15/88	07/19/88	07/27/88	07/28/88	
10400	91	L3/HT01	2	07/15/88	07/19/88	07/27/88	07/28/88	

Table II: Analytical History (page 14 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX ICAP Ext.	EP TOX ICAP Prep.	EP TOX ICAP Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
10400	92	M3/HT01	2	07/15/88	07/19/88	07/27/88	07/28/88	
10400	93	K4/HT01	7	07/15/88	07/20/88	07/27/88	07/28/88	
10400	94	J4/HT01	2	07/18/88	07/20/88	07/27/88	07/28/88	
10400	95	L4/HT01	3.5	07/18/88	07/20/88	07/27/88	07/28/88	
10400	96	M4/HT01	8	07/18/88	07/20/88	07/27/88	07/28/88	
10400	97	N4/HT01	5	07/18/88	07/20/88	07/27/88	07/28/88	
10400	98	P11/HT01	2	07/18/88	07/20/88	07/27/88	07/28/88	
10400	99	I5/HT01	8	07/18/88	07/20/88	07/27/88	07/28/88	
10400	100	Field Blk	FB		NA	NA	NA	
10400	101	M11/HT01	7	07/19/88	07/21/88	07/27/88	07/28/88	
10400	102	R5/HT01	7	07/19/88	07/21/88	07/27/88	07/28/88	
10400	103	S7/HT01	4	07/19/88	07/21/88	07/27/88	07/28/88	
10400	104	T7/HT01	7	07/19/88	07/21/88	07/27/88	07/28/88	
10400	105	U7/HT01	1	07/19/88	07/21/88	07/27/88	07/28/88	
10400	106	Field Blk	FB		NA	NA	NA	
10400	107	G8/HB01	5	07/21/88	07/25/88	07/27/88	07/28/88	
10400	108	H8/HB01	0.9	07/21/88	07/25/88	07/27/88	07/28/88	
10400	109	I8/HB01	5	07/21/88	07/25/88	07/27/88	07/28/88	
10400	110	J8/HB01	0.7	07/21/88	07/25/88	07/27/88	07/28/88	
10400	111	K8/HB01	5	07/21/88	07/25/88	07/27/88	07/28/88	
10400	112	K7/HB01	3.5	07/21/88	07/25/88	07/27/88	07/28/88	
10400	113	Trip Blk	FB		NA	NA	NA	
Interim Report #6								
10400	114	G6/HB01	0.1	07/22/88	07/28/88	08/03/88	08/04/88	
10400	115	I6/HB01	5.0	07/22/88	07/28/88	08/03/88	08/04/88	
10400	116	F7/HB01	7.5	07/22/88	07/28/88	08/03/88	08/04/88	
10400	117	I4/HB01	2.5	07/22/88	07/28/88	08/03/88	08/04/88	
10400	118	J5/HB01	2.5	07/22/88	07/28/88	08/03/88	08/04/88	
10400	119	G9/HB01	0.7	07/22/88	07/28/88	08/03/88	08/04/88	
10400	120	I7/HB01	2.5	07/22/88	07/25/88	08/03/88	08/04/88	
10400	121	J7/HB01	5.0	07/22/88	07/25/88	08/03/88	08/04/88	
10400	122	Vol. Blk	FB		NA	NA	NA	
10400	123	F10/HB01	0.7	07/25/88	07/27/88	08/03/88	08/04/88	#123 Retest 1 ext. 08/15/88
10400	124	H9/HB01	5	07/25/88	07/27/88	08/03/88	08/04/88	#123 Retest 1 prep.08/18/88
10400	125	J6/HB01	0.5	07/25/88	07/27/88	08/03/88	08/04/88	#123 Retest 1 anal.08/18/88
10400	126	K6/HB01	7.5	07/25/88	07/27/88	08/03/88	08/04/88	#123 Retest 2 ext. 08/25/88
10400	127	M6/HB01	0.6	07/25/88	07/27/88	08/03/88	08/04/88	#123 Retest 2 prep.08/30/88
10400	128	Vol. Blk	FB		NA	NA	NA	#123 Retest 2 anal.08/31/88
10400	129	J1/HB01	7.5	07/26/88	07/28/88	08/03/88	08/04/88	
10400	130	L1/HB01	5.0	07/26/88	07/28/88	08/03/88	08/04/88	
10400	131	L1/HB01	11.0	07/26/88	07/28/88	08/03/88	08/04/88	
10400	132	K5/HB01	0.5	07/26/88	07/28/88	08/03/88	08/04/88	
10400	133	L5/HB01	5.0	07/26/88	07/28/88	08/03/88	08/04/88	
10400	134	M5/HB01	7.5	07/26/88	07/28/88	08/03/88	08/04/88	
10400	135	Vol. Blk	FB		NA	NA	NA	
10400	136	H5/HB01	0.3	07/27/88	08/01/88	08/03/88	08/04/88	
10400	137	F6/HB01	5	07/27/88	08/01/88	08/03/88	08/04/88	
10400	138	G5/HB01	7.5	07/27/88	08/01/88	08/03/88	08/04/88	

Table II: Analytical History (page 15 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX Ext.	EP TOX ICAP Prep.	EP TOX Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
10400	139	H4/HB01	7.5	07/27/88	08/01/88	08/03/88	08/04/88	
10400	140	I3/HB01	0.5	07/27/88	08/01/88	08/03/88	08/04/88	
10400	141	J3/HB01	5	07/27/88	08/01/88	08/03/88	08/04/88	
10400	142	06/HB01	0.5	07/27/88	08/01/88	08/03/88	08/04/88	
10400	143	Spoon	RinseB	07/27/88	NA	NA	NA	
10400	144	Vol. Blk	FB		NA	NA	NA	
10400	145	G4/HB01	0.3	07/28/88	08/01/88	08/03/88	08/04/88	
10400	146	H3/HB01	5	07/28/88	08/01/88	08/03/88	08/04/88	
10400	147	W7/HB01	2.5	07/28/88	08/04/88	08/05/88	08/08/88	
10400	148	V7/HB01	5	07/28/88	08/01/88	08/03/88	08/04/88	
10400	149	W5/HB01	7.5	07/28/88	08/01/88	08/03/88	08/04/88	
10400	150	W3/HB01	0.2	07/28/88	08/01/88	08/03/88	08/04/88	
10400	151	V3/HB01	2.5	07/28/88	08/01/88	08/03/88	08/04/88	
10400	152	V5/HB01	0.2	07/28/88	08/01/88	08/03/88	08/04/88	
10400	153	Vol. Blk	FB		NA	NA	NA	
Interim Report #7								
10400	154	I9/HB01	0.4	07/29/88	08/02/88	08/11/88	08/11/88	
10400	155	J9/HB01	5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	156	K9/HB01	7.5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	157	L9/HB01	0.5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	158	L10/HB01	2.5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	159	M9/HB01	5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	160	N9/HB01	2.5	07/29/88	08/02/88	08/11/88	08/11/88	
10400	161	Vol. Blk	FB		NA	NA	NA	
10400	162	I10/HB01	2.5	08/01/88	08/04/88	08/11/88	08/11/88	
10400	163	M10/HB01	0.6	08/01/88	08/04/88	08/11/88	08/11/88	
10400	164	N10/HB01	7.5	08/01/88	08/08/88	08/11/88	08/11/88	
10400	165	010/HB01	2.5	08/01/88	08/04/88	08/11/88	08/11/88	
10400	166	09/HB01	0.7	08/01/88	08/04/88	08/11/88	08/11/88	
10400	167	Vol. Blk	FB		NA	NA	NA	
10400	168	Q9/HB01	2.5	08/02/88	08/04/88	08/11/88	08/11/88	
10400	169	R9/HB01	0.4	08/02/88	08/04/88	08/11/88	08/11/88	
10400	170	S9/HB01	7.5	08/02/88	08/04/88	08/11/88	08/11/88	
10400	171	N8/HB01	0.6	08/02/88	08/04/88	08/11/88	08/11/88	
10400	172	08/HB01	5	08/02/88	08/04/88	08/11/88	08/11/88	
10400	173	P8/HB01	7.5	08/02/88	08/04/88	08/11/88	08/11/88	
10400	174	Vol. Blk	FB		NA	NA	NA	
10400	175	N1/HB01	0.6	08/03/88	08/09/88	08/11/88	08/11/88	
10400	176	P1/HB01	5	08/03/88	08/08/88	08/11/88	08/11/88	
10400	177	R1/HB01	2.5	08/03/88	08/08/88	08/11/88	08/11/88	
10400	178	R1/HB01	11	08/03/88	08/08/88	08/11/88	08/11/88	
10400	179	U1/HB01	7.5	08/03/88	08/08/88	08/11/88	08/11/88	
10400	180	V1/HB01	0.3	08/03/88	08/08/88	08/11/88	08/11/88	
10400	181	03/HB01	7.5	08/03/88	08/08/88	08/11/88	08/11/88	
10400	182	Vol. Blk	FB		NA	NA	NA	
10400	183	N2/HB01	2.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	184	N3/HB01	7.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	185	N3/HB01	11	08/04/88	08/09/88	08/11/88	08/11/88	

Table II: Analytical History (page 16 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX ICAP Ext.	EP TOX ICAP Prep.	EP TOX ICAP Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
10400	186	P3/HB01	5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	187	04/HB01	1.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	188	P4/HB01	2.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	189	S2/HB01	1.2	08/04/88	08/09/88	08/11/88	08/11/88	
10400	190	T2/HB01	2.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	191	T3/HB01	7.5	08/04/88	08/09/88	08/11/88	08/11/88	
10400	192	Vol. Blk	FB		NA	NA	NA	
Interim Report #8								
10400	193	R4/HB01	0.5	08/05/88	08/09/88	08/18/88	08/18/88	
10400	194	S4/HB01	2.5	08/05/88	08/09/88	08/18/88	08/18/88	
10400	195	T4/HB01	7.5	08/05/88	08/09/88	08/18/88	08/18/88	
10400	196	P5/HB01	5	08/05/88	08/09/88	08/18/88	08/18/88	
10400	197	S5/HB01	0.1	08/05/88	08/09/88	08/18/88	08/18/88	
10400	198	T5/HB01	0.4	08/05/88	08/09/88	08/18/88	08/18/88	
10400	199	R6/HB01	0.2	08/05/88	08/09/88	08/18/88	08/18/88	
10400	200	P6/HB01	0.5	08/05/88	08/09/88	08/18/88	08/18/88	
10400	201	Vol. Blk	FB		NA	NA	NA	
10400	202	Q4/HB01	7.5	08/08/88	08/10/88	08/18/88	08/18/88	
10400	203	Q6/HB01	3	08/08/88	08/10/88	08/18/88	08/18/88	
10400	204	Q7/HB01	5	08/08/88	08/10/88	08/18/88	08/18/88	
10400	205	Q8/HB01	1	08/08/88	08/10/88	08/18/88	08/18/88	
10400	206	Q10/HB01	7.5	08/08/88	08/10/88	08/18/88	08/18/88	
10400	207	Q11/HB01	5	08/08/88	08/10/88	08/18/88	08/18/88	
10400	208	Vol. Blk	FB		NA	NA	NA	
10400	209	L11/HB01	2.5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	210	N11/HB01	5	08/09/88	08/15/88	08/18/88	08/18/88	
10400	211	R11/HB01	7.5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	212	T11/HB01	1	08/09/88	08/11/88	08/18/88	08/18/88	
10400	213	V11/HB01	7.5	08/09/88	08/15/88	08/18/88	08/18/88	
10400	214	W11/HB01	2	08/09/88	08/11/88	08/18/88	08/18/88	
10400	215	T12/HB01	5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	216	W12/HB01	7.5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	217	S8/HB01	2.5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	218	S8/HB01	11	08/09/88	08/11/88	08/18/88	08/18/88	
10400	219	T8/HB01	1.2	08/09/88	08/11/88	08/18/88	08/18/88	
10400	220	Q2/HB01	2	08/09/88	08/11/88	08/18/88	08/18/88	
10400	221	V9/HB01	0.6	08/09/88	08/11/88	08/18/88	08/18/88	
10400	222	W9/HB01	7.5	08/09/88	08/11/88	08/18/88	08/18/88	
10400	223	Vol. Blk	FB		NA	NA	NA	
10400	224	P10/HB01	1	08/10/88	08/15/88	08/18/88	08/18/88	
10400	225	P9/HB01	7.5	08/10/88	08/15/88	08/18/88	08/18/88	
10400	226	P9/HB01	11	08/10/88	08/15/88	08/18/88	08/18/88	
10400	227	05/HB01	2.5	08/10/88	08/15/88	08/18/88	08/18/88	
10400	228	P2/HB01	1.9	08/10/88	08/15/88	08/18/88	08/18/88	
10400	229	L7/HB01	0.6	08/10/88	08/15/88	08/18/88	08/18/88	
10400	230	M7/HB01	5	08/10/88	08/15/88	08/18/88	08/18/88	
10400	231	N7/HB01	2.5	08/10/88	08/15/88	08/18/88	08/18/88	
10400	232	07/HB01	7.5	08/10/88	08/15/88	08/18/88	08/18/88	

Table II: Analytical History (page 17 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	EP TOX ICAP Ext.	EP TOX ICAP Prep.	EP TOX ICAP Anal.	Exceptions to EP TOX ICAP Ext./Prep./Anal. Dates
10400	233	Vol. Blk	FB		NA	NA	NA	
10400	234	U2/HB01	5	08/11/88	08/15/88	08/18/88	08/18/88	
10400	235	B1/HB01	0.2	08/11/88	08/15/88	08/18/88	08/18/88	
10400	236	B3/HB01	2.5	08/11/88	08/16/88	08/18/88	08/18/88	
10400	237	A12/HB01	0.2	08/11/88	08/15/88	08/18/88	08/18/88	
10400	238	A13/HB01	7.5	08/11/88	08/15/88	08/18/88	08/18/88	
10400	239	B13/HB01	0.2	08/11/88	08/15/88	08/18/88	08/18/88	
10400	240	Vol. Blk	FB		NA	NA	NA	
Interim Report #9								
10400	241	L6/HB01	2.5	08/12/88	08/16/88	08/24/88	08/25/88	
10400	242	N6/HB01	7.5	08/12/88	08/16/88	08/24/88	08/25/88	
10400	243	M8/HB01	0.7	08/12/88	08/16/88	08/24/88	08/25/88	
10400	244	L8/HB01	7.5	08/12/88	08/16/88	08/24/88	08/25/88	
10400	245	L8/HB01	11	08/12/88	08/16/88	08/24/88	08/25/88	
10400	246	E9/HB01	1.1	08/12/88	08/22/88	08/24/88	08/25/88	
10400	247	Vol. Blk	FB		NA	NA	NA	
10400	248	R2/HB01	7.5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	249	Q3/HB01	0.5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	250	R3/HB01	2.5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	251	S3/HB01	7.5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	252	O2/HB01	5	08/15/88	08/22/88	08/24/88	08/25/88	
10400	253	R10/HB01	5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	254	T9/HB01	5	08/15/88	08/17/88	08/24/88	08/25/88	
10400	255	Vol. Blk	FB		NA	NA	NA	
10400	256	O11/HB01	7.5	08/16/88	08/18/88	08/24/88	08/25/88	
10400	257	R8/HB01	5	08/16/88	08/18/88	08/24/88	08/25/88	
10400	258	R8/HB01	11	08/16/88	08/18/88	08/24/88	08/25/88	
10400	259	S6/HB01	7.5	08/16/88	08/18/88	08/24/88	08/25/88	
10400	260	T6/HB01	5	08/16/88	08/18/88	08/24/88	08/25/88	
10400	261	Vol. Blk	FB		NA	NA	NA	
10400	262	U3/HB01	0.0	08/17/88	08/22/88	08/24/88	08/25/88	
10400	263	P7/HB01	0.7	08/17/88	08/22/88	08/24/88	08/25/88	
10400	264	R7/HB01	0.6	08/17/88	08/22/88	08/24/88	08/25/88	
10400	265	M1/HB01	2.5	08/17/88	08/22/88	08/24/88	08/25/88	
10400	266	Vol. Blk	FB		NA	NA	NA	
10400	267	N5/HB01	5	08/24/88	08/25/88	08/30/88	08/31/88	

Table II: Analytical History (page 18 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
Interim Report #1								
10400	1	B9/HT01	2	06/17/88	06/17/88	06/20/88	06/17/88	06/20/88
10400	2	E7/HT01	2.5	06/17/88	06/17/88	06/20/88	06/17/88	06/20/88
10400	3	Q5/HT01	4	06/17/88	06/17/88	06/20/88	06/17/88	06/20/88
Interim Report #2								
10400	4	C1/HT01	9	06/27/88	NA	NA	NA	NA
10400	5	C3/HT01	1	06/27/88	07/03/88	07/08/88	07/03/88	07/06/88
10400	6	C5/HT01	4	06/27/88	07/03/88	07/07/88	07/03/88	07/07/88
10400	7	C7/HT01	1.5	06/27/88	NA	NA	NA	NA
10400	8	C9/HT01	8	06/27/88	NA	NA	NA	NA
10400	9	A11/HT01	4	06/28/88	07/03/88	07/06/88	07/03/88	07/07/88
10400	10	B11/HT01	8	06/28/88	07/03/88	07/08/88	07/03/88	07/07/88
10400	11	C11/HT01	4	06/28/88	07/03/88	07/08/88	07/03/88	07/07/88
10400	12	D11/HT01	1.5	06/28/88	07/03/88	07/08/88	07/03/88	07/07/88
10400	13	E11/HT01	4	06/28/88	07/03/88	07/08/88	07/03/88	07/07/88
10400	14	B12/HT01	5	06/28/88	NA	NA	NA	NA
10400	15				NA	NA	NA	NA
10400	16	F11/HT01	5	06/29/88	NA	NA	NA	NA
10400	17	G11/HT01	7	06/29/88	NA	NA	NA	NA
10400	18	H11/HT01	5.5	06/29/88	07/03/88	07/07/88	07/03/88	07/08/88
10400	19	I11/HT01	2	06/29/88	07/03/88	07/07/88	07/03/88	07/08/88
10400	20	J12/HT01	6.5	06/29/88	NA	NA	NA	NA
10400	21				NA	NA	NA	NA
10400	22	C12/HT01	2	06/30/88	07/03/88	07/08/88	07/03/88	07/08/88
10400	23	D12/HT01	7	06/30/88	07/03/88	07/07/88	07/03/88	07/08/88
10400	24	C13/HT01	4	06/30/88	NA	NA	NA	NA
10400	25	D13/HT01	3	06/30/88	NA	NA	NA	NA
10400	26	F13/HT01	8	06/30/88	NA	NA	NA	NA
10400	27	Spoon	RinseB	06/30/88	07/15/88*	07/18/88	07/02/88	07/06/88
10400	28	PACCAR	TB		NA	NA	NA	NA
10400	29	PACCAR	FB		NA	NA	NA	NA
Interim Report #3								
10400	30	H13/HT01	2	07/01/88	NA	NA	NA	NA
10400	31	H12/HT01	4	07/01/88	NA	NA	NA	NA
10400	32	F12/HT01	3	07/01/88	NA	NA	NA	NA
10400	33	Field Blk	FB		NA	NA	NA	NA
10400	34	J13/HT01	6	07/05/88	NA	NA	NA	NA
10400	35	L12/HT01	2	07/05/88	NA	NA	NA	NA
10400	36	L13/HT01	9	07/05/88	NA	NA	NA	NA
10400	37	N12/HT01	4	07/05/88	NA	NA	NA	NA
10400	38	N13/HT01	3	07/05/88	NA	NA	NA	NA
10400	39	Field Blk	FB		NA	NA	NA	NA
10400	40	R12/HT01	3	07/06/88	07/11/88	07/14/88	07/11/88	07/13/88
10400	41	P12/HT01	7	07/06/88	NA	NA	NA	NA
10400	42	P13/HT01	5	07/06/88	NA	NA	NA	NA
10400	43	T13/HT01	2	07/06/88	NA	NA	NA	NA
10400	44	R13/HT01	6	07/06/88	07/11/88	07/14/88	07/11/88	07/13/88
10400	45	P13/HT01	11	07/06/88	NA	NA	NA	NA

Table II: Analytical History (page 19 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
10400	46	Field Blk	FB		NA	NA	NA	NA
10400	47	D1/HT01	5	07/07/88	07/11/88	07/14/88	07/11/88	07/14/88
10400	48	D3/HT01	3	07/07/88	NA	NA	NA	NA
10400	49	D5/HT01	4	07/07/88	NA	NA	NA	NA
10400	50	V13/HT01	6	07/07/88	NA	NA	NA	NA
10400	51	V12/HT01	6	07/07/88	NA	NA	NA	NA
10400	52	Vol. Blk	FB		NA	NA	NA	NA
Interim Report #4								
10400	53	A9/HT01	7	07/08/88	NA	NA	NA	NA
10400	54	A7/HT01	2	07/08/88	NA	NA	NA	NA
10400	55	A5/HT01	4	07/08/88	NA	NA	NA	NA
10400	56	B7/HT01	7	07/08/88	NA	NA	NA	NA
10400	57	B5/HT01	3	07/08/88	NA	NA	NA	NA
10400	58	Vol. Blk	FB		NA	NA	NA	NA
10400	59	A1/HT01	9	07/11/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	60	A3/HT01	5	07/11/88	07/13/88	07/19/88	07/13/88	07/20/88
10400	61	A3/HT01	11	07/11/88	07/13/88	07/19/88	07/13/88	07/20/88
10400	62	D7/HT01	7	07/11/88	NA	NA	NA	NA
10400	63	E5/HT01	8	07/11/88	NA	NA	NA	NA
10400	64	E6/HT01	2	07/11/88	07/13/88	07/19/88	07/13/88	07/19/88
10400	65	E8/HT01	4	07/11/88	NA	NA	NA	NA
10400	66	VOA Blank	FB		NA	NA	NA	NA
10400	67	D9/HT01	5	07/12/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	68	D9/HT01	11	07/12/88	NA	NA	NA	NA
10400	69	F3/HT01	4	07/12/88	NA	NA	NA	NA
10400	70	F4/HT01	8	07/12/88	NA	NA	NA	NA
10400	71	F5/HT01	5	07/12/88	07/13/88	07/19/88	07/13/88	07/20/88
10400	72	G3/HT01	4	07/12/88	NA	NA	NA	NA
10400	73	Spoon	RinseB	07/12/88	07/14/88	07/18/88	07/14/88	07/18/88
10400	74	Vol. Blk	FB		NA	NA	NA	NA
10400	75	H1/HT01	1	07/13/88	NA	NA	NA	NA
10400	76	H1/HT01	11	07/13/88	NA	NA	NA	NA
10400	77	H6/HT01	7	07/13/88	NA	NA	NA	NA
10400	78	H7/HT01	1	07/13/88	07/18/88	07/20/88	07/18/88	07/21/88
10400	79	F1/HT01	2	07/13/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	80	F8/HT01	2	07/13/88	NA	NA	NA	NA
10400	81	G7/HT01	4	07/13/88	NA	NA	NA	NA
10400	82	Field Blk	FB		NA	NA	NA	NA
10400	83	E10/HT01	4	07/14/88	NA	NA	NA	NA
10400	84	F9/HT01	7	07/14/88	NA	NA	NA	NA
10400	85	G10/HT01	3	07/14/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	86	J11/HT01	7	07/14/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	87	K11/HT01	2	07/14/88	07/18/88	07/20/88	07/18/88	07/20/88
10400	88	H10/HT01	7	07/14/88	NA	NA	NA	NA
10400	89	Field Blk	FB		NA	NA	NA	NA
Interim Report #5								
10400	90	K3/HT01	4	07/15/88	07/21/88	07/27/88	07/27/88*	07/28/88
10400	91	L3/HT01	2	07/15/88	07/21/88	07/27/88	07/21/88	07/27/88

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Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
10400	92	M3/HT01	2	07/15/88	07/21/88	07/27/88	07/21/88	07/27/88
10400	93	K4/HT01	7	07/15/88	NA	NA	NA	NA
10400	94	J4/HT01	2	07/18/88	07/25/88	07/29/88	07/25/88	07/28/88
10400	95	L4/HT01	3.5	07/18/88	NA	NA	NA	NA
10400	96	M4/HT01	8	07/18/88	NA	NA	NA	NA
10400	97	N4/HT01	5	07/18/88	NA	NA	NA	NA
10400	98	P11/HT01	2	07/18/88	07/21/88	07/29/88	07/21/88	07/26/88
10400	99	I5/HT01	8	07/18/88	NA	NA	NA	NA
10400	100	Field Blk	FB		NA	NA	NA	NA
10400	101	M11/HT01	7	07/19/88	NA	NA	NA	NA
10400	102	R5/HT01	7	07/19/88	07/21/88	07/29/88	07/21/88	07/27/88
10400	103	S7/HT01	4	07/19/88	07/25/88	07/28/88	07/25/88	07/28/88
10400	104	T7/HT01	7	07/19/88	NA	NA	NA	NA
10400	105	U7/HT01	1	07/19/88	07/25/88	07/29/88	07/25/88	07/28/88
10400	106	Field Blk	FB		NA	NA	NA	NA
10400	107	G8/HB01	5	07/21/88	NA	NA	NA	NA
10400	108	H8/HB01	0.9	07/21/88	NA	NA	NA	NA
10400	109	I8/HB01	5	07/21/88	NA	NA	NA	NA
10400	110	J8/HB01	0.7	07/21/88	07/25/88	07/29/88	07/25/88	07/27/88
10400	111	K8/HB01	5	07/21/88	NA	NA	NA	NA
10400	112	K7/HB01	3.5	07/21/88	NA	NA	NA	NA
10400	113	Trip Blk	FB		NA	NA	NA	NA
Interim Report #6								
10400	114	G6/HB01	0.1	07/22/88	07/27/88	08/01/88	07/27/88	08/03/88
10400	115	I6/HB01	5.0	07/22/88	07/27/88	08/01/88	07/27/88	08/01/88
10400	116	F7/HB01	7.5	07/22/88	NA	NA	NA	NA
10400	117	I4/HB01	2.5	07/22/88	07/27/88	08/02/88	07/27/88	08/02/88
10400	118	J5/HB01	2.5	07/22/88	07/27/88	08/03/88	07/27/88	08/03/88
10400	119	G9/HB01	0.7	07/22/88	NA	NA	NA	NA
10400	120	I7/HB01	2.5	07/22/88	NA	NA	NA	NA
10400	121	J7/HB01	5.0	07/22/88	NA	NA	NA	NA
10400	122	Vol. Blk	FB		NA	NA	NA	NA
10400	123	F10/HB01	0.7	07/25/88	NA	NA	NA	NA
10400	124	H9/HB01	5	07/25/88	NA	NA	NA	NA
10400	125	J6/HB01	0.5	07/25/88	07/29/88	08/03/88	07/29/88	08/03/88
10400	126	K6/HB01	7.5	07/25/88	07/29/88	08/03/88	07/29/88	08/02/88
10400	127	M6/HB01	0.6	07/25/88	07/29/88	08/04/88	07/29/88	08/02/88
10400	128	Vol. Blk	FB		NA	NA	NA	NA
10400	129	J1/HB01	7.5	07/26/88	NA	NA	NA	NA
10400	130	L1/HB01	5.0	07/26/88	07/27/88	08/04/88	07/27/88	08/02/88
10400	131	L1/HB01	11.0	07/26/88	07/27/88	08/04/88	07/27/88	08/02/88
10400	132	K5/HB01	0.5	07/26/88	08/01/88	08/04/88	08/01/88	08/04/88
10400	133	L5/HB01	5.0	07/26/88	NA	NA	NA	NA
10400	134	M5/HB01	7.5	07/26/88	NA	NA	NA	NA
10400	135	Vol. Blk	FB		NA	NA	NA	NA
10400	136	H5/HB01	0.3	07/27/88	NA	NA	NA	NA
10400	137	F6/HB01	5	07/27/88	07/29/88	08/04/88	07/29/88	08/02/88
10400	138	G5/HB01	7.5	07/27/88	07/29/88	08/04/88	07/29/88	08/02/88

Table II: Analytical History (page 21 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
10400	139	H4/HB01	7.5	07/27/88	NA	NA	NA	NA
10400	140	I3/HB01	0.5	07/27/88	NA	NA	NA	NA
10400	141	J3/HB01	5	07/27/88	07/29/88	08/04/88	07/29/88	08/02/88
10400	142	06/HB01	0.5	07/27/88	NA	NA	NA	NA
10400	143	Spoon	RinseB	07/27/88	07/29/88	08/01/88	07/29/88	08/01/88
10400	144	Vol. Blk	FB		NA	NA	NA	NA
10400	145	G4/HB01	0.3	07/28/88	08/01/88	08/04/88	08/01/88	08/04/88
10400	146	H3/HB01	5	07/28/88	NA	NA	NA	NA
10400	147	W7/HB01	2.5	07/28/88	08/01/88	08/04/88	08/01/88	08/03/88
10400	148	V7/HB01	5	07/28/88	08/02/88	08/04/88	08/02/88	08/04/88
10400	149	W5/HB01	7.5	07/28/88	08/01/88	08/04/88	08/01/88	08/03/88
10400	150	W3/HB01	0.2	07/28/88	08/02/88	08/05/88	08/02/88	08/04/88
10400	151	V3/HB01	2.5	07/28/88	08/01/88	08/05/88	08/01/88	08/04/88
10400	152	V5/HB01	0.2	07/28/88	08/02/88	08/05/88	08/02/88	08/04/88
10400	153	Vol. Blk	FB		NA	NA	NA	NA
Interim Report #7								
10400	154	I9/HB01	0.4	07/29/88	08/04/88	08/09/88	08/04/88	08/09/88
10400	155	J9/HB01	5	07/29/88	08/04/88	08/09/88	08/04/88	08/09/88
10400	156	K9/HB01	7.5	07/29/88	NA	NA	NA	NA
10400	157	L9/HB01	0.5	07/29/88	08/04/88	08/09/88	08/04/88	08/08/88
10400	158	L10/HB01	2.5	07/29/88	08/04/88	08/10/88	08/04/88	08/09/88
10400	159	M9/HB01	5	07/29/88	08/04/88	08/10/88	08/04/88	08/08/88
10400	160	N9/HB01	2.5	07/29/88	NA	NA	NA	NA
10400	161	Vol. Blk	FB		NA	NA	NA	NA
10400	162	I10/HB01	2.5	08/01/88	NA	NA	NA	NA
10400	163	M10/HB01	0.6	08/01/88	08/04/88	08/10/88	08/04/88	08/08/88
10400	164	N10/HB01	7.5	08/01/88	NA	NA	NA	NA
10400	165	010/HB01	2.5	08/01/88	08/08/88	08/12/88	08/08/88	08/11/88
10400	166	09/HB01	0.7	08/01/88	08/08/88	08/13/88	08/08/88	08/12/88
10400	167	Vol. Blk	FB		NA	NA	NA	NA
10400	168	Q9/HB01	2.5	08/02/88	08/04/88	08/10/88	08/04/88	08/08/88
10400	169	R9/HB01	0.4	08/02/88	NA	NA	NA	NA
10400	170	S9/HB01	7.5	08/02/88	08/04/88	08/10/88	08/04/88	08/09/88
10400	171	N8/HB01	0.6	08/02/88	08/08/88	08/14/88	08/08/88	08/12/88
10400	172	08/HB01	5	08/02/88	NA	NA	NA	NA
10400	173	P8/HB01	7.5	08/02/88	NA	NA	NA	NA
10400	174	Vol. Blk	FB		NA	NA	NA	NA
10400	175	N1/HB01	0.6	08/03/88	08/10/88	08/13/88	08/10/88	08/11/88
10400	176	P1/HB01	5	08/03/88	08/10/88	08/12/88	08/10/88	08/11/88
10400	177	R1/HB01	2.5	08/03/88	08/10/88	08/13/88	08/10/88	08/11/88
10400	178	R1/HB01	11	08/03/88	08/10/88	08/13/88	08/10/88	08/11/88
10400	179	U1/HB01	7.5	08/03/88	08/04/88	08/12/88	08/04/88	08/09/88
10400	180	V1/HB01	0.3	08/03/88	08/10/88	08/15/88	08/10/88	08/12/88
10400	181	03/HB01	7.5	08/03/88	08/04/88	08/10/88	08/04/88	08/09/88
10400	182	Vol. Blk	FB		NA	NA	NA	NA
10400	183	N2/HB01	2.5	08/04/88	08/10/88	08/13/88	08/10/88	08/11/88
10400	184	N3/HB01	7.5	08/04/88	08/08/88	08/12/88	08/08/88	08/10/88
10400	185	N3/HB01	11	08/04/88	08/08/88	08/12/88	08/08/88	08/11/88

Table II: Analytical History (page 22 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
10400	186	P3/HB01	5	08/04/88	NA	NA	NA	NA
10400	187	04/HB01	1.5	08/04/88	08/08/88	08/14/88	08/08/88	08/11/88
10400	188	P4/HB01	2.5	08/04/88	NA	NA	NA	NA
10400	189	S2/HB01	1.2	08/04/88	08/10/88	08/12/88	08/10/88	08/11/88
10400	190	T2/HB01	2.5	08/04/88	NA	NA	NA	NA
10400	191	T3/HB01	7.5	08/04/88	08/08/88	08/14/88	08/08/88	08/12/88
10400	192	Vol. Blk	FB		NA	NA	NA	NA
Interim Report #8								
10400	193	R4/HB01	0.5	08/05/88	08/12/88	08/16/88	08/12/88	08/18/88
10400	194	S4/HB01	2.5	08/05/88	NA	NA	NA	NA
10400	195	T4/HB01	7.5	08/05/88	NA	NA	NA	NA
10400	196	P5/HB01	5	08/05/88	NA	NA	NA	NA
10400	197	S5/HB01	0.1	08/05/88	08/12/88	08/17/88	08/12/88	08/17/88
10400	198	T5/HB01	0.4	08/05/88	08/12/88	08/17/88	08/12/88	08/17/88
10400	199	R6/HB01	0.2	08/05/88	08/12/88	08/17/88	08/12/88	08/18/88
10400	200	P6/HB01	0.5	08/05/88	08/12/88	08/16/88	08/12/88	08/17/88
10400	201	Vol. Blk	FB		NA	NA	NA	NA
10400	202	Q4/HB01	7.5	08/08/88	08/13/88	08/15/88	08/13/88	08/15/88
10400	203	Q6/HB01	3	08/08/88	08/13/88	08/15/88	08/13/88	08/15/88
10400	204	Q7/HB01	5	08/08/88	08/12/88	08/16/88	08/12/88	08/18/88
10400	205	Q8/HB01	1	08/08/88	08/12/88	08/16/88	08/12/88	08/19/88
10400	206	Q10/HB01	7.5	08/08/88	NA	NA	NA	NA
10400	207	Q11/HB01	5	08/08/88	08/12/88	08/16/88	08/12/88	08/16/88
10400	208	Vol. Blk	FB		NA	NA	NA	NA
10400	209	L11/HB01	2.5	08/09/88	08/12/88	08/18/88	08/12/88	08/16/88
10400	210	N11/HB01	5	08/09/88	NA	NA	NA	NA
10400	211	R11/HB01	7.5	08/09/88	NA	NA	NA	NA
10400	212	T11/HB01	1	08/09/88	08/13/88	08/17/88	08/13/88	08/16/88
10400	213	V11/HB01	7.5	08/09/88	NA	NA	NA	NA
10400	214	W11/HB01	2	08/09/88	NA	NA	NA	NA
10400	215	T12/HB01	5	08/09/88	NA	NA	NA	NA
10400	216	W12/HB01	7.5	08/09/88	08/12/88	08/17/88	08/12/88	08/16/88
10400	217	S8/HB01	2.5	08/09/88	NA	NA	NA	NA
10400	218	S8/HB01	11	08/09/88	NA	NA	NA	NA
10400	219	T8/HB01	1.2	08/09/88	NA	NA	NA	NA
10400	220	Q2/HB01	2	08/09/88	08/13/88	08/15/88	08/13/88	08/15/88
10400	221	V9/HB01	0.6	08/09/88	08/13/88	08/16/88	08/13/88	08/15/88
10400	222	W9/HB01	7.5	08/09/88	NA	NA	NA	NA
10400	223	Vol. Blk	FB		NA	NA	NA	NA
10400	224	P10/HB01	1	08/10/88	08/12/88	08/17/88	08/12/88	08/19/88
10400	225	P9/HB01	7.5	08/10/88	08/12/88	08/17/88	08/12/88	08/18/88
10400	226	P9/HB01	11	08/10/88	08/12/88	08/17/88	08/12/88	08/19/88
10400	227	05/HB01	2.5	08/10/88	NA	NA	NA	NA
10400	228	P2/HB01	1.9	08/10/88	08/16/88	08/18/88	08/16/88	08/19/88
10400	229	L7/HB01	0.6	08/10/88	08/16/88	08/18/88	08/16/88	08/19/88
10400	230	M7/HB01	5	08/10/88	NA	NA	NA	NA
10400	231	N7/HB01	2.5	08/10/88	NA	NA	NA	NA
10400	232	07/HB01	7.5	08/10/88	NA	NA	NA	NA

Table II: Analytical History (page 23 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	GC/FID Prep.	GC/FID Anal.	GC/MS BAN Prep.	GC/MS BAN Anal.
10400	233	Vol. Blk	FB		NA	NA	NA	NA
10400	234	U2/HB01	5	08/11/88	08/13/88	08/17/88	08/13/88	08/15/88
10400	235	B1/HB01	0.2	08/11/88	08/16/88	08/18/88	08/16/88	08/19/88
10400	236	B3/HB01	2.5	08/11/88	08/13/88	08/16/88	08/13/88	08/15/88
10400	237	A12/HB01	0.2	08/11/88	NA	NA	NA	NA
10400	238	A13/HB01	7.5	08/11/88	08/13/88	08/15/88	08/13/88	08/15/88
10400	239	B13/HB01	0.2	08/11/88	08/16/88	08/18/88	08/16/88	08/18/88
10400	240	Vol. Blk	FB		NA	NA	NA	NA
Interim Report #9								
10400	241	L6/HB01	2.5	08/12/88	NA	NA	NA	NA
10400	242	N6/HB01	7.5	08/12/88	08/19/88	08/22/88	08/19/88	08/25/88
10400	243	M8/HB01	0.7	08/12/88	08/19/88	08/22/88	08/19/88	08/25/88
10400	244	L8/HB01	7.5	08/12/88	NA	NA	NA	NA
10400	245	L8/HB01	11	08/12/88	NA	NA	NA	NA
10400	246	E9/HB01	1.1	08/12/88	08/19/88	08/22/88	08/19/88	08/24/88
10400	247	Vol. Blk	FB		NA	NA	NA	NA
10400	248	R2/HB01	7.5	08/15/88	08/23/88*	08/28/88	08/23/88*	08/25/88
10400	249	Q3/HB01	0.5	08/15/88	08/23/88*	08/28/88	08/23/88*	08/25/88
10400	250	R3/HB01	2.5	08/15/88	NA	NA	NA	NA
10400	251	S3/HB01	7.5	08/15/88	NA	NA	NA	NA
10400	252	O2/HB01	5	08/15/88	NA	NA	NA	NA
10400	253	R10/HB01	5	08/15/88	NA	NA	NA	NA
10400	254	T9/HB01	5	08/15/88	NA	NA	NA	NA
10400	255	Vol. Blk	FB		NA	NA	NA	NA
10400	256	O11/HB01	7.5	08/16/88	NA	NA	NA	NA
10400	257	R8/HB01	5	08/16/88	NA	NA	NA	NA
10400	258	R8/HB01	11	08/16/88	NA	NA	NA	NA
10400	259	S6/HB01	7.5	08/16/88	NA	NA	NA	NA
10400	260	T6/HB01	5	08/16/88	NA	NA	NA	NA
10400	261	Vol. Blk	FB		NA	NA	NA	NA
10400	262	U3/HB01	0.0	08/17/88	08/23/88	08/28/88	08/23/88	08/25/88
10400	263	P7/HB01	0.7	08/17/88	08/23/88	08/29/88	08/23/88	08/25/88
10400	264	R7/HB01	0.6	08/17/88	08/19/88	08/22/88	08/19/88	08/24/88
10400	265	M1/HB01	2.5	08/17/88	08/23/88	08/29/88	08/23/88	08/25/88
10400	266	Vol. Blk	FB		NA	NA	NA	NA
10400	267	N5/HB01	5	08/24/88	NA	NA	NA	NA

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
Interim Report #1							
10400	1	B9/HT01	2	06/17/88	06/20/88	06/23/88	06/21/88
10400	2	E7/HT01	2.5	06/17/88	06/20/88	06/23/88	06/21/88
10400	3	Q5/HT01	4	06/17/88	06/20/88	06/23/88	06/22/88
Interim Report #2							
10400	4	C1/HT01	9	06/27/88	NA	NA	NA
10400	5	C3/HT01	1	06/27/88	07/03/88	07/08/88	NA
10400	6	C5/HT01	4	06/27/88	07/03/88	07/08/88	NA
10400	7	C7/HT01	1.5	06/27/88	NA	NA	NA
10400	8	C9/HT01	8	06/27/88	NA	NA	06/29/88
10400	9	A11/HT01	4	06/28/88	07/03/88	07/08/88	NA
10400	10	B11/HT01	8	06/28/88	07/03/88	07/08/88	NA
10400	11	C11/HT01	4	06/28/88	07/03/88	07/08/88	NA
10400	12	D11/HT01	1.5	06/28/88	07/03/88	07/08/88	NA
10400	13	E11/HT01	4	06/28/88	07/03/88	07/08/88	06/29/88
10400	14	B12/HT01	5	06/28/88	NA	NA	NA
10400	15				NA	NA	06/29/88
10400	16	F11/HT01	5	06/29/88	NA	NA	NA
10400	17	G11/HT01	7	06/29/88	NA	NA	NA
10400	18	H11/HT01	5.5	06/29/88	07/03/88	07/08/88	06/30/88
10400	19	I11/HT01	2	06/29/88	07/03/88	07/08/88	NA
10400	20	J12/HT01	6.5	06/29/88	NA	NA	06/30/88
10400	21				NA	NA	06/30/88
10400	22	C12/HT01	2	06/30/88	07/03/88	07/08/88	NA
10400	23	D12/HT01	7	06/30/88	07/03/88	07/08/88	NA
10400	24	C13/HT01	4	06/30/88	NA	NA	NA
10400	25	D13/HT01	3	06/30/88	NA	NA	NA
10400	26	F13/HT01	8	06/30/88	NA	NA	07/05/88
10400	27	Spoon	RinseB	06/30/88	07/02/88	07/08/88	07/05/88
10400	28	PACCAR	TB		NA	NA	07/05/88
10400	29	PACCAR	FB		NA	NA	NA
Interim Report #3							
10400	30	H13/HT01	2	07/01/88	NA	NA	NA
10400	31	H12/HT01	4	07/01/88	NA	NA	NA
10400	32	F12/HT01	3	07/01/88	NA	NA	NA
10400	33	Field Blk	FB		NA	NA	NA
10400	34	J13/HT01	6	07/05/88	NA	NA	NA
10400	35	L12/HT01	2	07/05/88	NA	NA	NA
10400	36	L13/HT01	9	07/05/88	NA	NA	NA
10400	37	N12/HT01	4	07/05/88	NA	NA	07/11/88
10400	38	N13/HT01	3	07/05/88	NA	NA	07/11/88
10400	39	Field Blk	FB		NA	NA	07/11/88
10400	40	R12/HT01	3	07/06/88	07/11/88	07/14/88	NA
10400	41	P12/HT01	7	07/06/88	NA	NA	NA
10400	42	P13/HT01	5	07/06/88	NA	NA	07/11/88
10400	43	T13/HT01	2	07/06/88	NA	NA	NA
10400	44	R13/HT01	6	07/06/88	07/11/88	07/14/88	NA
10400	45	P13/HT01	11	07/06/88	NA	NA	07/11/88

Table II: Analytical History (page 25 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
10400	46	Field Blk	FB		NA	NA	07/11/88
10400	47	D1/HT01	5	07/07/88	07/11/88	07/14/88	NA
10400	48	D3/HT01	3	07/07/88	NA	NA	07/11/88
10400	49	D5/HT01	4	07/07/88	NA	NA	07/11/88
10400	50	V13/HT01	6	07/07/88	NA	NA	NA
10400	51	V12/HT01	6	07/07/88	NA	NA	NA
10400	52	Vol. Blk	FB		NA	NA	07/11/88
Interim Report #4							
10400	53	A9/HT01	7	07/08/88	NA	NA	NA
10400	54	A7/HT01	2	07/08/88	NA	NA	NA
10400	55	A5/HT01	4	07/08/88	NA	NA	07/18/88
10400	56	B7/HT01	7	07/08/88	NA	NA	NA
10400	57	B5/HT01	3	07/08/88	NA	NA	07/18/88
10400	58	Vol. Blk	FB		NA	NA	07/19/88*
10400	59	A1/HT01	9	07/11/88	07/18/88	07/20/88	NA
10400	60	A3/HT01	5	07/11/88	07/13/88	07/15/88	07/19/88
10400	61	A3/HT01	11	07/11/88	07/13/88	07/15/88	07/19/88
10400	62	D7/HT01	7	07/11/88	NA	NA	NA
10400	63	E5/HT01	8	07/11/88	NA	NA	NA
10400	64	E6/HT01	2	07/11/88	07/13/88	07/15/88	07/18/88
10400	65	E8/HT01	4	07/11/88	NA	NA	NA
10400	66	VOA Blank	FB		NA	NA	07/19/88
10400	67	D9/HT01	5	07/12/88	07/18/88	07/20/88	NA
10400	68	D9/HT01	11	07/12/88	NA	NA	NA
10400	69	F3/HT01	4	07/12/88	NA	NA	07/18/88
10400	70	F4/HT01	8	07/12/88	NA	NA	NA
10400	71	F5/HT01	5	07/12/88	07/13/88	07/15/88	NA
10400	72	G3/HT01	4	07/12/88	NA	NA	07/18/88
10400	73	Spoon	RinseB	07/12/88	07/14/88	07/15/88	07/19/88
10400	74	Vol. Blk	FB		NA	NA	07/20/88
10400	75	H1/HT01	1	07/13/88	NA	NA	07/18/88
10400	76	H1/HT01	11	07/13/88	NA	NA	07/18/88
10400	77	H6/HT01	7	07/13/88	NA	NA	NA
10400	78	H7/HT01	1	07/13/88	07/18/88	07/20/88	NA
10400	79	F1/HT01	2	07/13/88	07/18/88	07/20/88	NA
10400	80	F8/HT01	2	07/13/88	NA	NA	07/18/88
10400	81	G7/HT01	4	07/13/88	NA	NA	07/19/88
10400	82	Field Blk	FB		NA	NA	07/20/88
10400	83	E10/HT01	4	07/14/88	NA	NA	07/18/88
10400	84	F9/HT01	7	07/14/88	NA	NA	07/18/88
10400	85	G10/HT01	3	07/14/88	07/18/88	07/20/88	NA
10400	86	J11/HT01	7	07/14/88	07/18/88	07/20/88	NA
10400	87	K11/HT01	2	07/14/88	07/18/88	07/20/88	07/18/88
10400	88	H10/HT01	7	07/14/88	NA	NA	NA
10400	89	Field Blk	FB		NA	NA	07/20/88
Interim Report #5							
10400	90	K3/HT01	4	07/15/88	07/21/88	07/27/88	NA
10400	91	L3/HT01	2	07/15/88	07/21/88	07/26/88	NA

Table II: Analytical History (page 26 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
10400	92	M3/HT01	2	07/15/88	07/21/88	07/27/88	NA
10400	93	K4/HT01	7	07/15/88	NA	NA	NA
10400	94	J4/HT01	2	07/18/88	07/25/88	07/27/88	NA
10400	95	L4/HT01	3.5	07/18/88	NA	NA	NA
10400	96	M4/HT01	8	07/18/88	NA	NA	NA
10400	97	N4/HT01	5	07/18/88	NA	NA	07/26/88
10400	98	P11/HT01	2	07/18/88	07/21/88	07/27/88	07/26/88
10400	99	I5/HT01	8	07/18/88	NA	NA	NA
10400	100	Field Blk	FB		NA	NA	07/26/88
10400	101	M11/HT01	7	07/19/88	NA	NA	NA
10400	102	R5/HT01	7	07/19/88	07/21/88	07/27/88	07/26/88
10400	103	S7/HT01	4	07/19/88	07/25/88	07/27/88	NA
10400	104	T7/HT01	7	07/19/88	NA	NA	NA
10400	105	U7/HT01	1	07/19/88	07/25/88	07/27/88	NA
10400	106	Field Blk	FB		NA	NA	07/27/88
10400	107	G8/HB01	5	07/21/88	NA	NA	NA
10400	108	H8/HB01	0.9	07/21/88	NA	NA	07/26/88
10400	109	I8/HB01	5	07/21/88	NA	NA	07/26/88
10400	110	J8/HB01	0.7	07/21/88	07/25/88	07/27/88	07/26/88
10400	111	K8/HB01	5	07/21/88	NA	NA	NA
10400	112	K7/HB01	3.5	07/21/88	NA	NA	NA
10400	113	Trip Blk	FB		NA	NA	07/26/88
Interim Report #6							
10400	114	G6/HB01	0.1	07/22/88	07/27/88	08/02/88	NA
10400	115	I6/HB01	5.0	07/22/88	07/27/88	08/02/88	NA
10400	116	F7/HB01	7.5	07/22/88	NA	NA	NA
10400	117	I4/HB01	2.5	07/22/88	07/27/88	08/02/88	NA
10400	118	J5/HB01	2.5	07/22/88	07/27/88	08/02/88	08/01/88
10400	119	G9/HB01	0.7	07/22/88	NA	NA	NA
10400	120	I7/HB01	2.5	07/22/88	NA	NA	08/01/88
10400	121	J7/HB01	5.0	07/22/88	NA	NA	NA
10400	122	Vol. Blk	FB		NA	NA	08/01/88
10400	123	F10/HB01	0.7	07/25/88	NA	NA	08/01/88
10400	124	H9/HB01	5	07/25/88	NA	NA	NA
10400	125	J6/HB01	0.5	07/25/88	07/29/88	08/02/88	NA
10400	126	K6/HB01	7.5	07/25/88	07/29/88	08/02/88	NA
10400	127	M6/HB01	0.6	07/25/88	07/29/88	08/02/88	NA
10400	128	Vol. Blk	FB		NA	NA	08/01/88
10400	129	J1/HB01	7.5	07/26/88	NA	NA	08/05/88
10400	130	L1/HB01	5.0	07/26/88	07/27/88	08/02/88	NA
10400	131	L1/HB01	11.0	07/26/88	07/27/88	08/02/88	NA
10400	132	K5/HB01	0.5	07/26/88	08/01/88	08/03/88	NA
10400	133	L5/HB01	5.0	07/26/88	NA	NA	NA
10400	134	M5/HB01	7.5	07/26/88	NA	NA	08/01/88
10400	135	Vol. Blk	FB		NA	NA	08/01/88
10400	136	H5/HB01	0.3	07/27/88	NA	NA	08/01/88
10400	137	F6/HB01	5	07/27/88	07/29/88	08/02/88	08/01/88
10400	138	G5/HB01	7.5	07/27/88	07/29/88	08/02/88	08/01/88

Table II: Analytical History (page 27 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
10400	139	H4/HB01	7.5	07/27/88	NA	NA	NA
10400	140	I3/HB01	0.5	07/27/88	NA	NA	08/01/88
10400	141	J3/HB01	5	07/27/88	07/29/88	08/02/88	NA
10400	142	06/HB01	0.5	07/27/88	NA	NA	08/01/88
10400	143	Spoon	RinseB	07/27/88	08/03/88	08/04/88	08/01/88
10400	144	Vol. Blk	FB		NA	NA	08/01/88
10400	145	G4/HB01	0.3	07/28/88	08/01/88	08/03/88	NA
10400	146	H3/HB01	5	07/28/88	NA	NA	NA
10400	147	W7/HB01	2.5	07/28/88	08/01/88	08/03/88	NA
10400	148	V7/HB01	5	07/28/88	08/02/88	08/04/88	NA
10400	149	W5/HB01	7.5	07/28/88	08/01/88	08/03/88	NA
10400	150	W3/HB01	0.2	07/28/88	08/02/88	08/04/88	NA
10400	151	V3/HB01	2.5	07/28/88	08/01/88	08/03/88	NA
10400	152	V5/HB01	0.2	07/28/88	08/02/88	08/04/88	NA
10400	153	Vol. Blk	FB		NA	NA	NA
Interim Report #7							
10400	154	I9/HB01	0.4	07/29/88	08/04/88	08/10/88	NA
10400	155	J9/HB01	5	07/29/88	08/04/88	08/10/88	NA
10400	156	K9/HB01	7.5	07/29/88	NA	NA	NA
10400	157	L9/HB01	0.5	07/29/88	08/04/88	08/10/88	NA
10400	158	L10/HB01	2.5	07/29/88	08/04/88	08/10/88	NA
10400	159	M9/HB01	5	07/29/88	08/04/88	08/10/88	NA
10400	160	N9/HB01	2.5	07/29/88	NA	NA	NA
10400	161	Vol. Blk	FB		NA	NA	NA
10400	162	I10/HB01	2.5	08/01/88	NA	NA	NA
10400	163	M10/HB01	0.6	08/01/88	08/04/88	08/10/88	08/08/88
10400	164	N10/HB01	7.5	08/01/88	NA	NA	NA
10400	165	010/HB01	2.5	08/01/88	08/08/88	08/10/88	NA
10400	166	09/HB01	0.7	08/01/88	08/08/88	08/10/88	NA
10400	167	Vol. Blk	FB		NA	NA	08/09/88
10400	168	Q9/HB01	2.5	08/02/88	08/04/88	08/12/88	08/08/88
10400	169	R9/HB01	0.4	08/02/88	NA	NA	08/08/88
10400	170	S9/HB01	7.5	08/02/88	08/04/88	08/10/88	NA
10400	171	N8/HB01	0.6	08/02/88	08/08/88	08/11/88	NA
10400	172	08/HB01	5	08/02/88	NA	NA	08/08/88
10400	173	P8/HB01	7.5	08/02/88	NA	NA	NA
10400	174	Vol. Blk	FB		NA	NA	08/09/88
10400	175	N1/HB01	0.6	08/03/88	08/10/88	08/11/88	NA
10400	176	P1/HB01	5	08/03/88	08/10/88	08/11/88	NA
10400	177	R1/HB01	2.5	08/03/88	08/10/88	08/11/88	NA
10400	178	R1/HB01	11	08/03/88	08/10/88	08/12/88	NA
10400	179	U1/HB01	7.5	08/03/88	08/04/88	08/10/88	08/08/88
10400	180	V1/HB01	0.3	08/03/88	08/10/88	08/12/88	NA
10400	181	03/HB01	7.5	08/03/88	08/04/88	08/10/88	NA
10400	182	Vol. Blk	FB		NA	NA	08/09/88
10400	183	N2/HB01	2.5	08/04/88	08/10/88	08/12/88	NA
10400	184	N3/HB01	7.5	08/04/88	08/08/88	08/11/88	NA
10400	185	N3/HB01	11	08/04/88	08/08/88	08/11/88	NA

Table II: Analytical History (page 28 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
10400	186	P3/HB01	5	08/04/88	NA	NA	08/08/88
10400	187	04/HB01	1.5	08/04/88	08/08/88	08/11/88	08/08/88
10400	188	P4/HB01	2.5	08/04/88	NA	NA	NA
10400	189	S2/HB01	1.2	08/04/88	08/10/88	08/12/88	NA
10400	190	T2/HB01	2.5	08/04/88	NA	NA	08/09/88
10400	191	T3/HB01	7.5	08/04/88	08/08/88	08/11/88	08/08/88
10400	192	Vol. Blk	FB		NA	NA	08/09/88
Interim Report #8							
10400	193	R4/HB01	0.5	08/05/88	08/12/88	08/17/88	08/15/88
10400	194	S4/HB01	2.5	08/05/88	NA	NA	NA
10400	195	T4/HB01	7.5	08/05/88	NA	NA	NA
10400	196	P5/HB01	5	08/05/88	NA	NA	NA
10400	197	S5/HB01	0.1	08/05/88	08/12/88	08/17/88	NA
10400	198	T5/HB01	0.4	08/05/88	08/12/88	08/18/88	NA
10400	199	R6/HB01	0.2	08/05/88	08/12/88	08/18/88	NA
10400	200	P6/HB01	0.5	08/05/88	08/12/88	08/17/88	08/15/88
10400	201	Vol. Blk	FB		NA	NA	08/16/88*
10400	202	Q4/HB01	7.5	08/08/88	08/13/88	08/17/88	NA
10400	203	Q6/HB01	3	08/08/88	08/13/88	08/17/88	NA
10400	204	Q7/HB01	5	08/08/88	08/12/88	08/17/88	08/15/88
10400	205	Q8/HB01	1	08/08/88	08/12/88	08/17/88	08/15/88
10400	206	Q10/HB01	7.5	08/08/88	NA	NA	NA
10400	207	Q11/HB01	5	08/08/88	08/12/88	08/17/88	NA
10400	208	Vol. Blk	FB		NA	NA	08/16/88
10400	209	L11/HB01	2.5	08/09/88	08/12/88	08/17/88	08/15/88
10400	210	N11/HB01	5	08/09/88	NA	NA	NA
10400	211	R11/HB01	7.5	08/09/88	NA	NA	NA
10400	212	T11/HB01	1	08/09/88	08/13/88	08/17/88	NA
10400	213	V11/HB01	7.5	08/09/88	NA	NA	08/15/88
10400	214	W11/HB01	2	08/09/88	NA	NA	NA
10400	215	T12/HB01	5	08/09/88	NA	NA	NA
10400	216	W12/HB01	7.5	08/09/88	08/12/88	08/17/88	NA
10400	217	S8/HB01	2.5	08/09/88	NA	NA	08/15/88
10400	218	S8/HB01	11	08/09/88	NA	NA	08/15/88
10400	219	T8/HB01	1.2	08/09/88	NA	NA	08/15/88
10400	220	Q2/HB01	2	08/09/88	08/13/88	08/17/88	NA
10400	221	V9/HB01	0.6	08/09/88	08/13/88	08/17/88	NA
10400	222	W9/HB01	7.5	08/09/88	NA	NA	NA
10400	223	Vol. Blk	FB		NA	NA	08/16/88
10400	224	P10/HB01	1	08/10/88	08/12/88	08/18/88	08/15/88
10400	225	P9/HB01	7.5	08/10/88	08/12/88	08/18/88	NA
10400	226	P9/HB01	11	08/10/88	08/12/88	08/18/88	NA
10400	227	05/HB01	2.5	08/10/88	NA	NA	08/16/88
10400	228	P2/HB01	1.9	08/10/88	08/16/88	08/18/88	NA
10400	229	L7/HB01	0.6	08/10/88	08/16/88	08/18/88	NA
10400	230	M7/HB01	5	08/10/88	NA	NA	NA
10400	231	N7/HB01	2.5	08/10/88	NA	NA	NA
10400	232	07/HB01	7.5	08/10/88	NA	NA	NA

Table II: Analytical History (page 29 of 30)

Lab Number	Sample Number	HC Station	Depth	Date Sampled	PCB Prep.	PCB Anal.	GC/MS VOA Anal.
10400	233	Vol. Blk	FB		NA	NA	08/16/88
10400	234	U2/HB01	5	08/11/88	08/13/88	08/17/88	08/16/88
10400	235	B1/HB01	0.2	08/11/88	08/16/88	08/18/88	NA
10400	236	B3/HB01	2.5	08/11/88	08/13/88	08/18/88	08/16/88
10400	237	A12/HB01	0.2	08/11/88	NA	NA	NA
10400	238	A13/HB01	7.5	08/11/88	08/13/88	08/17/88	NA
10400	239	B13/HB01	0.2	08/11/88	08/16/88	08/18/88	NA
10400	240	Vol. Blk	FB		NA	NA	08/16/88
Interim Report #9							
10400	241	L6/HB01	2.5	08/12/88	NA	NA	NA
10400	242	N6/HB01	7.5	08/12/88	08/19/88	08/24/88	NA
10400	243	M8/HB01	0.7	08/12/88	08/19/88	08/24/88	08/22/88
10400	244	L8/HB01	7.5	08/12/88	NA	NA	NA
10400	245	L8/HB01	11	08/12/88	NA	NA	NA
10400	246	E9/HB01	1.1	08/12/88	08/19/88	08/24/88	NA
10400	247	Vol. Blk	FB		NA	NA	08/22/88
10400	248	R2/HB01	7.5	08/15/88	08/23/88	08/24/88	NA
10400	249	Q3/HB01	0.5	08/15/88	08/23/88	08/25/88	NA
10400	250	R3/HB01	2.5	08/15/88	NA	NA	08/22/88
10400	251	S3/HB01	7.5	08/15/88	NA	NA	NA
10400	252	02/HB01	5	08/15/88	NA	NA	NA
10400	253	R10/HB01	5	08/15/88	NA	NA	08/22/88
10400	254	T9/HB01	5	08/15/88	NA	NA	NA
10400	255	Vol. Blk	FB		NA	NA	08/23/88
10400	256	011/HB01	7.5	08/16/88	NA	NA	NA
10400	257	R8/HB01	5	08/16/88	NA	NA	08/22/88
10400	258	R8/HB01	11	08/16/88	NA	NA	08/22/88
10400	259	S6/HB01	7.5	08/16/88	NA	NA	NA
10400	260	T6/HB01	5	08/16/88	NA	NA	NA
10400	261	Vol. Blk	FB		NA	NA	08/23/88
10400	262	U3/HB01	0.0	08/17/88	08/23/88	08/25/88	NA
10400	263	P7/HB01	0.7	08/17/88	08/23/88	08/25/88	NA
10400	264	R7/HB01	0.6	08/17/88	08/19/88	08/24/88	08/22/88
10400	265	M1/HB01	2.5	08/17/88	08/23/88	08/25/88	NA
10400	266	Vol. Blk	FB		NA	NA	08/23/88
10400	267	N5/HB01	5	08/24/88	NA	NA	08/30/88

Table II: Analytical History (page 30 of 30)

Quality Control Report
Summary of Findings

Total Petroleum Hydrocarbon/Oil and Grease

All total petroleum hydrocarbon data generated for this project have been determined acceptable for use. All positive results which have been blank corrected were flagged "X". If blank correction yielded a result which was below the CRDL, the "U" flag was applied. Final results for 133 samples were flagged "X".

Total Arsenic

All total Arsenic data generated for this project have been determined acceptable for use. No data qualification was required.

Total Metals

All total metals data generated for this project have been determined acceptable for use. The following qualifications were applied to total metals results:

- 201 data points in 232 samples were flagged "B" to indicate the compound of interest was detected in both the sample and the associated method blank.

- 186 data points in 232 samples were flagged "E" to indicate results are estimates. RPD values for matrix spike/matrix spike duplicate and/or matrix spike/matrix spike triplicate recoveries associated with the samples were outside established control limits for both initial analysis and reanalysis.

Extractable Metals

All extractable metals data generated for this project have been determined acceptable for use. No data qualification was required.

GC/FID Screen

All GC/FID screen data generated for this project have been determined acceptable for use. The following qualifications were applied to GC/FID screen results:

- 3 sample results were flagged "E" to indicate initial or reanalysis was performed outside established holding time.

Polychlorinated Biphenyls (PCB)

All PCB data generated for this project have been determined acceptable for use. No data qualification was required.

Volatile Organics

All volatile organics data generated for this project have been determined acceptable for use. The following qualifications were applied to volatile organics results:

- 229 data points in 107 samples were flagged "E" to indicate results are estimates as initial analyses were performed outside holding time; or surrogate recoveries were outside control limits in both initial analysis and reanalysis; or internal standard recoveries were outside control limits in both initial analysis and reanalysis.

- 9 data points in 107 samples were flagged "B" to indicate the compound(s) of interest were detected in both the sample and associated method blank.

Semi-Volatile Organics

All semi-volatile organics data generated for this project have been determined acceptable for use. The following qualifications were applied to semi-volatile organics results:

- 365 data points in 118 samples were flagged "E" to indicate results are estimates as initial analysis or reanalysis was performed outside holding times; or due to matrix spike recoveries outside control limits in the initial analysis and reanalysis; or RPD values for matrix spike/matrix spike duplicate/matrix spike triplicate recoveries associated with the samples were outside control limits in initial analysis and reanalysis.

- 42 data points in 118 samples were flagged "B" to indicate the compound(s) of interest were detected in both the sample and associated method blank.

Completeness

Completeness represents the percentage of generated data points which are fully useable for intended purposes. A project goal of 80% completeness was set; the laboratory goal was 90% completeness.

There is no universally accepted method for measuring completeness. Two reasonable approaches are:

A) Compare the quantity of unuseable data points (those flagged "R") to the quantity of data points generated overall on submitted samples. By this approach, 0 points of 16,737 (determined in 229 soil, 3 water rinse blank and 35 volatile organics field/trip blank samples) have been flagged "R", for a completeness percentage of 100.

B) More stringently, compare the quantity of qualified data points (those flagged "R", "E" "B", and "X") to the quantity of data points generated overall on submitted samples. For this project, 1168 points of 16,737 have been so flagged (including those which may bear more than one such flag), for a completeness percentage of 93.0.

By either approach, both project and laboratory goals for completeness have been achieved.

Total Petroleum Hydrocarbons
(Methods SW 3540 / EP 418.1)

This section provides an evaluation of Total Petroleum Hydrocarbon data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Functional Guidelines does not explicitly identify criteria for evaluating Total Petroleum Hydrocarbon (TPH) analyses. In concurrence with requirements set forth in the project Work Order, TPH data quality has been evaluated in accordance with Functional Guidelines when applicable. Quality control procedures not addressed in Functional Guidelines were evaluated in accordance with Laucks Testing Laboratories' internal Quality Assurance procedures.

Sample Holding Time:

Per the project Work Order, unpreserved soil samples must be extracted and analyzed within 28 days of sample collection. Functional Guidelines does not suggest holding times for this analysis.

All samples were extracted and analyzed within the holding time specified in the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for inorganic analyses. It does not delineate calibration criteria for Total Petroleum Hydrocarbon analysis. Per Laucks Testing Laboratories' internal QA procedures, one standard and one instrument blank are analyzed for initial calibration. A continuing calibration standard and instrument blank are analyzed after every 10 samples. The initial and continuing calibration verification results must not exceed 10% of the true value.

All initial and continuing calibrations met criteria specified by Laucks Testing Laboratories' internal QA procedures.

Method Blank:

Functional Guidelines specifies that, for inorganic analyses, at least one method blank must be prepared and analyzed for every 20 samples or batch of samples, whichever is more frequent. It does not specify criteria for addressing blank contamination in this analysis. Laucks Testing Laboratories' internal QA procedures specify that, should any contaminant be detected in the TPH blank, all associated sample results will be blank corrected (indicated by the "X" flag). If the sample result after blank correction is less than the

Contract Required Detection Limit (CRDL), the result is reported as undetected. The project Work Order details CRDL criteria in Table 4, "Detection Limit Goals", attached herein as Appendix A.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch and results normalized to the soil dry basis. Target compounds were detected above the CRDL in the following method blanks:

Sample	Compound	Concentration
B06290G.S01	TPH/OG	26 mg/kg DB
B06300G.S01	TPH/OG	21 mg/kg DB
B07010G.S02	TPH/OG	24 mg/kg DB
B07060G.S01	TPH/OG	24 mg/kg DB
B07070G.S02	TPH/OG	34 mg/kg DB
B07080G.S01	TPH/OG	32 mg/kg DB
B07160G.S01	TPH/OG	27 mg/kg DB
B07220G.S01	TPH/OG	24 mg/kg DB
B07260G.S01	TPH/OG	34 mg/kg DB
B08020G.S01	TPH/OG	23 mg/kg DB
B08040G.S01	TPH/OG	38 mg/kg DB
B08040G.W01	TPH/OG	1.1 mg/l
B08080G.S02	TPH/OG	30 mg/kg DB
B08090G.S01	TPH/OG	31 mg/kg DB
B08120G.S02	TPH/OG	31 mg/kg DB
B08160G.S01	TPH/OG	24 mg/kg DB
B08170G.S01	TPH/OG	25 mg/kg DB
B08250G.S02	TPH/OG	38 mg/kg DB

Functional Guidelines does not explicitly specify criteria for addressing blank contamination above the CRDL for this analysis. It does, however, specify that, for inorganic analyses, no corrective action or data qualification is required for compounds detected below the CRDL in the method blank.

Good laboratory practice dictates that blank contamination levels should not exceed the limit of detection. Blank contamination levels exceeding the specified detection limit should be taken into consideration when interpreting data associated with that blank, although there are no guidelines available outlining an acceptable relationship between sample concentration and blank result for this analysis.

All positive results which were blank corrected have been flagged "X".

Matrix Spike:

Functional Guidelines specifies that, for inorganic analyses, at least one spiked sample analysis must be performed for every 20 samples or batch of samples, whichever is more frequent. It does not explicitly specify matrix spike criteria for Total Petroleum Hydrocarbon analysis. The project Work Order requires matrix spike/matrix spike duplicate/matrix spike triplicate analysis. Functional Guidelines indicates, for inorganic analyses, spike recovery results must be within control limits specified in the project Work Order. These control limits are detailed in Table 5, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recoveries were within the control limits specified in the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify matrix spike duplicate and triplicate evaluation criteria for inorganic analyses. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 5, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits specified in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not specify instrument quality control criteria for instrumentation used for Total Petroleum Hydrocarbon analysis. Per Laucks Testing Laboratories' internal QA procedures, instrument drift is monitored through the analysis of calibration verification standards and calibration blanks. Calibration verification results must be within 10% of the initial calibration.

Instrument quality control criteria as specified by Laucks Testing Laboratories' internal QA procedures were met for all analysis dates.

Laboratory Quality Control:

Functional Guidelines does not specify laboratory quality control criteria for Total Petroleum Hydrocarbon analysis. Laboratory quality control is monitored through blank, calibration standard and matrix spike analysis.

Laboratory quality control was acceptable.

Other QC Issues:

Rinsate blank sample 10400-27 was analyzed as Total Oil and Grease, not the required Total Petroleum Hydrocarbon Oil and Grease, due to laboratory error.

Aqueous field and rinsate blanks were extracted separately from soil samples. As these blanks were considered to be quality control samples in themselves, additional quality control (matrix spike) was not required.

Total Arsenic
(Methods LX SM3 / SW 7061)

This section provides an evaluation of the total arsenic data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection. The project Work Order specifies that unpreserved soil samples must be digested and analyzed within 180 days of sample collection. Functional Guidelines suggests a similar holding time for soils.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for Atomic Absorption (AA) analysis. It also specifies that at least one calibration blank and three standards must be used in establishing an analytical curve for the AA analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value, with the exception of tin and mercury for which the results must fall within control limits of 80-120% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Material, or a contractor prepared standard from a source other than that used for initial calibration standards. For AA analyses, the continuing calibration results must fall within 90-110% of the true value, with the exception of tin and mercury for which the results must fall within the control limits 80-120% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed. Per Functional Guidelines, the aqueous field blank is not governed by the redigestion and reanalysis criteria.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch and results normalized to the soil dry basis. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent, as well as the monthly analysis of one solid LCS for all analytes. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. The solid LCS must be EPA material. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%, while solid LCS results must be within EPA established control limits, attached herein as Appendix D.

Functional Guidelines does not specify LCS requirements for soil samples. U.S.E.P.A Contract Laboratory Program, Statement of Work for Inorganics Analysis specifies that one EPA solid LCS should be analyzed for each group of soil samples or sample digestion batch, whichever is more frequent. The solid LCS results must also be within EPA established control limits, detailed in Appendix D.

All Laboratory Control Standard results were within control limits specified by EPA and in Functional Guidelines .

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies the spike must be added prior to digestion and the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 5, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify criteria for evaluating matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery values cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 5, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery values were within control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not explicitly specify criteria for evaluating Atomic Absorption (AA) instrument performance. Per the U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganic Analysis, one atomic absorption standard at the Contract Required Detection Limit (CRDL) concentration must be analyzed. All compounds must be detected in the CRDL standard. This guideline was applied to all AA analyses performed under the project Work Order.

All CRDL criteria were met for all analysis dates.

Sample Result Verification:

Functional Guidelines specifies that all data reduction, reporting and documentation must be performed in accordance with the appropriate Statement of Work. The project Work Order details detection limits in Table 4, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits are acceptable based on criteria set forth in the project Work Order.

Other QC Issues:

Sample 10400-20 contained 150 mg/kg (dry basis) Arsenic. Samples 10400-20MS, 10400-20MSD and 10400-20MST were spiked at an inappropriate level with respect to the sample concentration. Both original and QC samples were redigested and reanalyzed with an appropriate spike level. The resulting matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within established control limits. Values reported are based on the second digestion and analysis.

A calibration curve drift was observed during the analysis performed on August 22. A recalibration was performed before the original calibration was deemed out of control. The analysis proceeded without further incident. As the analysis was at no time determined to be out of control, all data generated during this analysis period are acceptable.

Total Metals
(Methods LX SM1 / SW 6010)

This section provides an evaluation of total metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, U.S.E.P.A., Office of Emergency & Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Copper, Nickel, Cadmium, Lead, Chromium, Zinc

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection. The project Work Order specifies that unpreserved soil samples must be digested and analyzed for the metals of interest on this project within 180 days of sample collection. Functional Guidelines suggests a similar holding time for soils.

All samples were digested and analyzed within the holding time specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for Inductively Coupled Plasma (ICP) analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. For Atomic Absorption (AA) analysis, one calibration blank and at least three standards must be used in establishing the analytical curve. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Material or a contractor prepared standard from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines for both ICP and AA analyses.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed. Aqueous field blanks are not governed by the redigestion and reanalysis requirements.

Samples were batched for analytical purposes. One method blank was prepared with each sample batch and results normalized to the soil dry basis. The following target compounds were detected in the blanks:

Sample	Compound	Concentration	Comment
B0623ICP.S01	Copper	4 mg/kg DB	(1)
B0623ICP.S01	Zinc	8 mg/kg DB	(1)
B0701ICP.S01	Chromium	1 mg/kg DB	(1)
B0701ICP.S01	Zinc	2 mg/kg DB	(1)
B0704ICP.S01	Copper	1 mg/kg DB	(1)
B0704ICP.S01	Zinc	4 mg/kg DB	(1)
B0706ICP.S01	Zinc	3 mg/kg DB	(1)
B0705ICP.W01	Copper	.001 mg/l	(2)
B0705ICP.W01	Zinc	.002 mg/l	(2)
B0711ICP.S01	Zinc	1 mg/kg DB	(1)
B0721ICP.S02	Zinc	2 mg/kg DB	(1)
B0725ICP.W01	Zinc	.002 mg/l	(2)
B0725ICP.S01	Lead	5 mg/kg DB	(1)
B0725ICP.S01	Zinc	2/mg/kg DB	(1)
B0725ICP.S02	Zinc	3 mg/kg DB	(1)
B0801ICP.S01	Zinc	4 mg/kg DB	(1)
B0805ICP.W01	Zinc	.002 mg/l	(2)
B0808ICP.S01	Nickel	2 mg/kg DB	(1)
B0808ICP.S02	Zinc	1 mg/kg DB	(1)
B0815ICP.S01	Zinc	2 mg/kg DB	(1)
B0815ICP.S02	Zinc	2 mg/kg DB	(1)
B0822ICP.S01	Zinc	2 mg/kg DB	(1)
B0822ICP.S02	Zinc	2 mg/kg DB	(1)

(1) Functional Guidelines specifies that if the blank concentration is above the CRDL, the concentration of the least concentrated associated sample must be a minimum of 10 times the blank concentration or all samples less than 10 times the blank concentration must be redigested and reanalyzed. The analyte

concentration in the least concentrated associated sample was greater than 10 times the blank concentration. No corrective action or data qualification is required.

Laucks Testing Laboratories utilizes the "B" flag to indicate the compound was detected in both the sample(s) and the associated blank. The associated samples have been flagged "B" to indicate the compound was present in both the blank and sample(s), regardless of sample concentration.

(2) The sample is an aqueous rinsate blank and is considered a field quality control sample. Functional Guidelines does not specify criteria for evaluating contamination levels in field blanks. Laucks Testing Laboratories utilizes the "B" flag to indicate the compound was detected in both the sample(s) and the associated blank. The associated samples have been flagged "B" to indicate the compound was present in blank and the sample(s).

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent, as well as the monthly analysis of one solid LCS for all analytes. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%, while solid LCS results must be within EPA established control limits, attached herein as Appendix D.

Functional Guidelines does not specify LCS requirements for soil samples. Laucks Testing Laboratories' internal QA procedures and U.S.E.P.A Contract Laboratory Program, Statement of Work for Inorganics Analysis each specify that one EPA solid LCS is analyzed for each group of samples received or sample digestion batch, whichever is more frequent. The solid LCS results must be within EPA established control limits, detailed in Appendix D.

All Laboratory Control Standard results met all criteria specified in Functional Guidelines and U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganics Analysis.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 5, "Control Limits", attached herein as Appendix B.

Matrix spike/matrix spike duplicate/matrix spike triplicate recoveries were in control with the following exceptions:

Sample	Compound	% Recovery	Limits
10400-64MS	Copper	71	75-125
10400-64MS	Zinc	59	75-125
10400-64MSD	Zinc	75	75-125
10400-88MS	Copper	66	75-125
10400-88MSD	Copper	68	75-125
10400-88MST	Copper	74	75-125
10400-88MS	Nickel	65	75-125
10400-88MSD	Nickel	69	75-125
10400-88MS	Cadmium	58	75-125
10400-88MSD	Cadmium	62	75-125
10400-88MST	Cadmium	65	75-125
10400-88MS	Lead	63	75-125
10400-88MSD	Lead	68	75-125
10400-88MST	Lead	71	75-125
10400-88MS	Chromium	64	75-125
10400-88MSD	Chromium	69	75-125
10400-88MS	Zinc	62	75-125
10400-88MSD	Zinc	68	75-125
10400-88MST	Zinc	72	75-125

The project Work Order specifies that matrix effect is documented through reanalysis. If, upon reanalysis, matrix spike recoveries remain out of control, no corrective action is required. Samples 10400-64MS/MSD/MST and 10400-88MS/MSD/MST were redigested and reanalyzed due to matrix spike recoveries outside control limits. All reanalysis results were within the specified matrix spike control limits. No corrective action or data qualification is required.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate results cannot exceed the control limits set forth in the project Work Order. The same required limits are detailed in Table 5, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order with the following exceptions:

Sample Number	Compound	% Recovery		RPD	Limits	Comment
		MS	MSD/T			
10400-64MS/MSD	Copper	71	97	30	0-5	(1)
10400-64MS/MST	Copper	71	109	42	0-5	(2)

Sample Number	Compound	% Recovery MS	MSD/T	RPD	Limits	Comment
10400-64MS/MSD	Nickel	84	95	12	0-6	(2)
10400-64MS/MST	Nickel	84	95	12	0-6	(2)
10400-64MS/MSD	Cadmium	83	94	12	0-7	(1)
10400-64MS/MST	Cadmium	83	95	13	0-7	(2)
10400-64MS/MSD	Lead	81	92	13	0-6	(2)
10400-64MS/MST	Lead	81	95	17	0-6	(2)
10400-64MS/MST	Chromium	85	99	16	0-8	(2)
10400-64MS/MSD	Zinc	59	74	23	0-5	(1)
10400-64MS/MST	Zinc	59	86	36	0-5	(2)
10400-64MS/MSTRE	Copper	98	86	14	0-5	(2)
10400-64MS/MSDRE	Nickel	81	87	7	0-6	(2)
10400-64MS/MSTRE	Cadmium	76	83	10	0-7	(2)
10400-64MS/MSDRE	Lead	84	93	10	0-6	(2)
10400-64MS/MSTRE	Lead	84	79	7	0-6	(2)
10400-64MS/MSDRE	Chromium	80	91	13	0-8	(2)
10400-64MS/MSTRE	Zinc	91	83	9	0-5	(2)
10400-88MS/MST	Copper	66	75	13	0-5	(2)
10400-88MS/MSD	Nickel	65	69	7	0-6	(1)
10400-88MS/MST	Nickel	65	75	15	0-6	(1)
10400-88MS/MST	Cadmium	58	65	11	0-7	(2)
10400-88MS/MSD	Lead	63	68	7	0-6	(2)
10400-88MS/MST	Lead	63	71	12	0-6	(2)
10400-88MS/MST	Chromium	64	76	17	0-8	(1)
10400-88MS/MSD	Zinc	62	68	9	0-5	(1)
10400-88MS/MST	Zinc	62	72	15	0-5	(1)
10400-88MS/MSTRE	Copper	81	87	6	0-5	(2)
10400-88MS/MSDRE	Cadmium	93	79	16	0-7	(2)
10400-88MS/MSTRE	Cadmium	93	86	9	0-7	(2)
10400-88MS/MSDRE	Lead	90	82	9	0-6	(2)
10400-88MS/MSTRE	Lead	90	78	14	0-6	(2)

Per the project Work Order, should RPD values fall outside control limits, reanalysis shall be performed to document matrix effect. Samples 10400-64 and 10400-88 have been redigested and reanalyzed, identified above as "RE".

(1) Per the project Work Order, matrix effect is documented through sample reanalysis. If, upon reanalysis, RPDs remain out of control, no corrective action is required. The samples were redigested and reanalyzed. Reanalysis results were within control limits. No corrective action or data qualification required.

(2) The project Work Order specifies that matrix effect should be documented through sample reanalysis. The samples were redigested and reanalyzed with RPD values remaining outside control limits. Functional Guidelines does not specify criteria for evaluating matrix spike/matrix spike duplicate results. Laucks Testing Laboratories has chosen to qualify as estimated the data for all associated compounds in all associated samples when QC sample results are outside RPD control limits, using the "E" flag.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/- 20% of the established mean value. ICP interference check sample analysis is not required for AA.

All ICP interference check sample results met all criteria specified in Functional Guidelines.

In addition, a CRDL standard must be analyzed and all compounds must be detected.

All CRDL criteria were met.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%. Serial dilutions are not required for AA analysis.

The following serial dilution results were outside the specified control limit:

Sample	Compound	Initial	Dilution	% D
10400-110	Cadmium	.02 mg/l	.014 mg/l	35
10400-112	Copper	.12 mg/l	.10 mg/l	18
10400-112	Nickel	.24 mg/l	.20 mg/l	18
10400-127	Lead	9. mg/l	15. mg/l	62
10400-142	Cadmium	.8 mg/l	2.0 mg/l	86
10400-162	Copper	29. mg/l	33. mg/l	13
10400-173	Zinc	49. mg/l	57. mg/l	15
10400-194	Nickel	.34 mg/l	.16 mg/l	16
10400-206	Chromium	.29 mg/l	.26 mg/l	11
10400-206	Copper	.25 mg/l	.22 mg/l	13
10400-219	Copper	.18 mg/l	.15 mg/l	19
10400-219	Nickel	.27 mg/l	.22 mg/l	22
10400-241	Chromium	28. mg/l	24. mg/l	16
10400-241	Nickel	28. mg/l	18. mg/l	56
10400-259	Nickel	22. mg/l	13. mg/l	60

Serial dilution samples were analyzed at a 5X dilution. U.S.E.P.A Contract Laboratory Program, Statement of Work for Inorganics Analysis specifies that initial and serial dilution results must agree within 10% if the analyte concentration is minimally a factor of 50 above the instrumental detection limit (IDL) in the original sample. Functional Guidelines specifies that the 10% criteria apply only if the analyte concentration is minimally a factor of

10 above the IDL after dilution. Both criteria represent the same concept. By either criteria, all diluted and undiluted sample results were below the minimum concentration factors, so the 10% criteria does not apply. No corrective action or data qualification is required.

Serial dilutions were not performed for samples 10400-1 through 10400-88. Functional Guidelines does not require data qualification should serial dilutions not be performed. Corrective action was taken to ensure serial dilutions were performed at the required frequency for all subsequent samples.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 4, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits met criteria specified in the project Work Order.

Other QC Issues:

Cadmium results for samples 10400-94, 10400-98, 10400-108, 10400-110 and 10400-172 were verified by Flame AA analysis (Method SW 7130) due to inconsistent results for ICP analysis. Flame AA values were reported as final results.

Lead results for samples 10400-90 and 10400-96 were confirmed using Flame AA analysis (Method SW 7420) due to inconsistent results for ICP analysis. Flame AA values were reported as final results.

EPTOX Metals
(Methods SW 1310, LX EP3 / SW 6010)

This section provides an evaluation of the extractable metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Copper, Nickel, Cadmium, Lead, Chromium, Zinc, Arsenic

Sample Holding Times:

The project Work Order specifies that unpreserved soil samples must be analyzed for the metals of interest on this project within 6 months of sample collection. Functional Guidelines suggests a similar holding time for soils.

All samples were extracted, digested and analyzed within the holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for ICP analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Material or a contractor prepared standard from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met all criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed. An exception is the aqueous soil field blank.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent, as well as the monthly analysis of one solid LCS for all analytes. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%, while solid LCS results must be within EPA established control limits, attached herein as Appendix D.

At least one aqueous LCS was extracted and analyzed with each sample batch for EPTOX analysis. All Laboratory Control Standard results met all criteria specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 5, "Control Limits", attached herein as Appendix B.

In accordance with the telephone conversation of 6/20/88 between Laucks Testing Laboratories (Barbara Gleason) and Hart Crowser (Philip Spadaro), EP Toxicity extractions were performed once on each QC sample and the resulting extract split into sample/MS/MSD/MST fractions for digestion and analysis. All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 5, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/- 20% of the established mean value.

All interference check sample results met all criteria specified in Functional Guidelines.

In addition, a standard at the CRDL must be analyzed and all compounds must be detected.

All CRDL criteria were met.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%.

All serial dilutions met criteria specified in Functional Guidelines with the following exceptions:

Sample	Compound	Initial	Dilution	% Difference
10400-162	Copper	29. mg/l	33. mg/l	13
10400-173	Zinc	49. mg/l	57. mg/l	15

Serial dilution samples were analyzed at a 5X dilution. U.S.E.P.A Contract Laboratory Program, Statement of Work for Inorganics Analysis specifies that initial and serial dilution results must agree within 10% if the analyte concentration is minimally a factor of 50 above the instrumental detection limit (IDL) in the original sample. Functional Guidelines specifies that the 10% criteria apply only if the analyte concentration is minimally a factor of 10 above the IDL after dilution. Both criteria represent the same concept. By either criteria, the Copper results for sample 10400-162 were below the minimum concentration factors, so the 10% criteria does not apply. No corrective action or data qualification is required.

Original results for sample 10400-173 were below the minimum criteria; diluted results were above the minimum criteria. Since results were not above the minimum requirement for both criteria, associated Zinc data were not qualified.

Serial dilutions were not performed for samples 10400-1 through 10400-88. Functional Guidelines does not require data qualification should serial dilutions not be performed. Corrective action was taken to ensure serial dilutions were performed at the required frequency for all subsequent samples.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 4, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits met criteria specified in the project Work Order.

Other QC Issues:

The interference check sample and the CRDL standard for Arsenic were not included in the initial analytical run for samples 10400-1 through 10400-3. The samples were reanalyzed with all required standards; reanalysis results were reported.

Sample 10400-123 was reextracted, redigested and reanalyzed in duplicate per client request. Initial extraction and analysis were performed on an unscreened sample portion per method requirements. Reextraction and reanalysis were performed on a screened sample portion, as an insufficient amount of unscreened sample remained. Reanalysis results were lower than initial results, which may be attributed to the removal of material during the screening process.

GC/FID Screen
(Methods SW 3550 / LX GC/FID)

This section provides an evaluation of the GC/FID analysis data by applicable criteria for GC/MS semi-volatile organic compounds found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988 and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

An abstract of the screening method employed by Laucks Testing Laboratories (LX GC/FID) is provided in the narrative section titled "Methods of Analysis".

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection. The project Work Order specifies that soil samples must be extracted within 7 days and analyzed within 40 days of sample collection for comparable semi-volatile organic compound determinations. Functional Guidelines does not specify a holding time in soils for a comparable analysis type.

All samples were extracted and analyzed within the prescribed holding times with the following exceptions:

A) One sample required reextraction due to initial extraction blank contamination:

10400-27

Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, the result for sample 10400-27 has been flagged "E" to indicate it is an estimate due to extraction outside holding time.

B) The following samples were initially extracted outside holding time:

10400-248
10400-249

Functional Guidelines specifies that, should sample holding times be exceeded, the results should be flagged as estimated. Following these guidelines, the results for samples 10400-248 and 10400-249 have been flagged "E" to indicate the results are estimates due to extraction outside holding time.

Calibration:

No calibration criteria are set forth in Functional Guidelines for this analysis. Per Laucks Testing Laboratories' internal QA procedures, one Phenanthrene standard at a single concentration was analyzed initially and as a continuing calibration.

In accordance with Laucks Testing Laboratories' internal QA procedures, all calibration criteria were met.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s) for a comparable analysis type. Should a contaminant be detected in the blank(s) but not in the sample(s), no corrective action or data qualification is required. If a contaminant is detected in both the sample and the associated blank, the data must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch and results normalized to the soil dry basis. No target compounds were detected in the blanks.

Duplicate/Triplicate Analysis:

Functional Guidelines specifies that all spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order indicates that, for this analysis, matrix spikes would not provide meaningful results. Instead, duplicate and triplicate analyses were performed. The project Work Order further specifies that all Relative Percent Difference (RPD) values between sample/duplicate and sample/triplicate results shall not exceed 30%, as shown Table 5, "Control Limits", attached herein as Appendix B. Should sample/duplicate/triplicate results fall below the Contract Required Detection Limit, RPD values are not calculated.

Based on criteria specified in the project Work Order, all sample/duplicate/triplicate RPD values were in control with the following exception:

Sample	Result (ug/kg)		RPD	Limits
	Sample	Triplicate		
10400-150	64000	95000	39	30

Per project Work Order specifications, reanalysis shall be performed when initial RPD values are outside established control limits. Sample 10400-150 was reextracted and reanalyzed. The reextraction and reanalysis were performed within holding times and results were within the required control limits. No data qualification is required. Values reported in the data report are the result of the second analysis.

Sample Result Verification:

Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated in accordance with the appropriate Statement of Work. Per the project Work Order, Laucks Testing Laboratories quantifies GC/FID screen samples by summing all sample peaks within a specified time window and comparing the result to a single Phenanthrene standard.

All reported results met criteria specified in the project Work Order and by Laucks Testing Laboratories' internal QA procedures.

Other QC Issues:

Aqueous field and rinsate blanks were extracted separately from soil samples. As these blanks were considered to be quality control samples in themselves, additional quality control (matrix spike) was not required.

Polychlorinated Biphenyls
(Method SW 3550 / SW 8080)

This section provides an evaluation of Polychlorinated Biphenyls (PCB) data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

Functional Guidelines specifies that unpreserved water samples must be extracted within 7 days of sample collection and analyzed within 40 days of sample collection. The project Work Order specifies that unpreserved soil samples must be extracted within 10 days of sample collection and analyzed within 40 days of sample collection. Functional Guidelines does not suggest a holding time for soils.

All samples were extracted and analyzed within holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies the Percent Relative Standard Deviation (%RSD) of the initial calibration factors for particular pesticide compounds cannot exceed 10%. It further specifies that the percent difference (%D) between initial and continuing calibration factors cannot exceed 15% (20% for the confirmation column). Laucks Testing Laboratories internally applies the same criteria to PCB compounds.

Based on criteria specified in Functional Guidelines and by Laucks Testing Laboratories' internal QA procedures, all initial calibrations were in control. Continuing calibrations were in control with the following exceptions:

Compound	Analysis Date	%D	Limits
Arochlor 1254	08/04/88	-16.3	0-15
Arochlor 1254	08/12/88	Not calculated	0-15
Arochlor 1260	08/19/88	+16.6	0-15

U.S.E.P.A Contract Laboratory Program, Statement of Work for Organics Analysis specifies that, should the % Difference value between the initial and continuing calibration be outside specified control limits, all samples analyzed after that continuing calibration standard must be reanalyzed. In all cases, the above-referenced standards were analyzed at the end of the analytical run; no samples followed these standards. All reported data were analyzed after a standard determined to be in control. No corrective action or data qualification is required.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a PCB be detected in the blank(s) but not in the sample(s), no action is taken. If a PCB is detected in both the sample and the associated blank, the data must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. A minimum of one method blank was prepared and analyzed with each sample batch and results normalized to the soil dry basis. No target compounds were detected in the method blanks.

Surrogate:

Functional Guidelines specifies the use of dibutylchlorendate (DBC) as a surrogate. Laucks Testing Laboratories adds an additional surrogate, isodrin. Per the project Work Order, should the isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control. It further specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for PCB analysis in Table 5, "Control Limits", attached herein as Appendix B.

Based on criteria specified in Functional Guidelines and by Laucks Testing Laboratories' internal QA procedures, all surrogate recoveries were in control.

Matrix Spike:

Functional Guidelines specifies that all spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details the matrix spike recoveries for PCB analysis in Table 5, "Control Limits", attached herein as Appendix B.

Based on criteria specified in the project Work Order, all matrix spike/matrix spike duplicate/matrix spike triplicate recoveries were in control.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within the required limits, detailed in Table 5, "Control Limits", and attached herein as Appendix B.

Based on criteria specified in the project Work Order, all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were in control.

Instrument Quality Control:

Functional Guidelines specifies the Percent Difference (%D) between the retention time of dibutylchlorendate in the standard and all subsequent analyses cannot exceet 0.3%. Functional Guidelines further specifies that all standards are to be analyzed in the proper 72-hour sequence. The 72-hour sequence is detailed in Appendix C.

Based on criteria specified in Functional Guidelines, instrument QC for all analysis dates was in control.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that positive identifications must be confirmed by dissimilar column analysis and that the retention times of reported compounds must fall within the calculated retention time windows for the two chromatographic columns. In addition, Functional Guidelines specifies that for multipeak compounds, such as PCBs, the retention times and relative peak height ratios of major component peaks should be compared against the appropriate standard chromatograms.

All reported results met compound identification criteria specified in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated as per the applicable Statement of Work. Per Laucks Testing Laboratories' internal QA procedures, all peaks determined to be a particular Arochlor are summed and quantified against an appropriate standard. The project Work Order details detection limit criteria in Table 4, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits met criteria specified in Functional Guidelines and the project Work Order.

Other QC Issues:

Sample 10400-143 was reextracted and reanalyzed due to surrogate omission in the initial extraction. Reextraction and reanalysis were performed within the prescribed holding time. All comments and results presented are based on reanalysis results.

Aqueous field and rinsate blanks were extracted separately from soil samples. As these blanks were considered to be quality control samples in themselves, additional quality control (matrix spike) was not required.

Volatile Organic Compounds
(Method SW 8240)

This section provides an evaluation of the volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988 and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be analyzed within 7 days of sample collection. The project Work Order specifies that unpreserved soil samples must be analyzed within 10 days of sample collection. Functional Guidelines does not suggest a holding time for soils.

All samples were analyzed within holding times specified by Functional Guidelines and the project Work Order with the following exceptions:

Sample	Date Received	Date Analyzed	Comments
10400-58	07/11/88	07/19/88	Aqueous Field Blank
10400-201	08/08/88	08/16/88	Aqueous Field Blank

Functional Guidelines and the project Work Order each specify that water samples must be analyzed within 7 days of sample collection. Samples were aqueous field blanks with results normalized to the soil dry basis. Since sample collection dates are not applicable to field blanks, Laucks Testing Laboratories has chosen to evaluate holding times based on the sample receipt date.

Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, all results for samples 10400-58 and 10400-201 have been flagged "E" to indicate the results are estimates based on analysis outside holding time.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria have been established to ensure mass resolution, identification and, to some degree, sensitivity. It defines both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Bromofluorobenzene (BFB), as shown in Appendix E.

Ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05. Per Laucks Testing Laboratories' internal QA procedures and U.S.E.P.A. Contract Laboratory Program, Statement of Work for Organics Analysis, these must be greater than or equal to 0.300, with the exception of bromoform, which must be greater than or equal to 0.250. These criteria are more stringent than those in Functional Guidelines.

Calibration criteria specified in Functional Guidelines and U.S.E.P.A Contract Laboratory Program, Statement of Work for Organics Analysis were met for all analysis dates.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. A minimum of one method blank was analyzed with each sample batch and results were normalized to the soil dry basis. The following target compounds were detected in the blanks:

Sample	Compound	Concentration
B0629MVOSJ2	Methylene Chloride	240 ug/kg DB
B0629MVOSJ2	Ethylbenzene	290 ug/kg DB
B0629MVOSJ2	m,p-Xylenes	320 ug/kg DB
B0719MVOSJ2	Acetone	860 ug/kg DB
B0808MVOSS1	Acetone	17 ug/kg DB
B0809MVOSS1	Acetone	2100 ug/kg DB
B0809MVOSS2	Acetone	36 ug/kg DB

Functional Guidelines specifies that when a common laboratory contaminant is detected in both the sample and the blank, results must be qualified when the sample concentration is less than 10 times the blank concentration. Positive results for all associated compounds in all samples associated with the above-referenced blanks have been flagged "B" to indicate the analyte of concern was detected in the associated blank as well as the samples, regardless of sample concentration.

Surrogate:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for volatile organics analysis in Table 5, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if one volatile surrogate is outside established control limies, or if one volatile surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented through sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

Based on criteria specified in Functional Guidelines and the project Work Order, all surrogate recoveries were in control with the following exceptions:

Sample	Compound	% Recovery	Limits	Comments
10400-13	d8-Toluene	136	81-117	(1)
10400-13	p-Bromofluorobenzene	68	75-115	(1)
10400-13RE	d8-Toluene	134	81-117	(2)
10400-13RE	p-Bromofluorobenzene	66	75-115	(2)
10400-200	d8-toluene	146	81-117	(1)
10400-200	p-Bromofluorobenzene	63	75-115	(1)
10400-200RE	d8-toluene	145	81-117	(2)
10400-200RE	p-bromofluorobenzene	61	75-115	(2)
10400-205	d8-toluene	132	81-117	(1)
10400-205	p-bromofluorobenzene	74	75-115	(1)
10400-205RE	d8-toluene	131	81-117	(2)
10400-205RE	p-bromofluorobenzene	64	75-115	(2)
10400-250	d8-toluene	121	81-117	(1)
10400-250RE	d8-toluene	128	81-117	(2)

(1) Per the project Work Order, should surrogate recoveries fall outside control limits, reanalysis is to be performed to document matrix effect. Sample has been reanalyzed, identified by "RE".

(2) Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The value is a result of reanalysis with surrogate recovery values remaining outside control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action required.

Functional Guidelines specifies that, should one volatile surrogate be outside control limits, results are to be qualified as estimates. Following these guidelines, all results for samples 10400-13RE, 10400-200RE, 10400-205RE and 10400-250 RE have been flagged "E" to indicate the results are estimates due to surrogate recoveries outside control limits.

Matrix Spike:

Functional Guidelines specifies that all spike recovery values must be within the advisory limits established in the appropriate Statement of Work. The project Work Order details the matrix spike recovery limits for volatile organics analysis in Table 5, "Control Limits", attached herein as Appendix B.

In accordance with criteria specified in the project Work Order, all matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were in control

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 5, "Control Limits", and attached herein as Appendix B.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were in control.

Instrument Quality Control:

Functional Guidelines specifies that internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. It further specifies that the retention time of the internal standard must not vary by more than +/- 30 seconds from the associated calibration standard.

Based on criteria specified in Functional Guidelines, all internal standards were acceptable with the following exceptions:

Sample	Compound	% Recovery	Limits	Comments
10400-187	D5-Chlorobenzene	44	-50% to +100%	(1)
10400-187RE	D5-Chlorobenzene	44	-50% to +100%	(2)
10400-200	Bromochloromethane	48	-50% to +100%	(1)
10400-200	1,4-Difluorobenzene	49	-50% to +100%	(1)
10400-200	D5-Chlorobenzene	30	-50% to +100%	(1)
10400-200RE	Bromochloromethane	49	-50% to +100%	(2)
10400-200RE	1,4-Difluorobenzene	49	-50% to +100%	(2)
10400-200RE	D5-Chlorobenzene	30	-50% to +100%	(2)
10400-205	D5-Chlorobenzene	38	-50% to +100%	(1)
10400-205RE	D5-Chlorobenzene	45	-50% to +100%	(1)

(1) Per the project Work Order, should recoveries fall outside control limits, reanalysis is to be performed to document matrix effect. Sample has been reanalyzed and is identified by "RE" following the sample number.

(2) Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The value is a result of reanalysis with internal standard recovery values remaining outside control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action required.

Functional Guidelines specifies that, should internal standard recoveries fall outside specified limits, results associated with that internal standard are to be flagged as estimated. All appropriate results for samples 10400-187RE, 10400-200RE and 10400-205RE have been flagged "E" to indicate the results are estimates due to internal standard values outside control limits.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

In accordance with criteria specified in Functional Guidelines, all reported compounds were correctly identified.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 4, "Detection Limit Goals", attached herein as Appendix A.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all reported results and detection limits were acceptable.

Other QC Issues:

Sample 10400-1MST was analyzed 38 minutes after the 12 hour QC period had expired. Sample 10400-26MST was analyzed 1 minute after the 12 hour QC period expired. The quality of the data is not affected and results have not been qualified.

Semi-Volatile Organic Compounds
(Methods SW 3550 / SW 8270)

This section provides an evaluation of semi-volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988 and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection. The project Work Order specifies that soil samples must be extracted within 7 days and analyzed within 40 days of sample collection. Functional Guidelines does not suggest a holding time for soils.

All samples were extracted and analyzed within the holding times specified in Functional Guidelines and the project Work Order with the following exceptions.

A) These samples required reextraction due to matrix spike recovery results which were outside control limits in the initial extraction and analysis:

10400-67MS
10400-67MSD
10400-67MST
10400-115MS
10400-115MSD
10400-115MST
10400-168MS
10400-168MSD
10400-168MST
10400-205MS
10400-205MSD
10400-205MST

All above-referenced samples were for quality control purposes. Associated original samples were extracted and analyzed within prescribed holding times. Analysis of reextracted quality control samples was performed within holding time requirements. Data qualification is not required.

B) The following samples required reextraction due to poor surrogate recoveries in initial extraction and analysis:

10400-90
10400-248
10400-249

Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, all results for samples 10400-90, 10400-248 and 10400-249 have been flagged "E" to indicate the results are estimates based on extraction outside holding time.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria are established to ensure mass resolution, identification and, to some degree, sensitivity. It details both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Decafluorotriphenylphosphine (DFTPP), as detailed in Appendix E.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05.

Initial calibrations for all analysis dates met criteria specified in Functional Guidelines.

Continuing calibrations for all analysis dates met criteria specified in Functional Guidelines with the following exception:

Sample	Compound	%D	Limit
10400-90	Pentachlorophenol	33.8	0-25

Functional Guidelines specifies that, if the %D between the Initial and Continuing Calibration for any Calibration Check Compound exceeds 25%, positive results for that compound should be qualified as estimated. Pentachlorophenol was not detected in sample 10400-90. Data qualification was not required.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each batch and results normalized to the soil dry basis. Target compounds were detected in the following blanks:

Sample	Compound	Concentration
B0702MSV.WLQ	Di-n-butyl phthalate	24 ug/l
B0702MSV.WLQ	Bis(2-ethylhexyl) phthalate	31 ug/l
B0713MPP.SLG	Bis(2-ethylhexyl) phthalate	45 ug/kg DB
B0721MPP.SLC	Bis(2-ethylhexyl) phthalate	41 ug/kg DB
B0727MPP.SLG	Di-n-butyl phthalate	73 ug/kg DB
B0727MPP.SLG	Bis(2-ethylhexyl) phthalate	140 ug/kg DB
B0810MPP.SLC	Bis(2-ethylhexyl) phthalate	43 ug/kg DB
B0810MPP.SLC	Di-N-Octyl Phthalate	250 ug/kg DB
B0812MPP.SLC	Bis(2-ethylhexyl) phthalate	130 ug/kg DB
B0812MPP.SLC	Di-N-Octyl Phthalate	47 ug/kg DB
B0816MPP.SLG	Bis(2-ethylhexyl) phthalate	1300 ug/kg DB
B0819MPP.SLE	Phenol	40 ug/kg DB
B0823MPP.SLI	Bis(2-ethylhexyl) phthalate	350 ug/kg DB

Functional Guidelines specifies that when a common laboratory contaminant is detected in both the sample and the blank, results must be qualified when the sample concentration is less than 10 times the blank concentration. Laucks Testing Laboratories utilizes the "B" flag to indicate the analyte of concern was detected in the associated blank as well as the samples, regardless of the sample concentration. All associated compounds in all samples associated with the above-referenced blanks have been flagged "B".

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for semi-volatile organics analysis in Table 5, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if two base/neutral or acid surrogates are outside established control limits, or if one base/neutral or acid surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

All surrogate recoveries were within the control limits specified in the project Work Order with the following exceptions:

Sample Number	Surrogate	% Recovery	Limits	Comments
B0714MSV.WLE	d14-p-terphenyl	28	33-141	(2)
B0617MSV.SLC	d5-phenol	69	27-105	(1)
10400-1	d5-phenol	30	27-105	(1)

Sample Number	Surrogate	% Recovery	Limits	Comments
10400-2	d5-phenol	50	27-105	(1)
10400-2MS	d5-phenol	66	27-105	(1)
10400-2MSD	d5-phenol	62	27-105	(1)
10400-2MST	d5-phenol	63	27-105	(1)
10400-3	d5-phenol	39	27-105	(1)
10400-3	d5-Nitrobenzene	43	45-100	(2)
10400-47	d5-Nitrobenzene	42	45-100	(2)
10400-79	d14-p-terphenyl	140	29-130	(2)
10400-118	d5-Nitrobenzene	172	45-100	(2)
10400-168MST	d5-Nitrobenzene	39	45-100	(2)
10400-180	2,4,6-Tribromophenol	18	19-122	(2)

(1) Due to the fact the surrogate spiking solution was prepared from a different stock solution than that used for the current 5-point calibration, all samples in the batch, with the exception of 10400-1 and 10400-3, exceeded the required recovery limits for d5-phenol. Because a significant difference in response has been documented for the two d5-phenol stock solutions in question, the mean response factor for the solution used for these samples (derived from the previous 5-point calibration) was used to calculate d5-phenol recoveries for the method blank and all samples in this set. By using this calculation method, all surrogate recoveries were within the required limits.

(2) Per Functional Guidelines and the project Work Order, one acid and/or one base/neutral surrogate compound may be out of control and the analysis be considered in control. No corrective action or data qualification required.

Matrix Spike:

Functional Guidelines specifies that all matrix spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details the matrix spike/matrix spike duplicate/matrix spike triplicate recoveries for semi-volatile organics analysis in Table 5, "Control Limits", attached herein as Appendix B.

The following matrix spike/matrix spike duplicate/matrix spike triplicate results were outside control limits:

Sample	Compound	% Recovery	Limits	Comments
10400-2MS	Phenol	96	39-95	(1)
10400-44MSD	2,4-Dinitrotoluene	93	28-89	(1)
10400-44MST	2,4-Dinitrotoluene	97	28-89	(1)
10400-64MS	2,4-Dinitrotoluene	94	28-89	(1)
10400-64MSD	2,4-Dinitrotoluene	96	28-89	(1)
10400-64MST	2,4-Dinitrotoluene	100	28-89	(1)
10400-67MS	2,4-Dinitrotoluene	96	28-89	(1)
10400-67MSD	2,4-Dinitrotoluene	91	28-89	(1)
10400-67MST	2,4-Dinitrotoluene	100	28-89	(1)
10400-67MSRE	1,4-Dichlorobenzene	37	38-103	(2)
10400-67MSDRE	1,4-Dichlorobenzene	26	38-103	(2)

Sample	Compound	% Recovery	Limits	Comments
10400-67MSTRE	1,4-Dichlorobenzene	28	38-103	(2)
10400-67MSRE2	2,4-Dinitrotoluene	93	28-89	(1)
10400-94MS	2,4-Dinitrotoluene	101	28-89	(1)
10400-94MSD	2,4-Dinitrotoluene	93	28-89	(1)
10400-94MST	2,4-Dinitrotoluene	90	28-89	(1)
10400-115MS	2,4-Dinitrotoluene	100	28-89	(1)
10400-115MSD	2,4-Dinitrotoluene	100	28-89	(1)
10400-115MS	Pentachlorophenol	110	17-109	(2)
10400-115MSD	Pentachlorophenol	116	17-109	(2)
10400-115MST	Pentachlorophenol	119	17-109	(2)
10400-115MST	2,4-Dinitrotoluene	101	28-89	(1)
10400-115MSRE	2,4-Dinitrotoluene	118	28-89	(1)
10400-115MSDRE	2,4-Dinitrotoluene	105	28-89	(1)
10400-115MSTRE	2,4-Dinitrotoluene	109	28-89	(1)
10400-147MS	2,4-Dinitrotoluene	99	28-89	(1)
10400-147MS	Pentachlorophenol	129	17-109	(2)
10400-150MS	2,4-Dinitrotoluene	98	28-89	(1)
10400-150MSD	2,4-Dinitrotoluene	92	28-89	(1)
10400-150MST	2,4-Dinitrotoluene	100	28-89	(1)
10400-158MS	2,4-Dinitrotoluene	101	28-89	(1)
10400-158MS	Pentachlorophenol	114	17-109	(2)
10400-158MSD	2,4-Dinitrotoluene	102	28-89	(1)
10400-158MSD	Pentachlorophenol	113	17-109	(2)
10400-158MST	2,4-Dinitrotoluene	100	28-89	(1)
10400-175MSD	2,4-Dinitrotoluene	90	28-89	(1)
10400-175MST	2,4-Dinitrotoluene	95	28-89	(1)
10400-184MS	2,4-Dinitrotoluene	95	28-89	(1)
10400-184MS	Pyrene	121	23-115	(2)
10400-184MSD	2,4-Dinitrotoluene	94	28-89	(1)
10400-184MSD	Pyrene	119	23-115	(2)
10400-205MS	Pentachlorophenol	0	17-109	(2)
10400-205MST	Pentachlorophenol	0	17-109	(2)
10400-205MSRE	Pentachlorophenol	12	17-109	(2)
10400-205MSDRE	Pentachlorophenol	0	17-109	(2)
10400-205MSTRE	Pentachlorophenol	0	17-109	(2)
10400-207MS	2,4-Dinitrotoluene	102	28-89	(1)
10400-207MSD	2,4-Dinitrotoluene	98	28-89	(1)
10400-207MST	2,4-Dinitrotoluene	93	28-89	(1)
10400-207MS	Pyrene	117	23-115	(2)
10400-236MS	Phenol	103	39-95	(1)
10400-236MSD	Phenol	99	39-95	(1)
10400-236MST	Phenol	101	39-95	(1)
10400-249MS	1,4-Dichlorobenzene	37	38-103	(2)
10400-249MSD	1,4-Dichlorobenzene	35	38-103	(2)
10400-249MST	1,4-Dichlorobenzene	36	38-103	(2)

(1) The project Work Order specifies that where a recovery exceeds the upper control limit, and that control limit is less than 100%, the recovery is considered in control to an upper limit of 120%. No corrective action or data qualification required.

(2) Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective

action is required. The value is a result of reanalysis with surrogate recovery values remaining outside control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action is required.

Functional Guidelines specifies that no action is taken on matrix spike/matrix spike duplicate/matrix spike triplicate data alone to qualify an entire case. Functional Guidelines further specifies that if it can be determined that the results of the MS/MSD/MST affect only the sample spiked, qualification should be limited to that sample alone. It does not specify the manner in which data should be qualified. Laucks Testing Laboratories has chosen to qualify as estimated the data for all associated compounds in all associated samples when QC sample results are outside matrix spike control limits, using the "E" flag.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that Relative Percent Difference (RPD) value between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies RPD control limits in Table 5, "Control Limits", attached herein as Appendix B.

Per Functional Guidelines, no action is required on matrix spike/matrix spike duplicate results alone. It recommends, however, these data be reviewed in conjunction with other QC criteria to determine the need for data qualification. The project Work Order specifies that matrix effect is documented through reanalysis. Should RPDs remain outside established control limits, no further corrective action is required.

RPD values were outside control limits in the following samples:

Sample	Compound	% Recovery		RPD	Limits
		MS	MSD/T		
10400-2MS/MSD	1,4-Dichlorobenzene	50	42	19	10
10400-2MS/MSD	1,2,4-Trichlorobenzene	72	61	17	9
10400-2MS/MST	1,4-Dichlorobenzene	50	44	13	10
10400-44MS/MSD	1,4-Dichlorobenzene	65	73	11	10
10400-44MS/MST	1,4-Dichlorobenzene	65	74	13	10
10400-67MS/MSD	Acenaphthene	81	73	11	8
10400-67MS/MSD	Pentachlorophenol	84	60	34	26
10400-67MS/MST	Pentachlorophenol	84	48	56	26
10400-67MS/MSDRE	1,4-Dichlorobenzene	37	26	34	10
10400-67MS/MSDRE	1,2,4-Trichlorobenzene	59	47	23	9
10400-67MS/MSDRE	Acenaphthene	66	61	9	8
10400-67MS/MSTRE	1,4-Dichlorobenzene	37	28	27	10
10400-67MS/MSTRE	1,2,4-Trichlorobenzene	59	49	18	9
10400-67MS/MSTRE	Acenaphthene	66	60	10	8
10400-67MS/MSDRE2	1,4-Dichlorobenzene	62	70	12	10
10400-67MS/MSTRE2	1,4-Dichlorobenzene	62	69	11	10
10400-67MS/MSTRE2	4-Chloro-3-Methylphenol	72	82	12	11
10400-94MS/MSD	1,4-Dichlorobenzene	52	65	23	10
10400-94MS/MSD	1,2,4-Trichlorobenzene	78	87	11	9
10400-94MS/MST	1,4-Dichlorobenzene	52	46	12	10

Sample	Compound	% Recovery MS	MSD/T	RPD	Limits
10400-94MS/MST	2,4-Dinitrotoluene	101	90	11	9
10400-115MS/MSD	1,2,4-Trichlorobenzene	59	67	13	9
10400-115MS/MST	1,2,4-Trichlorobenzene	59	66	12	9
10400-115MS/MST	1,4-Dichlorobenzene	50	59	17	10
10400-115MS/MSDRE	1,4-Dichlorobenzene	71	63	12	10
10400-115MS/MSDRE	1,2,4-Trichlorobenzene	79	71	11	9
10400-115MS/MSDRE	2,4-Dinitrotoluene	118	105	12	9
10400-115MS/MSTRE	1,4-Dichlorobenzene	71	59	19	10
10400-115MS/MSTRE	Pyrene	109	91	17	11
10400-125MS/MSD	1,4-Dichlorobenzene	61	70	14	10
10400-125MS/MSD	1,2,4-Trichlorobenzene	73	83	12	10
10400-125MS/MSD	Pyrene	80	71	12	11
10400-125MS/MST	1,4-Dichlorobenzene	61	73	19	10
10400-125MS/MST	1,2,4-Trichlorobenzene	73	86	17	9
10400-125MS/MST	4-Chloro-3-Methylphenol	86	97	12	11
10400-147MS/MSD	Phenol	76	62	20	13
10400-147MS/MSD	2-Chlorophenol	67	56	19	15
10400-147MS/MSD	1,4-Dichlorobenzene	79	61	26	10
10400-147MS/MSD	N-Nitroso-di-n-Propylamine	97	70	33	16
10400-147MS/MSD	1,2,4-Trichlorobenzene	89	75	16	9
10400-147MS/MSD	4-Chloro-3-Methylphenol	99	84	16	11
10400-147MS/MSD	Acenaphthene	87	76	14	8
10400-147MS/MSD	4-Nitrophenol	112	85	27	13
10400-147MS/MSD	2,4-Dinitrotoluene	99	87	13	9
10400-147MS/MST	Phenol	76	64	18	13
10400-147MS/MST	1,4-Dichlorobenzene	79	61	25	10
10400-147MS/MST	N-Nitroso-di-n-Propylamine	97	71	31	16
10400-147MS/MST	1,2,4-Trichlorobenzene	89	78	13	9
10400-147MS/MST	Acenaphthene	87	80	9	8
10400-147MS/MST	4-Nitrophenol	112	81	33	13
10400-147MS/MST	2,4-Dinitrotoluene	99	83	18	9
10400-147MS/MST	Pentachlorophenol	129	91	34	26
10400-150MS/MSD	Acenaphthene	94	86	9	8
10400-150MS/MST	1,4-Dichlorobenzene	59	66	11	10
10400-175MS/MSD	Acenaphthene	81	88	9	8
10400-175MS/MST	1,4-Dichlorobenzene	51	70	31	10
10400-175MS/MST	1,2,4-Trichlorobenzene	67	85	23	9
10400-175MS/MST	Acenaphthene	81	89	9	8
10400-175MS/MST	2,4-Dinitrotoluene	87	95	10	9
10400-175MS/MST	Pentachlorophenol	50	37	31	26
10400-205MS/MSD	Pentachlorophenol	0	39	200	26
10400-205MS/MST	Pentachlorophenol	0	0	NA	26
10400-205MS/MSDRE	Pentachlorophenol	12	0	200	26
10400-205MS/MSTRE	Pentachlorophenol	12	0	200	26

Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The value is a result of reanalysis with RPDs remaining outside control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action is required.

Functional Guidelines specifies that no action is taken on matrix spike/matrix spike duplicate/matrix spike triplicate data alone to qualify an entire case. Functional Guidelines further specifies that if it can be determined that the results of the MS/MSD/MST affect only the sample spiked, qualification should be limited to that sample alone. It does not specify the manner in which data should be qualified. Laucks Testing Laboratories has chosen to qualify as estimated the data for all associated compounds in all associated samples when QC sample results are outside RPD control limits, using the "E" flag. All associated results have been flagged "E" to indicate the results are estimates due to RPDs outside control limits.

Instrument Quality Control:

Functional Guidelines specifies internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. In addition, the retention time of the internal standard must not vary more than 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within plus or minus 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 4, "Detection Limit Goals", attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

Pentachlorophenol and Fluoranthene peaks in samples 10400-193 and 10400-205 required manual integration by the analyst due to instrument error. Manual integration was performed properly and the resulting area count values were within control limits. No data qualification was required.

FIELD REPLICATES

Field replicates are multiple samples taken at the same time and placed under similar circumstances, each of which is treated the same throughout the field and laboratory analytical procedures. The laboratory is unaware of which samples have been replicated. In general, field replicates can be most useful in evaluating variation attributable to the sampling, sub-sampling, handling, and storage aspects of an analysis. But the difference between analytical results for field replicates will also include variation attributable to laboratory factors such as extraction, analysts, reagents, instrumentation, etc.

A total of eleven (11) replicate soil samples were collected and analyzed for this project. The Hart Crowser station identifications are the following: P13/HT01; A3/HT01; D9/HT01; H1/HT01; L1/HB01; R1/HB01; N3/HB01; S8/HB01; P9/HB01; L8/HB01; and R8/HB01. The replicate soil sample for an individual station is identified by sample depth (11 feet). One replicate soil sample was analyzed per 20 soil samples received.

Inorganics

There is no specific review criteria for field replicate analyses comparability in the Functional Guidelines. The functional guidelines specifies that at least one laboratory duplicate sample must be analyzed from each group of samples of a similar matrix type for each sampling event or for each 20 samples received, whichever is more frequent. If soil duplicate analysis results for a particular inorganic analyte fall outside the control windows of ± 35 percent for RPD (sample values greater than 5 times the CRDL) or ± CRDL (sample values less than 5 times the CRDL), whichever is appropriate, the results for that analyte in all other samples of the same matrix type should be flagged as estimated (J). The relative percent differences of field replicates were compared to the control windows specified for laboratory duplicate results. Listed below are the RPD values for sample duplicates exceeding the control limit of ± 35 percent or ± CRDL, whichever is appropriate.

Sample Numbers	Compound	RPD (> 5 x CRDL)	Std. Dev. (< 5 x CRDL)	RDP Limits (Percent) or CRDL (mg/kg)
10400-42,45	Copper	116	--	± 35
10400-42,45	Nickel	--	6	± 2
10400-42,45	Zinc	70	--	± 35
10400-60,61	Copper	44	--	± 35
10400-60,61	Lead	--	6	± 5
10400-67,68	Chromium	44	--	± 35
10400-67,68	Zinc	69	--	± 35
10400-75,76	Copper	105	--	± 35
10400-75,76	Nickel	80	--	± 35
10400-75,76	Lead	76	--	± 35
10400-75,76	Chromium	106	--	± 35
10400-225,226	Copper	58	--	± 35
10400-225,226	Lead	99	--	± 35

Total Petroleum Hydrocarbons

Sample Numbers	RPD (> 5 x CRDL)	Std. Dev. (< 5 x CRDL)	RDP Limits (Percent) or CRDL (mg/kg)
10400-42,45	57	--	± 35
10400-60,61	62	--	± 35
10400-67,68	--	21	± 20
10400-75,76	110	--	± 35

Total Arsenic

Sample Numbers	RPD (> 5 x CRDL)	Std. Dev. (< 5 x CRDL)	RDP Limits (Percent) or CRDL (mg/kg)
10400-42,45	--	0.7	± 0.5
10400-67,68	158	--	± 35
10400-257,258	123	--	± 35

Volatile and Semivolatile Organics

There is no specific review criteria for field duplicate analyses comparability in the Functional Guidelines. Listed below are the relative percent differences (RPD) for sample duplicates.

Sample Numbers	Compound	RPD
10400-42,45	Total Volatiles	39
10400-60,61	Total Volatiles	33
10400-60,61	Total Semivolatiles	43
10400-130,131	Total Semivolatiles	23
10400-177,178	Total Semivolatiles	15
10400-184,185	Total Semivolatiles	200
10400-217,218	Total Volatiles	84
10400-225,226	Total Semivolatiles	141
10400-257,258	Total Volatiles	26

GC/FID Screen

There is no specific review criteria for field duplicate analyses comparability in the Functional Guidelines. Listed below are the relative percent differences (RPD) for sample duplicates.

Sample Numbers	RPD
10400-60,61	82
10400-130,131	0
10400-225,226	200

Pesticides and PCBs

There is no specific review criteria for field duplicate analyses comparability in the Functional Guidelines. Pesticides and PCBs were not detected in field replicate samples.

CONCLUSIONS

Replicate analysis results can be used as an indicator of the overall precision of the sample results. It was our intention to analyze soils in duplicate for each chemical analysis based on the project sampling scheme.

The non-homogeneous nature of soil samples often makes it difficult to achieve good duplicate results compared to aqueous samples (U.S.E.P.A., 1988). Poor replicate precision may be a result of sample non-homogeneity, sampling method defects, or laboratory technique.

Generally, the percent difference between replicate soil samples is greater for samples collected in the test pits versus borings. A stainless steel spoon was used to sample soils from test pit walls, compared with a split-spoon sampler for the borings (see Appendix A). Therefore, further non-homogeneity may occur with different sampling methods.

RINSE BLANKS

The purpose of the rinse blank samples is to assess the degree to which a parameter of interest is added or removed during field operations such as equipment decontamination or sample filtration. Three rinse blank samples were collected and analyzed for TPH, total metals, EPTOX metals, volatile and extractable priority pollutant organic compounds, Pesticides/PCBs, and GC/FID screen (selection 1.1 via the decision process schematic). The sample identification and laboratory results are discussed below.

The rinse blanks identified as laboratory No. 27 and No. 73 were collected during rinsing of a sampling spoon (test pits). The rinse blank identified as No. 143 was collected during rinsing of a split spoon (borings). Overall, the compounds tested were undetected except for the following:

Sample Number	Compound	Result	Qualifier
27	Petroleum O&G	0.5 mg/L	
27	Total Copper	0.009 mg/L	B
27	Total Zinc	0.087 mg/L	B
27	Chloroform	29 ug/L	
27	Bromodichloromethane	1 ug/L	
27	Bis(2-ethylhexyl)phthalate	4 ug/L	B
73	Total Zinc	0.002 mg/L	B
73	Chloroform	41 ug/L	
73	Bromodichloromethane	1 ug/L	
143	Total Copper	0.002 mg/L	B
143	Total Zinc	0.35 mg/L	B
143	Chloroform	25 ug/L	
143	Bis(2-ethylhexyl)phthalate	4 ug/L	B

NOTE: B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself.

Many of the compounds detected in the rinse blanks were also detected in the method blank (e.g., zinc). Chloroform and bromodichloromethane are found in municipal drinking water primarily as a consequence of chlorination (e.g., reported concentrations of chloroform range <0.3 - 311 ppb; Sittig, 1981). The sampling and split spoons were washed in subsequent baths of alconox and tap water before the distilled water rinse. Therefore, the detection of these compounds in the rinse blanks can be explained.

Reference

Sittig, Marshal, 1981. Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, N.J. 729p.

U.S. Environmental Protection Agency, February 1, 1988, Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses.

U.S. Environmental Protection Agency, May 28, 1985, Laboratory Data Validation, Functional Guidelines for Evaluating Pesticides/PCBs Analyses.

U.S. Environmental Protection Agency, Undated, Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses.

APPENDIX A
TABLE 4
(page 1)
DETECTION LIMIT GOALS

	WATER		SOIL	
TEST	MDL	CRDL	MDL (% AR)	CRDL (% AR)
Total Solids	NR	NR	0.1	0.1
TEST	(mg/l)	(mg/l)	(mg/kg DB)	(mg/kg DB)
Petroleum Hydrocarbons (O & G)	0.1	0.1	20	20
TOTAL METALS:	(mg/l)	(mg/l)		
Copper	NR	NR	1	1
Nickel	NR	NR	2	2
Cadmium	NR	NR	0.5	0.5
Lead	NR	NR	5	5
Chromium	NR	NR	1	1
Zinc	NR	NR	1	1
Arsenic	NR	NR	0.5	0.5
TEST DISSOLVED METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST EP TOXICITY METALS:			(mg/l)	(mg/l)
Copper	NR	NR	0.1	0.1
Nickel	NR	NR	0.1	0.1
Cadmium	NR	NR	0.01	0.01
Lead	NR	NR	0.1	0.1
Chromium	NR	NR	0.1	0.1
Zinc	NR	NR	0.1	0.1
Arsenic	NR	NR	0.2	0.2

NR = analysis for this analyte in this matrix is Not Required
MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 4
(page 2)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/FID Screen, calculated as Phenanthrene	400	400	10 000	10 000
PCB's:				
Aroclor-1016	0.5	0.5	33	33
Aroclor-1221	0.5	0.5	33	33
Aroclor-1232	0.5	0.5	33	33
Aroclor-1242	0.5	0.5	33	33
Aroclor-1248	0.5	0.5	33	33
Aroclor-1254	1	1	67	67
Aroclor-1260	1	1	67	67

TEST GC/MS EXTRACTABLES:	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
Phenol	2	2	33	33
Aniline	10	10	170	170
Bis(2-chloroethyl)ether	2	2	33	33
2-Chlorophenol	2	2	33	33
1,3-Dichlorobenzene	2	2	33	33
1,4-Dichlorobenzene	2	2	33	33
Benzyl alcohol	2	2	33	33
1,2-Dichlorobenzene	2	2	33	33
2-Methylphenol	2	2	33	33
Bis(2-chloroisopropyl)ether	2	2	33	33
4-Methylphenol	2	2	33	33
N-Nitroso-di-n-propylamine	2	2	33	33
Hexachloroethane	4	4	67	67
Nitrobenzene	2	2	33	33
Isophorone	2	2	33	33
2-Nitrophenol	4	4	67	67
2,4-Dimethylphenol	2	2	33	33
Benzoic Acid	50	50	830	830
Bis(2-chloroethoxy)methane	2	2	33	33
2,4-Dichlorophenol	4	4	67	67
1,2,4-Trichlorobenzene	2	2	33	33
Naphthalene	4	4	67	67
4-Chloroaniline	2	2	33	33
Hexachlorobutadiene	2	2	33	33
4-Chloro-3-methylphenol	4	4	67	67
2-Methylnaphthalene	2	2	33	33
Hexachlorocyclopentadiene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 4
(page 3)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS EXTRACTABLES(cont):				
2,4,6-Trichlorophenol	4	4	67	67
2,4,5-Trichlorophenol	4	4	67	67
2-Chloronaphthalene	2	2	33	33
2-Nitroaniline	4	4	67	67
Dimethyl phthalate	2	2	33	33
Acenaphthylene	2	2	33	33
2,6-Dinitrotoluene	4	4	67	67
3-Nitroaniline	10	10	170	170
Acenaphthene	2	2	33	33
2,4-Dinitrophenol	20	20	330	330
4-Nitrophenol	20	20	330	330
Dibenzofuran	2	2	33	33
2,4-Dinitrotoluene	4	4	67	67
Diethyl phthalate	2	2	33	33
4-Chlorophenyl phenylether	2	2	33	33
Fluorene	2	2	33	33
4-Nitroaniline	4	4	67	67
4,6-Dinitro-2-methylphenol	20	20	330	330
N-Nitrosodiphenylamine	1	1	33	33
1,2-Diphenylhydrazine	4	4	67	67
4-Bromophenyl phenylether	4	4	67	67
Hexachlorobenzene	2	2	33	33
Pentachlorophenol	20	20	330	330
Phenanthrene	2	2	33	33
Anthracene	2	2	33	33
Di-n-butyl phthalate	2	2	33	33
Fluoranthene	2	2	33	33
Pyrene	2	2	33	33
Benzidine	50	50	830	830
Butylbenzylphthalate	2	2	33	33
3,3'-Dichlorobenzidine	20	20	330	330
Benzo(a)anthracene	2	2	33	33
Chrysene	2	2	33	33
Bis(2-ethylhexyl)phthalate	2	2	33	33
Di-n-octyl phthalate	2	2	33	33
Benzo(b)fluoranthene	4	4	67	67
Benzo(k)fluoranthene	4	4	67	67
Benzo(a)pyrene	4	4	67	67
Indeno(1,2,3-cd)pyrene	4	4	67	67
Dibenzo(a,h)anthracene	4	4	67	67
Benzo(g,h,i)perylene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 4
(page 4)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS VOLATILES:				
Chloromethane	1	1	2	2
Bromomethane	1	1	2	2
Vinyl Chloride	1	1	2	2
Chloroethane	3	3	6	6
Methylene Chloride	1	1	2	2
Acetone	5	5	10	10
Carbon Disulfide	1	1	2	2
1,1-Dichloroethene	1	1	2	2
1,1-Dichloroethane	1	1	2	2
trans-1,2-Dichloroethene	1	1	2	2
cis-1,2-Dichloroethene	1	1	2	2
total-1,2-Dichloroethene	1	1	2	2
Chloroform	1	1	2	2
2-Butanone	3	3	6	6
1,2-Dichloroethane	1	1	2	2
1,1,1-Trichloroethane	1	1	2	2
Carbon Tetrachloride	1	1	2	2
Vinyl Acetate	1	1	2	2
Bromodichloromethane	1	1	2	2
1,2-Dichloropropane	1	1	2	2
Trichloroethene	1	1	2	2
Benzene	1	1	2	2
Dibromochloromethane	3	3	6	6
1,1,2-Trichloroethane	1	1	2	2
Bromoform	1	1	2	2
4-Methyl-2-Pentanone	3	3	6	6
2-Hexanone	3	3	6	6
1,1,2,2-Tetrachloroethane	3	3	6	6
Tetrachloroethene	1	1	2	2
Toluene	1	1	2	2
Chlorobenzene	3	3	6	6
trans-1,3-Dichloropropene	3	3	6	6
Ethylbenzene	1	1	2	2
cis-1,3-Dichloropropene	3	3	6	6
Styrene	1	1	2	2
Total Xylenes	1	1	2	2

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 4
(page 5)
DETECTION LIMIT GOALS

COMMENTS:

Actual reported Sample Detection Limits (SDLs) may vary from the target detection limits listed herein. There are several circumstances which can result in SDLs which are elevated above the CRDLs. Typically, these are:

1) Insufficient sample volume submitted to perform preparation according to established methodology.

2) Dilution of a sample extract or digest for reasons of matrix interference or to bring another compound of interest within linear range.

3) Extraction of the sample at the "medium" or "high" levels, rather than a typical "low" level extraction. This involves employing a smaller sample size and is a decision made on visual appearance of the sample and/or odor.

In addition, it should be noted that the limits of detection shown for soil analysis have been normalized to reflect a total solids value of 100%. In fact, soil samples will generally have total solids of 75-80% and SDLs will be correspondingly increased.

APPENDIX B
TABLE 5
(page 1)
CONTROL LIMITS
(Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate)

	WATER		SOIL	
TEST	% Recovery	RPD	% Recovery	RPD
Petroleum Hydrocarbons (O & G)	74-126	0-11	82-114	0-13
TOTAL METALS:				
Copper	75-125*	0-7	75-125*	0-5
Nickel	75-125*	0-5	75-125*	0-6
Cadmium	75-125*	0-5	75-125*	0-7
Lead	75-125*	0-7	75-125*	0-6
Chromium	75-125*	0-6	75-125*	0-8
Zinc	75-125*	0-6	75-125*	0-5
Arsenic	75-125*	0-7	69-118	0-8
(water control limits apply to EP Toxicity Metals)				
GC/FID Screen, calculated as Phenanthrene	@	@	@	@
PCBs:				
Aroclor 1260	20-150#	0-30#	20-150#	0-41#
GC/MS EXTRACTABLES:				
Phenol	16-72	0-18	39-95	0-13
2-Chlorophenol	31-122	0-15	25-102*	0-15
1,4-Dichlorobenzene	36-97*	0-16	38-103	0-10
N-Nitroso-di-n-propylamine	41-116*	0-17	41-126*	0-16
1,2,4-Trichlorobenzene	50-105	0-14	43-110	0-9
4-Chloro-3-methylphenol	46-108	0-11	47-113	0-11
Acenaphthylene	44-110	0-12	45-116	0-8
4-Nitrophenol	10-78	0-21	11-114*	0-13
2,4-Dinitrotoluene	43-109	0-15	28-89*	0-9
Pentachlorophenol	35-120	0-11	17-109*	0-26
Pyrene	26-127*	0-11	23-115	0-11
GC/MS VOLATILES:				
1,1-Dichloroethane	53-131	0-7	59-129	0-8
Trichloroethene	71-120*	0-7	76-145	0-9
Benzene	76-127*	0-8	66-142*	0-9
Toluene	76-125*	0-13	59-139*	0-8
Chlorobenzene	73-128	0-8	68-139	0-7

= This is an estimated limit and is not based on experimentally derived data.

Hart Crowser
J-1639-09

QUALITY ASSURANCE DATA FOR GROUNDWATER SAMPLES COLLECTED IN OCTOBER 1988

APPENDIX B
TABLE 5
(page 2)
CONTROL LIMITS
(Surrogate Spike)

TEST	WATER % Recovery	SOIL % Recovery
GC/FID Screen, calculated as Phenanthrene	@	@
PCBs:		
Dibutylchlorendate	43-152	24-154
Isodrin	32-96	20-112
GC/MS EXTRACTABLES:		
2-Fluorophenol	18-75	30-99
d5-Phenol	15-49	27-105
2-Bromophenol	36-113	30-107
d5-Nitrobenzene	45-105	45-100
2-Fluorobiphenyl	44-100	54-103
d10-Azobenzene	48-116	34-123
2,4,6-Tribromophenol	26-122	19-122*
d14-p-Terphenyl	33-141*	29-130
GC/MS VOLATILES:		
d4-1,2-Dichloroethane	79-116	74-125
d8-Toluene	88-110*	81-117*
p-Bromofluorobenzene	86-115*	75-115

* = EPA Control Limits (all others are Laucks in-house)

@ = Addition of spiking and/or surrogate compounds to an extract of what is anticipated to be a contaminated sample prepared for screening analysis is not meaningful. The spiking and/or surrogate compounds will interfere with, and most probably enhance, sample results. Therefore, the laboratory will perform duplicate and triplicate sample analyses on one per twenty (or one per batch, if fewer than twenty) screens, with an RPD goal of 30% between the replicates.

APPENDIX B
TABLE 5
(page 3)
CONTROL LIMITS

COMMENTS:

Where a recovery exceeds the upper control limit, and that control limit was <100%, the recovery will be deemed in control to an upper limit of 120%.

In the case of GC/MS extractables up to two surrogates (one acid and/or one base/neutral compound) may be out of control and the analysis be deemed in control, with no requirement for re-analysis.

In the case of the PCB analysis, dibutylchlorendate (DBC) is the CLP surrogate and isodrin is a second surrogate added at Laucks' discretion. Should isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control.

COMPLETENESS:

Laboratory goal is 90% completeness. Matrix effect is documented through performance of a re-analysis. Should recoveries or RPDs remain out of control, no further corrective action is required. If data are 90% complete, outliers are regarded as anomalies.

APPENDIX C
72 Hour Sequence for Pesticide/PCB Analysis

1. Evaluation Standard Mix A
2. Evaluation Standard Mix B
3. Evaluation Standard Mix C
4. Individual Standard Mix A*
5. Individual Standard Mix B*
6. Toxaphene
7. Arochlors 1016/1260
8. Arochlor 1221**
9. Arochlor 1232**
10. Arochlor 1242
11. Arochlor 1248
12. Arochlor 1254
13. 5 Samples
14. Evaluation Standard Mix B
15. 5 Samples
16. Individual Standard Mix A or B
17. 5 Samples
18. Evaluation Standard Mix B
19. 5 Samples
20. Individual Standard Mix A or B (whichever not run in step 16)
21. 5 Samples
22. Repeat the above sequence starting with Evaluation Standard Mix B (step 14)
23. Pesticide/PCB analysis sequence must end with Individual Standard Mix A <u>and</u> B regardless of number of samples analyzed

---

* These may be one mixture.

** Arochlors 1221 and 1232 must be analyzed at a minimum of <u>once per month</u> on each instrument and each column. Copies of these chromatograms must be submitted with each Case for instruments and columns used to quantitate samples in that Case.

<u>U.S.E.P.A Contract Laboratory Program, Statement of Work for Organics Analysis, 10/86</u>

APPENDIX D
Control Limits
Solid Laboratory Control Sample
LCS (0287)

Element	True Value (mg/kg)	Control Limits (mg/kg)		
Al	325	225	-	424
Sb	211	127	-	294
As	917	635	-	1199
Ba	[4.8]	0	-	40
Be	19.4	16.5	-	22.3
Cd	45.4	35.7	-	55.1
Ca	196200	166800	-	225600
Cr	99.6	79.2	-	120
Co	144	125	-	162
Cu	6910	6006	-	7820
Fe	22430	17770	-	27080
Pb	236	188	-	285
Mg	118100	100400	-	129900
Mn	208	177	-	139
Hg	12.7	8.5	-	17.0
Ni	60.9	49.2	-	72.6
K	[50]	0	-	1000
Ag	22.2	15.5	-	29.0
Se	39.2	19.1	-	59.4
Na	[50]	0	-	1000
Tl	39.0	24.6	-	53.5
V	65.8	51.7	-	79.9
Zn	187	138	-	236

[x] Denotes values which are greater than or equal to the instrument detection limit but less than the contract required detection limit.
Values for these elements are below the CRDL and the windows are given for advisory purposes only.

Quality Assurance Laboratory, Environmental Research Center, University of Nevada, Las Vegas.

APPENDIX E
Tuning and Performance Criteria

Decafluorotriphenylphosphine (DFTPP)

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988.

Sample Receipt

Thirty water samples were received between the dates of July 5 and July 12, 1988. All samples were received intact and in good condition, with no exceptions.

Laboratory number 10740 was assigned to this project and each individual sample was given a discrete sub-sample number (i.e.,10740-1, 10740-2, etc). The attached Table I details the identification of each sample and the date on which it was received.

There were no discrepancies between sample identification and the chain-of-custody documents.

At your verbal requests not all samples were analyzed. The samples which were held without analysis, and dates of notification, were:

Lab No.	Identification	Notification Date
10740-18	Rinse Blank 12:30	07/08/88
10740-19	MW-2D 09:00	07/12/88
10740-22	Poss. Petroleum Prod.	07/11/88
10740-27	Rinse Blank	07/11/88

At your request, one sample was not logged into the laboratory numbering system. This sample was received on July 8, 1988 and is identified as LW-13S 10:50.

At your request, Hart Crowser's sample identification was changed for two samples. Laucks' lab no. 12740-17 was changed from MW-2D to MW-2I and Laucks' lab no. 12740-19 was changed from MW-2I to MW-2D by the laboratory after consultation with your office.

The samples were held in cold storage at 4°C until removed for preparation and/or analysis.

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Date Rec'd	Interim Due Date
10740	1	PACCAR	LW-5D	07/05/88	07/05/88	08/11/88
10740	2	PACCAR	LW-15S	07/05/88	07/05/88	08/11/88
10740	3	PACCAR	LW-12S	07/05/88	07/05/88	08/11/88
10740	4	PACCAR	LW-12D	07/05/88	07/05/88	08/11/88
10740	5		LW-2S	07/06/88	07/06/88	08/11/88
10740	6		LW-2D	07/06/88	07/06/88	08/11/88
10740	7		LW-3S	07/06/88	07/06/88	08/11/88
10740	8		LW-3D	07/06/88	07/06/88	08/11/88
10740	9		LW-9D	07/06/88	07/06/88	08/11/88
10740	10		LW-9S	07/06/88	07/06/88	08/11/88
10740	11		LW-5S	07/07/88	07/07/88	08/11/88
10740	12		DM-3D	07/07/88	07/07/88	08/11/88
10740	13		LW-6D	07/07/88	07/07/88	08/11/88
10740	14		LW-6S	07/07/88	07/07/88	08/11/88
10740	15		LW-10D	07/07/88	07/07/88	08/11/88
10740	16		LW-10S	07/07/88	07/07/88	08/11/88
10740	17		MW-2I	07/07/88	07/07/88	08/11/88
10740	18	rinse	blank	07/07/88	07/07/88	08/11/88
10740	19		MW-2D	07/08/88	07/08/88	08/11/88
10740	20		LW-13S	07/08/88	07/08/88	08/11/88
10740	21		LW-13D	07/08/88	07/08/88	08/11/88
10740	22	Petro.	LW-13D	07/08/88	07/08/88	08/11/88
10740	23		MW-3I	07/08/88	07/08/88	08/11/88
10740	24		LW-14S	07/08/88	07/08/88	08/11/88
10740	25		LW-1S	07/08/88	07/08/88	08/11/88
10740	26		LW-1D	07/08/88	07/08/88	08/11/88
10740	27	rinse	blank	07/08/88	07/08/88	08/11/88
10740	28		LW-8D	07/11/88	07/11/88	08/11/88
10740	29		MW-1	07/11/88	07/11/88	08/11/88
10740	30	rinse	blank	07/12/88	07/12/88	08/11/88

Table I: Sample Identification (page 1 of 1)

Methods of Analysis

Samples were analyzed as specified in the communication of June 30, 1988 (letter from Barbara Gleason to Philip Spadaro) and Laboratory Work Order of July 7,1988.

Specific methods of analysis employed are shown on each sample result page. Two letter codes are used to indicate the volumes from which test methods are drawn. These codes are defined as shown below:

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986.

EP = Methods for Chemical Analysis of Water and Wastes, U.S.E.P.A., March, 1983.

LX = A Laucks Testing Laboratories in-house method or modification of a previously published method. LX methods are described below.

Laucks Testing Laboratories Methods

WM1: A modification of method SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM3-A: Modification of Standard Methods 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI and Laucks uses preserved, not digested, sample.

Reporting Conventions

The following abbreviations appear in these reports:

MDL = Method Detection Limit

SDL = Sample Detection Limit This figure can vary from sample to sample, dependent on sample size, matrix interferences, etc.

CRDL = Contract Recommended Detection Limit.

RE = Reported values are the results for a re-extracted and re-analyzed sample.

Sample results may be flagged with a one-letter code designed to provide additional information about the analysis or the value reported. The flags employed are defined below. Where no flag is present, the analyte was detected and the value reported is the measured concentration.

U = The analyte was not detected. The value reported is the greater of the SDL or the CRDL, if any.

B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. (If the sample result is U flagged, no B flag is applied.)

D = The value reported is based on analysis of a diluted sample or extract. The dilution was made to bring another compound of interest within linear range or because of matrix effect.

E = The reported value is qualified and should be considered an estimate. Comments on reasons for this qualification appear in the Quality Control Report accompanying these test results. (This is equivalent to the Functional Guidelines "J" flag.)

R = The flagged data point is not useable, for reasons discussed in the Quality Control Report.

By convention, if an analyte is not detected and if the SDL is less than the CRDL, the CRDL value is reported with a U flag. The implication is that no analyte was detected at the SDL level either. If the SDL is larger than the CRDL, it becomes the value which is U flagged.

Analytical History

Dates of analysis for every preparation and analytical procedure are shown on the data sheets provided for each sample. In addition, this information is summarized in attached Table II for all samples.

Any preparation or analytical procedure performed outside of holding times is marked (*) and appropriate comments appear in the Quality Control narrative included with this report.

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Dissolved Arsenic Prep.	Dissolved Arsenic Anal.	Dissolved ICAP Prep.	Dissolved ICAP Anal.
10740	1	PACCAR	LW-5D	07/05/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	2	PACCAR	LW-15S	07/05/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	3	PACCAR	LW-12S	07/05/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	4	PACCAR	LW-12D	07/05/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	5		LW-2S	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	6		LW-2D	07/06/88	NA	NA	NA	NA
10740	7		LW-3S	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	8		LW-3D	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	9		LW-9D	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	10		LW-9S	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	11		LW-5S	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	12		DM-3D	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	13		LW-6D	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	14		LW-6S	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	15		LW-10D	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	16		LW-10S	07/07/88	NA	NA	NA	NA
10740	17		MW-2I	07/07/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	18	rinse	blank	07/07/88	NA	NA	NA	NA
10740	19		MW-2D	07/08/88	NA	NA	NA	NA
10740	20		LW-13S	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	21		LW-13D	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	22	Petro.	LW-13D	07/08/88	NA	NA	NA	NA
10740	23		MW-3I	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	24		LW-14S	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	25		LW-1S	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	26		LW-1D	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	27	rinse	blank	07/08/88	NA	NA	NA	NA
10740	28		LW-8D	07/11/88	NA	NA	NA	NA
10740	29		MW-1	07/11/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	30	rinse	blank	07/12/88	08/01/88	08/02/88	07/26/88	08/02/88

Table II: Analytical History (page 1 of 3)

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Total Arsenic Prep.	Total Arsenic Anal.	Total ICAP Prep.	Total ICAP Anal.
10740	1	PACCAR	LW-5D	07/05/88	NA	NA	NA	NA
10740	2	PACCAR	LW-15S	07/05/88	NA	NA	NA	NA
10740	3	PACCAR	LW-12S	07/05/88	NA	NA	NA	NA
10740	4	PACCAR	LW-12D	07/05/88	NA	NA	NA	NA
10740	5		LW-2S	07/06/88	NA	NA	NA	NA
10740	6		LW-2D	07/06/88	NA	NA	NA	NA
10740	7		LW-3S	07/06/88	NA	NA	NA	NA
10740	8		LW-3D	07/06/88	NA	NA	NA	NA
10740	9		LW-9D	07/06/88	NA	NA	NA	NA
10740	10		LW-9S	07/06/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	11		LW-5S	07/07/88	NA	NA	NA	NA
10740	12		DM-3D	07/07/88	NA	NA	NA	NA
10740	13		LW-6D	07/07/88	NA	NA	NA	NA
10740	14		LW-6S	07/07/88	NA	NA	NA	NA
10740	15		LW-10D	07/07/88	NA	NA	NA	NA
10740	16		LW-10S	07/07/88	NA	NA	NA	NA
10740	17		MW-2I	07/07/88	NA	NA	NA	NA
10740	18	rinse	blank	07/07/88	NA	NA	NA	NA
10740	19		MW-2D	07/08/88	NA	NA	NA	NA
10740	20		LW-13S	07/08/88	NA	NA	NA	NA
10740	21		LW-13D	07/08/88	NA	NA	NA	NA
10740	22	Petro.	LW-13D	07/08/88	NA	NA	NA	NA
10740	23		MW-3I	07/08/88	08/01/88	08/02/88	07/26/88	08/02/88
10740	24		LW-14S	07/08/88	NA	NA	NA	NA
10740	25		LW-1S	07/08/88	NA	NA	NA	NA
10740	26		LW-1D	07/08/88	NA	NA	NA	NA
10740	27	rinse	blank	07/08/88	NA	NA	NA	NA
10740	28		LW-8D	07/11/88	NA	NA	NA	NA
10740	29		MW-1	07/11/88	NA	NA	NA	NA
10740	30	rinse	blank	07/12/88	08/01/88	08/02/88	07/26/88	08/02/88

Table II: Analytical History (page 2 of 3)

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	GC/MS BAN Prep.	GC/MS BAN Anal.	GC/MS VOA Anal.
10740	1	PACCAR	LW-5D	07/05/88	NA	NA	NA
10740	2	PACCAR	LW-15S	07/05/88	NA	NA	07/11/88
10740	3	PACCAR	LW-12S	07/05/88	07/09/88	07/13/88	07/11/88
10740	4	PACCAR	LW-12D	07/05/88	07/09/88	07/13/88	07/11/88
10740	5		LW-2S	07/06/88	07/09/88	07/13/88	07/11/88
10740	6		LW-2D	07/06/88	NA	NA	07/11/88
10740	7		LW-3S	07/06/88	07/09/88	07/14/88	07/11/88
10740	8		LW-3D	07/06/88	07/09/88	07/13/88	07/11/88
10740	9		LW-9D	07/06/88	07/09/88	07/14/88	07/11/88
10740	10		LW-9S	07/06/88	07/09/88	07/14/88	07/11/88
10740	11		LW-5S	07/07/88	NA	NA	NA
10740	12		DM-3D	07/07/88	07/18/88*	07/22/88	07/12/88
10740	13		LW-6D	07/07/88	07/11/88	07/14/88	07/12/88
10740	14		LW-6S	07/07/88	07/11/88	07/15/88	07/12/88
10740	15		LW-10D	07/07/88	NA	NA	07/12/88
10740	16		LW-10S	07/07/88	07/11/88	07/15/88	07/12/88
10740	17		MW-2I	07/07/88	07/14/88	07/21/88	07/12/88
10740	18	rinse	blank	07/07/88	NA	NA	NA
10740	19		MW-2D	07/08/88	NA	NA	NA
10740	20		LW-13S	07/08/88	07/14/88	07/21/88	07/12/88
10740	21		LW-13D	07/08/88	NA	NA	NA
10740	22	Petro.	LW-13D	07/08/88	NA	NA	NA
10740	23		MW-3I	07/08/88	07/14/88	07/21/88	07/12/88
10740	24		LW-14S	07/08/88	07/23/88*	08/08/88	07/12/88
10740	25		LW-1S	07/08/88	07/14/88	07/21/88	07/12/88
10740	26		LW-1D	07/08/88	NA	NA	07/12/88
10740	27	rinse	blank	07/08/88	NA	NA	NA
10740	28		LW-8D	07/11/88	NA	NA	07/12/88
10740	29		MW-1	07/11/88	07/14/88	07/20/88	07/12/88
10740	30	rinse	blank	07/12/88	07/14/88	07/18/88	07/16/88

* Indicates procedure performed outside of holding time.

Table II: Analytical History (page 3 of 3)

Quality Control Report
Summary

Total and Dissolved Arsenic

All total and dissolved arsenic data generated for this project are determined to be acceptable for use. No data qualification was required.

Total and Dissolved Metals

All total and dissolved metals data generated for this project are determined to be acceptable for use. The following results have been qualified:

- Zinc result for sample 10740-1 has been qualified as an estimate due to serial dilution result outside of control limits.

- Zinc result for sample 10740-8 has been qualified as an estimate since the sample concentration was less than 10 times the blank concentration; redigestion and reanalysis were not performed.

- Zinc results for samples 10740-1 through 10740-5 and 10740-7 through 10740-15 have been qualified due to associated blank contamination.

Volatile Organics

All volatile organics data generated for this project are determined to be acceptable for use. No data qualification was required.

Semi-Volatile Organics

All semi-volatile organics data generated for this project are determined to be acceptable for use with the following qualifications and exceptions:

- Results for sample 10740-12RE and 10740-24RE have been qualified as estimated due to extraction outside of holding time.

- Reported results for Bis(2-ethylhexyl) phthalate in samples 10740-3 through 10740-5 and 10740-8 have been qualified due to associated method blank contamination.

- Negative acid compound results for sample 10740-12RE have been qualified as unuseable due to surrogate recoveries outside control limits.

Completeness

Completeness represents the percentage of generated data points which are fully useable for intended purposes. A project goal of 80% completeness was set; the laboratory goal was 90% completeness.

There is no universally accepted method for measuring completeness. Two reasonable approaches are:

A) Compare the quantity of unuseable data points (those flagged "R") to the quantity of data points generated overall on submitted samples. By this approach, 15 points of 2208 have been "R" flagged, for a completeness percentage of 99.3.

B) More stringently, compare the quantity of qualified data points (those flagged "R", "E" and "B") to the quantity of data points generated overall on submitted samples. For this project, 160 points of 2208 have been so flagged (including those which are double-flagged), for a completeness percentage of 92.7.

By either approach, both project and laboratory goals for completeness have been achieved.

Total and Dissolved Arsenic
(Methods LX WM3-A / SW 7061)

This section provides an evaluation of the total arsenic data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies the daily instrument calibration for Atomic Absorption (AA) analysis. It also specifies that a calibration blank and at least three standards must be used in establishing an analytical curve for AA analyses. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value, with the exception of tin and mercury for which the results must fall within control limits of 80-120% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the CRDL. The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For AA analyses, the continuing calibration results must fall within 90-110% of the true value, with the exception of tin and mercury for which the results must fall within the control limits 80-120% of the true value.

Initial and continuing calibrations for all analysis dates met all criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. Two method blanks were prepared with each batch for a total of 4 method blanks. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results were within control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not explicitly specify criteria for evaluating Atomic Absorption (AA) instrument performance. Per the U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganic Analysis, one atomic absorption standard at the Contract Required Detection Limit (CRDL) concentration must be analyzed. All compounds must be detected in the CRDL standard. This guideline was applied to all AA analyses performed under the project Work Order.

All CRDL criteria were met for all analysis dates.

Sample Result Verification:

Functional Guidelines specifies that all data reduction, reporting and documentation must be performed in accordance with the appropriate Statement of Work. The project Work Order details detection limits in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits are acceptable based on criteria set forth in the project Work Order.

Other QC Issues:

Three samples, 10740-10, 23, and 30, were analyzed for both total and dissolved metals. All remaining samples were analyzed for dissolved metals only. Per the project Work Order, samples for dissolved metal analysis will be filtered in the field prior to being placed in laboratory containers. Analytical procedures for total and dissolved metals were the same.

Total and Dissolved Metals
(Methods LX WM1 / SW 6010)

This section provides an evaluation of the total metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency & Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Copper, Nickel, Lead, Chromium, Zinc

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for ICP analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the CRDL. The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. One method blank was prepared with each batch for a total of 2 blanks. No target compounds were detected in the blanks with the following exception:

Blank ID	Compound	Concentration
B0726ICP.W01	Zinc	0.001 mg/l

Per Functional Guidelines, if the blank concentration is less than the CRDL, no corrective action is required. In addition, if the blank concentration is above the CRDL, the concentration of the least concentrated associated sample must be 10 times the blank concentration.

The blank concentration was at the CRDL. The analyte concentration in the least concentrated sample (10740-8) was 7 times the blank concentration. Functional Guidelines specifies that, should the sample concentration be less than 10 times the blank concentration, results are to be qualified. Laucks Testing Laboratories utilizes the "B" flag to indicate the compound was detected in both the sample(s) and associated blank. Sample 10740-8 has been flagged "B" per the aforementioned criteria. In addition, the result has been "E" flagged as an estimate, as the sample was not redigested or reanalyzed. All other associated samples contained an analyte concentration in excess of 10 times the blank concentration. Per Functional Guidelines, positive results at a concentration greater than 10 times the blank concentration do not require qualification as estimates. They are, however, "B" flagged, as the detected compound was present in the associated blank.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/- 20% of the established mean value.

Interference check sample results for all analysis dates met criteria specified in Functional Guidelines.

In addition, a standard at the CRDL concentration must be analyzed and all compounds must be detected.

All compounds were detected in the CRDL standard for all analysis dates.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%.

Two serial dilutions were performed. All results were in control with the following exceptions:

Sample	Compound	Initial	Dilution	% Difference	Comments
10740-1	Lead	.006 mg/l	.011 mg/l	59	(2)
10740-1	Zinc	.034 mg/l	.039 mg/l	14	(1)
10740-24	Chromium	.001 mg/l	.006 mg/l	143	(2)

(1) Functional Guidelines specifies that, if the difference between the original and diluted results is not within 10%, interference effects should be suspected and all data should be qualified. In accordance with Functional Guidelines, the result has been flagged "E" to indicate the result is estimated due to possible interferences.

(2) Functional Guidelines specifies that the 10% criteria apply only if the analyte concentration is minimally 10 times above the detection limit after dilution. The diluted result is less than 10 times the detection limit. No corrective action required.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits were acceptable per criteria specified in the project Work Order.

Other QC Issues:

Three samples, 10740-10,23 and 30, were analyzed for both total and dissolved metals. All remaining samples were analyzed for dissolved metals only. Per the project Work Order, samples for dissolved metals analysis will be filtered in the field prior to being placed in laboratory containers. Analytical procedures for total and dissolved metals were the same.

Volatile Organic Compounds
(Method SW 8240)

This section provides an evaluation of the volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be analyzed within 7 days of sample collection.

All volatile organics samples were analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria have been established to ensure mass resolution, identification and, to some degree, sensitivity. It defines both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Bromofluorobenzene (BFB), as shown in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05. Per Laucks Testing Laboratories' internal QA procedures, and U.S.E.P.A.'s Statement of Work for the Contract Laboratory Program, these must be greater than or equal to 0.300, with the exception of bromoform, which must be greater than or equal to 0.250. These criteria are more stringent than those in Functional Guidelines.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in

Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in both Functional Guidelines and Laucks Testing Laboratories' internal quality assurance procedures.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was analyzed with each sample batch, for a total of 3 method blanks. No target compounds were detected in any of the method blanks.

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if one volatile surrogate is outside established control limits, or if one volatile surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

Surrogate recovery values for all samples and blanks were within control limits specified in the project Work Order.

Matrix Spikes:

Functional Guidelines specifies that all spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details the matrix spike recoveries for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within the control limits specified in the project Work Order.

Matrix Spike Duplicates/Triplicates:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate /matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines specifies that internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. It further specifies that the retention time of the internal standard must not vary by more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met the identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", and attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

None.

Semi-Volatile Organic Compounds
(Methods SW 3510 / SW 8270)

This section provides an evaluation of the semi-volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection.

All samples were extracted and analyzed within the holding times specified in Functional Guidelines with the following exceptions:

Sample	Date Sampled	Date Extracted	Comments
10740-12	07/07/88	07/18/88	Reextraction required
10740-24	07/08/88	07/23/88	Reextraction required

The samples were reextracted due to low surrogate recoveries in the initial extraction. Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, all results for the above-referenced samples have been flagged "E" to indicate the results are estimated.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. It details both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Decafluorotriphenylphosphine (DFTPP), as detailed in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and the Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared with each batch for a total of 5 blanks. No target analytes were detected in the blanks with the following exception:

Sample	Compound	Concentration
B0709MSV.WLQ	Bis(2-ethylhexyl) phthalate	2 ug/l

Functional Guidelines specifies that when a common laboratory contaminant is detected in both the sample and the blank, results must be qualified when the sample concentration is less than 10 times the blank concentration. Compound concentrations in the associated samples were less than 10 times the blank concentration. All reported results for Bis(2-ethylhexyl) phthalate in the samples of concern have been flagged "B" to indicate the analyte of concern was detected in the associated blank as well as the samples.

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if two base/neutral or acid surrogates are outside established control limits, or if one base/neutral or acid surrogate has a recovery of less than 10%, reanalysis should be performed.⁻ It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

All surrogate recoveries were within the established control limits with the following exceptions:

Sample	Compound	% Recovery	Limits	Comments
B0709MSV.WLQ	d5-Phenol	54	15-49	(1) (2)
B0714MSV.WLE	d14-p-Terphenyl	28	33-141	(2)
10740-3	2-Fluorophenol	11	18-75	(2)
10740-5	d5-Phenol	61	15-49	(1) (2)
10740-7	d5-Phenol	58	15-49	(1) (2)
10740-8MS	d5-Phenol	74	15-49	(1) (2)
10740-8MSD	d5-Phenol	74	15-49	(1) (2)
10740-8MST	d5-Phenol	77	15-49	(1) (2)
10740-9	d5-Phenol	53	15-49	(1) (2)
10740-12RE	2-Fluorophenol	2	18-75	(3) (5)
10740-12RE	d5-Phenol	1	15-49	(3) (5)
10740-12RE	2-Bromophenol	8	36-113	(3) (5)
10740-12RE	2,4,6-Tribromophenol	10	26-122	(3) (4)
10740-13MS	d5-Phenol	50	15-49	(1) (2)
10740-13MST	d5-Phenol	50	15-49	(1) (2)

(1) Per the project Work Order, if an established upper control limit is less than 100%, the recovery will be deemed in control to an upper control limit of 120%. See Appendix B. No corrective action required.

(2) Per Functional Guidelines and the project Work Order, two acid or base/neutral surrogate compounds may be out of control and the analysis be considered in control. No corrective action required.

(3) Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The value is a result of reanalysis with surrogate recovery values remaining outside control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action required.

(4) Functional Guidelines specifies that, if at least two acid or base/neutral surrogate recovery values are outside control limits but above 10%, all results in that acid or base/neutral fraction should be qualified as estimated. No positive results were reported. Negative results have been

flagged per (5) due to other sample surrogates exhibiting recoveries below 10%.

(5) Per Functional Guidelines, if any surrogate in an acid or base/neutral fraction shows less than 10% recovery, all positive results for that fraction should be flagged as estimated and all negative results should be flagged as unuseable. No positive results were reported. In accordance with Functional Guidelines, negative acid compound results have been flagged "R" to indicate the results are unuseable.

Matrix Spike:

Functional Guidelines specifies that all matrix spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details matrix spike/matrix spike duplicate/matrix spike triplicate control limits for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were in control with the following exceptions:

Sample	Compound	% Recovery	Limits
10740-8MS	Phenol	76	16-72
10740-8MSD	Phenol	82	16-72
10740-8MSD	4-Nitrophenol	85	10-78
10740-8MST	Phenol	75	16-72
10740-8MST	4-Nitrophenol	86	10-78
10740-13MST	4-Nitrophenol	79	10-78

Per the project Work Order, if an established upper control limit is less than 100%, the recovery will be deemed in control to an upper control limit of 120%. See Appendix B. No corrective action required.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines specifies internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. In addition, the retention time of the internal standard must not vary more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

Samples 10740-12 and 10740-24 required reextraction due to low surrogate recovery values in the initial extraction. All results and comments presented are based on the reextraction and not the initial extraction.

RINSE BLANKS

The purpose of the rinse blank samples is to assess the degree to which a parameter of interest is added or removed during field operations such as equipment decontamination or sample filtration. One rinse blank sample was collected and analyzed for dissolved metals, total metals, volatile and extractable priority pollutant organic compounds. The sample identification and laboratory results are discussed below.

The rinse blank identified as laboratory No. 30 was collected during rinsing of a stainless steel bailer. Overall, the compounds tested were undetected except for the following:

Sample Number	Compound	Result	Qualifier
30	dissolved copper	0.002 mg/L	---
30	total copper	0.002 mg/L	---

APPENDIX A
TABLE 2
(page 1)
DETECTION LIMIT GOALS

TEST	WATER MDL	WATER CRDL	SOIL MDL (% AR)	SOIL CRDL (% AR)
Total Solids	NR	NR	0.1	0.1
TEST	(mg/l)	(mg/l)	(mg/kg DB)	(mg/kg DB)
Petroleum Hydrocarbons (O & G)	0.1	0.1	20	20
TOTAL METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	1	1
Nickel	0.002	0.002	2	2
Cadmium	NR	NR	0.5	0.5
Lead	0.005	0.005	5	5
Chromium	0.001	0.001	1	1
Zinc	0.001	0.001	1	1
Arsenic	0.005	0.005	0.5	0.5
TEST DISSOLVED METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST EP TOXICITY METALS:			(mg/l)	(mg/l)
Copper	NR	NR	0.1	0.1
Nickel	NR	NR	0.1	0.1
Cadmium	NR	NR	0.01	0.01
Lead	NR	NR	0.1	0.1
Chromium	NR	NR	0.1	0.1
Zinc	NR	NR	0.1	0.1
Arsenic	NR	NR	0.2	0.2

NR = analysis for this analyte in this matrix is Not Required
MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 2)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/FID Screen, calculated as Phenanthrene	400	400	10 000	10 000
PCB's:				
Aroclor-1016	0.5	0.5	33	33
Aroclor-1221	0.5	0.5	33	33
Aroclor-1232	0.5	0.5	33	33
Aroclor-1242	0.5	0.5	33	33
Aroclor-1248	0.5	0.5	33	33
Aroclor-1254	1	1	67	67
Aroclor-1260	1	1	67	67

TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/MS EXTRACTABLES:				
Phenol	2	2	33	33
Aniline	10	10	170	170
Bis(2-chloroethyl)ether	2	2	33	33
2-Chlorophenol	2	2	33	33
1,3-Dichlorobenzene	2	2	33	33
1,4-Dichlorobenzene	2	2	33	33
Benzyl alcohol	2	2	33	33
1,2-Dichlorobenzene	2	2	33	33
2-Methylphenol	2	2	33	33
Bis(2-chloroisopropyl)ether	2	2	33	33
4-Methylphenol	2	2	33	33
N-Nitroso-di-n-propylamine	2	2	33	33
Hexachloroethane	4	4	67	67
Nitrobenzene	2	2	33	33
Isophorone	2	2	33	33
2-Nitrophenol	4	4	67	67
2,4-Dimethylphenol	2	2	33	33
Benzoic Acid	50	50	830	830
Bis(2-chloroethoxy)methane	2	2	33	33
2,4-Dichlorophenol	4	4	67	67
1,2,4-Trichlorobenzene	2	2	33	33
Naphthalene	4	4	67	67
4-Chloroaniline	2	2	33	33
Hexachlorobutadiene	2	2	33	33
4-Chloro-3-methylphenol	4	4	67	67
2-Methylnaphthalene	2	2	33	33
Hexachlorocyclopentadiene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 3)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS EXTRACTABLES(cont):				
2,4,6-Trichlorophenol	4	4	67	67
2,4,5-Trichlorophenol	4	4	67	67
2-Chloronaphthalene	2	2	33	33
2-Nitroaniline	4	4	67	67
Dimethyl phthalate	2	2	33	33
Acenaphthylene	2	2	33	33
2,6-Dinitrotoluene	4	4	67	67
3-Nitroaniline	10	10	170	170
Acenaphthene	2	2	33	33
2,4-Dinitrophenol	20	20	330	330
4-Nitrophenol	20	20	330	330
Dibenzofuran	2	2	33	33
2,4-Dinitrotoluene	4	4	67	67
Diethyl phthalate	2	2	33	33
4-Chlorophenyl phenylether	2	2	33	33
Fluorene	2	2	33	33
4-Nitroaniline	4	4	67	67
4,6-Dinitro-2-methylphenol	20	20	330	330
N-Nitrosodiphenylamine	1	1	33	33
1,2-Diphenylhydrazine	4	4	67	67
4-Bromophenyl phenylether	4	4	67	67
Hexachlorobenzene	2	2	33	33
Pentachlorophenol	20	20	330	330
Phenanthrene	2	2	33	33
Anthracene	2	2	33	33
Di-n-butyl phthalate	2	2	33	33
Fluoranthene	2	2	33	33
Pyrene	2	2	33	33
Benzidine	50	50	830	830
Butylbenzylphthalate	2	2	33	33
3,3'-Dichlorobenzidine	20	20	330	330
Benzo(a)anthracene	2	2	33	33
Chrysene	2	2	33	33
Bis(2-ethylhexyl)phthalate	2	2	33	33
Di-n-octyl phthalate	2	2	33	33
Benzo(b)fluoranthene	4	4	67	67
Benzo(k)fluoranthene	4	4	67	67
Benzo(a)pyrene	4	4	67	67
Indeno(1,2,3-cd)pyrene	4	4	67	67
Dibenzo(a,h)anthracene	4	4	67	67
Benzo(g,h,i)perylene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 4)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS VOLATILES:				
Chloromethane	1	1	2	2
Bromomethane	1	1	2	2
Vinyl Chloride	1	1	2	2
Chloroethane	3	3	6	6
Methylene Chloride	1	1	2	2
Acetone	5	5	10	10
Carbon Disulfide	1	1	2	2
1,1-Dichloroethene	1	1	2	2
1,1-Dichloroethane	1	1	2	2
trans-1,2-Dichloroethene	1	1	2	2
cis-1,2-Dichloroethene	1	1	2	2
total-1,2-Dichloroethene	1	1	2	2
Chloroform	1	1	2	2
2-Butanone	3	3	6	6
1,2-Dichloroethane	1	1	2	2
1,1,1-Trichloroethane	1	1	2	2
Carbon Tetrachloride	1	1	2	2
Vinyl Acetate	1	1	2	2
Bromodichloromethane	1	1	2	2
1,2-Dichloropropane	1	1	2	2
Trichloroethene	1	1	2	2
Benzene	1	1	2	2
Dibromochloromethane	3	3	6	6
1,1,2-Trichloroethane	1	1	2	2
Bromoform	1	1	2	2
4-Methyl-2-Pentanone	3	3	6	6
2-Hexanone	3	3	6	6
1,1,2,2-Tetrachloroethane	3	3	6	6
Tetrachloroethene	1	1	2	2
Toluene	1	1	2	2
Chlorobenzene	3	3	6	6
trans-1,3-Dichloropropene	3	3	6	6
Ethylbenzene	1	1	2	2
cis-1,3-Dichloropropene	3	3	6	6
Styrene	1	1	2	2
Total Xylenes	1	1	2	2

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 5)
DETECTION LIMIT GOALS

COMMENTS:

Actual reported Sample Detection Limits (SDLs) may vary from the target detection limits listed herein. There are several circumstances which can result in SDLs which are elevated above the CRDLs. Typically, these are:

1) Insufficient sample volume submitted to perform preparation according to established methodology.

2) Dilution of a sample extract or digest for reasons of matrix interference or to bring another compound of interest within linear range.

3) Extraction of the sample at the "medium" or "high" levels, rather than a typical "low" level extraction. This involves employing a smaller sample size and is a decision made on visual appearance of the sample and/or odor.

In addition, it should be noted that the limits of detection shown for soil analysis have been normalized to reflect a total solids value of 100%. In fact, soil samples will generally have total solids of 75-80% and SDLs will be correspondingly increased.

APPENDIX B
TABLE 3
(page 1)
CONTROL LIMITS
(Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate)

	WATER		SOIL	
TEST	% Recovery	RPD	% Recovery	RPD
Petroleum Hydrocarbons (O & G)	74-126	0-11	82-114	0-13
TOTAL METALS:				
Copper	75-125*	0-7	75-125*	0-5
Nickel	75-125*	0-5	75-125*	0-6
Cadmium	75-125*	0-5	75-125*	0-7
Lead	75-125*	0-7	75-125*	0-6
Chromium	75-125*	0-6	75-125*	0-8
Zinc	75-125*	0-6	75-125*	0-5
Arsenic	75-125*	0-7	69-118	0-8
(water control limits apply to EP Toxicity Metals)				
GC/FID Screen, calculated as Phenanthrene	@	@	@	@
PCBs:				
Aroclor 1260	20-150#	0-30#	20-150#	0-41#
GC/MS EXTRACTABLES:				
Phenol	16-72	0-18	39-95	0-13
2-Chlorophenol	31-122	0-15	25-102*	0-15
1,4-Dichlorobenzene	36-97*	0-16	38-103	0-10
N-Nitroso-di-n-propylamine	41-116*	0-17	41-126*	0-16
1,2,4-Trichlorobenzene	50-105	0-14	43-110	0-9
4-Chloro-3-methylphenol	46-108	0-11	47-113	0-11
Acenaphthylene	44-110	0-12	45-116	0-8
4-Nitrophenol	10-78	0-21	11-114*	0-13
2,4-Dinitrotoluene	43-109	0-15	28-89*	0-9
Pentachlorophenol	35-120	0-11	17-109*	0-26
Pyrene	26-127*	0-11	23-115	0-11
GC/MS VOLATILES:				
1,1-Dichloroethane	53-131	0-7	59-129	0-8
Trichloroethene	71-120*	0-7	76-145	0-9
Benzene	76-127*	0-8	66-142*	0-9
Toluene	76-125*	0-13	59-139*	0-8
Chlorobenzene	73-128	0-8	68-139	0-7

= This is an estimated limit and is not based on experimentally derived data.

APPENDIX B
TABLE 3
(page 2)
CONTROL LIMITS
(Surrogate Spike)

TEST	WATER % Recovery	SOIL % Recovery
GC/FID Screen, calculated as Phenanthrene	@	@
PCBs:		
Dibutylchlorendate	43-152	24-154
Isodrin	32-96	20-112
GC/MS EXTRACTABLES:		
2-Fluorophenol	18-75	30-99
d5-Phenol	15-49	27-105
2-Bromophenol	36-113	30-107
d5-Nitrobenzene	45-105	45-100
2-Fluorobiphenyl	44-100	54-103
d10-Azobenzene	48-116	34-123
2,4,6-Tribromophenol	26-122	19-122*
d14-p-Terphenyl	33-141*	29-130
GC/MS VOLATILES:		
d4-1,2-Dichloroethane	79-116	74-125
d8-Toluene	88-110*	81-117*
p-Bromofluorobenzene	86-115*	75-115

* = EPA Control Limits (all others are Laucks in-house)

@ = Addition of spiking and/or surrogate compounds to an extract of what is anticipated to be a contaminated sample prepared for screening analysis is not meaningful. The spiking and/or surrogate compounds will interfere with, and most probably enhance, sample results. Therefore, the laboratory will perform duplicate and triplicate sample analyses on one per twenty (or one per batch, if fewer than twenty) screens, with an RPD goal of 30% between the replicates.

APPENDIX B
TABLE 3
(page 3)
CONTROL LIMITS

COMMENTS:

Where a recovery exceeds the upper control limit, and that control limit was <100%, the recovery will be deemed in control to an upper limit of 120%.

In the case of GC/MS extractables up to two surrogates (one acid and/or one base/neutral compound) may be out of control and the analysis be deemed in control, with no requirement for re-analysis.

In the case of the PCB analysis, dibutylchlorendate (DBC) is the CLP surrogate and isodrin is a second surrogate added at Laucks' discretion. Should isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control.

COMPLETENESS:

Laboratory goal is 90% completeness. Matrix effect is documented through performance of a re-analysis. Should recoveries or RPDs remain out of control, no further corrective action is required. If data are 90% complete, outliers are regarded as anomalies.

APPENDIX C
TUNING AND PERFORMANCE CRITERIA

Decafluorotriphenylphosphine (DFTPP)

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988.

Hart Crowser
J-1639-09

QUALITY ASSURANCE DATA FOR GROUNDWATER SAMPLES COLLECTED DURING JULY 1988

Sample Receipt

Thirty water samples were received between the dates of August 26 and October 11, 1988. All samples were received intact and in good condition, with no exceptions.

Laboratory number 11800 was assigned to this project and each individual sample was given a discrete sub-sample number (i.e.,11800-1, 11800-2, etc). The attached Table I details the identification of each sample and the date on which it was received.

There were no discrepancies between sample identification and the chain-of-custody documents, with the following exceptions:

Lab No.	Identification	Comment
11800-13	OSP-25	The blue label, one liter plastic container for hardness analysis was not labeled with your sample ID (OSP-25). Other identification (date, time, etc.) were present.
11800-15	MW-10R	The sample identification on one of the VOA bottles was MW-R.
11800-16	OSP-3D	All sample containers showed the date sampled as 6/10/88 (correct date is 10/6/88).
11800-20	OSP-4D	All one liter amber organic extractable bottles for this sample were received with no marks on the labels. The bottles identified by the process of elimination.
11800-2 11800-3 11800-4 11800-5 11800-6	MW-2D"R" OW-5S OW-4S OW-4D Field Blk	The chain-of-custody that detailed these samples was received with the "testing" columns blank. The analysis information was filled in by the laboratory after consultation with your office on 10/05/88.

At your verbal request not all samples were analyzed. The sample which was held without analysis, and date of notification, was:

Lab No.	Identification	Notification Date
11800-15	MW-10R	10/07/88

The samples were held in cold storage at 4°C until removed for preparation and/or analysis.

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Date Rec'd	Interim Due Date
11800	1	PACCAR	OW-Blank	08/24/88	08/26/88	11/14/88
11800	2	PACCAR	MW-2D"R"	10/03/88	10/03/88	11/14/88
11800	3	PACCAR	OW-5S	10/03/88	10/03/88	11/14/88
11800	4	PACCAR	OW-4S	10/03/88	10/03/88	11/14/88
11800	5	PACCAR	OW-4D	10/03/88	10/03/88	11/14/88
11800	6		FB		10/03/88	11/14/88
11800	7	PACCAR	OW-5D	10/04/88	10/04/88	11/14/88
11800	8	PACCAR	DM-2D	10/04/88	10/04/88	11/14/88
11800	9	PACCAR	OSP-1S	10/04/88	10/04/88	11/14/88
11800	10	PACCAR	OSP-1D	10/04/88	10/04/88	11/14/88
11800	11	PACCAR	OSP-2D	10/04/88	10/04/88	11/14/88
11800	12		FB		10/04/88	11/14/88
11800	13	PACCAR	OSP-2S	10/06/88	10/06/88	11/14/88
11800	14	PACCAR	MW-10	10/06/88	10/06/88	11/14/88
11800	15	PACCAR	MW-10R	10/06/88	10/06/88	11/14/88
11800	16	PACCAR	OSP-3D	10/06/88	10/06/88	11/14/88
11800	17		FB		10/06/88	11/14/88
11800	18	PACCAR	OSP-4S	10/07/88	10/07/88	11/14/88
11800	19	PACCAR	OSP-4SR	10/07/88	10/07/88	11/14/88
11800	20	PACCAR	OSP-4D	10/07/88	10/07/88	11/14/88
11800	21		FB		10/07/88	11/14/88
11800	22	PACCAR	OSP-5S	10/10/88	10/10/88	11/14/88
11800	23	PACCAR	OSP-5D	10/10/88	10/10/88	11/14/88
11800	24	PACCAR	OSP-6S	10/10/88	10/10/88	11/14/88
11800	25	PACCAR	OSP-6D	10/10/88	10/10/88	11/14/88
11800	26	PACCAR	OSP-6DR	10/10/88	10/10/88	11/14/88
11800	27		FB		10/10/88	11/14/88
11800	28	PACCAR	OSP-7S	10/11/88	10/11/88	11/14/88
11800	29	PACCAR	OSP-7D	10/11/88	10/11/88	11/14/88
11800	30		FB		10/11/88	11/14/88

Table I: Sample Identification (page 1 of 1)

Methods of Analysis

Samples were analyzed as specified in the communication of June 30, 1988 (letter from Barbara Gleason to Philip Spadaro) and Laboratory Work Order of July 7,1988.

Specific methods of analysis employed are shown on each sample result page. Two letter codes are used to indicate the volumes from which test methods are drawn. These codes are defined as shown below:

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986.

EP = Methods for Chemical Analysis of Water and Wastes, U.S.E.P.A., March, 1983.

LX = A Laucks Testing Laboratories in-house method or modification of a previously published method. LX methods are described below.

Laucks Testing Laboratories Methods

WM1: A modification of method SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM3-A: Modification of Standard Methods 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI and Laucks uses preserved, not digested, sample.

Reporting Conventions

The following abbreviations appear in these reports:

MDL = Method Detection Limit

SDL = Sample Detection Limit This figure can vary from sample to sample, dependent on sample size, matrix interferences, etc.

CRDL = Contract Recommended Detection Limit.

RE = Reported values are the results for a re-extracted and re-analyzed sample.

Sample results may be flagged with a one-letter code designed to provide additional information about the analysis or the value reported. The flags employed are defined below. Where no flag is present, the analyte was detected and the value reported is the measured concentration.

U = The analyte was not detected. The value reported is the greater of the SDL or the CRDL, if any.

B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. (If the sample result is U flagged, no B flag is applied.)

D = The value reported is based on analysis of a diluted sample or extract. The dilution was made to bring another compound of interest within linear range or because of matrix effect.

E = The reported value is qualified and should be considered an estimate. Comments on reasons for this qualification appear in the Quality Control Report accompanying these test results. (This is equivalent to the Functional Guidelines "J" flag.)

R = The flagged data point is not useable, for reasons discussed in the Quality Control Report.

By convention, if an analyte is not detected and if the SDL is less than the CRDL, the CRDL value is reported with a U flag. The implication is that no analyte was detected at the SDL level either. If the SDL is larger than the CRDL, it becomes the value which is U flagged.

Analytical History

Dates of analysis for every preparation and analytical procedure are shown on the data sheets provided for each sample. In addition, this information is summarized in attached Table II for all samples.

The value shown to the right of any date is the number of days which elapsed between sampling and either preparation or analysis. In the case of GC/MS ABN analysis, it is the number of elapsed days between sample preparation and analysis.

Any preparation or analytical procedure performed outside of holding times is marked (*) and appropriate comments appear in the Quality Control narrative included with this report.

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Dissolved Arsenic Prep.		Anal.		Dissolved ICAP Prep.		Anal.	
11800	1	PACCAR	OW-Blank	08/24/88	NA		NA		NA		NA	
11800	2	PACCAR	MW-2D"R"	10/03/88	10/06/88	3	10/07/88	4	10/18/88	15	10/26/88	23
11800	3	PACCAR	OW-5S	10/03/88	10/06/88	3	10/07/88	4	10/18/88	15	10/26/88	23
11800	4	PACCAR	OW-4S	10/03/88	10/06/88	3	10/07/88	4	10/18/88	15	10/26/88	23
11800	5	PACCAR	OW-4D	10/03/88	10/06/88	3	10/07/88	4	10/18/88	15	10/26/88	23
11800	6		FB		NA		NA		NA		NA	
11800	7	PACCAR	OW-5D	10/04/88	10/06/88	2	10/07/88	3	10/18/88	14	10/26/88	22
11800	8	PACCAR	DM-2D	10/04/88	10/06/88	2	10/07/88	3	10/18/88	14	10/26/88	22
11800	9	PACCAR	OSP-1S	10/04/88	10/06/88	2	10/07/88	3	10/18/88	14	10/26/88	22
11800	10	PACCAR	OSP-1D	10/04/88	10/06/88	2	10/07/88	3	10/18/88	14	10/26/88	22
11800	11	PACCAR	OSP-2D	10/04/88	10/06/88	2	10/07/88	3	10/18/88	14	10/26/88	22
11800	12		FB		NA		NA		NA		NA	
11800	13	PACCAR	OSP-2S	10/06/88	10/12/88	6	10/12/88	6	10/18/88	12	10/26/88	20
11800	14	PACCAR	MW-10	10/06/88	10/12/88	6	10/12/88	6	10/18/88	12	10/26/88	20
11800	15	PACCAR	MW-10R	10/06/88	NA		NA		NA		NA	
11800	16	PACCAR	OSP-3D	10/06/88	10/12/88	6	10/12/88	6	10/18/88	12	10/26/88	20
11800	17		FB		NA		NA		NA		NA	
11800	18	PACCAR	OSP-4S	10/07/88	10/12/88	5	10/12/88	5	10/18/88	11	10/26/88	19
11800	19	PACCAR	OSP-4SR	10/07/88	10/12/88	5	10/12/88	5	10/18/88	11	10/26/88	19
11800	20	PACCAR	OSP-4D	10/07/88	10/12/88	5	10/12/88	5	10/18/88	11	10/26/88	19
11800	21		FB		NA		NA		NA		NA	
11800	22	PACCAR	OSP-5S	10/10/88	10/12/88	2	10/12/88	2	10/18/88	8	10/26/88	16
11800	23	PACCAR	OSP-5D	10/10/88	10/12/88	2	10/12/88	2	10/18/88	8	10/26/88	16
11800	24	PACCAR	OSP-6S	10/10/88	10/12/88	2	10/12/88	2	10/18/88	8	10/26/88	16
11800	25	PACCAR	OSP-6D	10/10/88	10/12/88	2	10/12/88	2	10/18/88	8	10/26/88	16
11800	26	PACCAR	OSP-6DR	10/10/88	10/12/88	2	10/12/88	2	10/18/88	8	10/26/88	16
11800	27		FB		NA		NA		NA		NA	
11800	28	PACCAR	OSP-7S	10/11/88	10/12/88	1	10/12/88	1	10/18/88	7	10/26/88	15
11800	29	PACCAR	OSP-7D	10/11/88	10/12/88	1	10/12/88	1	10/18/88	7	10/26/88	15
11800	30		FB		NA		NA		NA		NA	

* Indicates procedure performed outside of holding time.

Table II: Analytical History (page 1 of 4)

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Total Arsenic Prep.	Total Arsenic Anal.	Total ICAP Prep.	Total ICAP Anal.
11800	1	PACCAR	OW-Blank	08/24/88	NA	NA	NA	NA
11800	2	PACCAR	MW-2D"R"	10/03/88	NA	NA	NA	NA
11800	3	PACCAR	OW-5S	10/03/88	NA	NA	NA	NA
11800	4	PACCAR	OW-4S	10/03/88	NA	NA	NA	NA
11800	5	PACCAR	OW-4D	10/03/88	NA	NA	NA	NA
11800	6		FB		NA	NA	NA	NA
11800	7	PACCAR	OW-5D	10/04/88	NA	NA	NA	NA
11800	8	PACCAR	DM-2D	10/04/88	NA	NA	NA	NA
11800	9	PACCAR	OSP-1S	10/04/88	NA	NA	NA	NA
11800	10	PACCAR	OSP-1D	10/04/88	NA	NA	NA	NA
11800	11	PACCAR	OSP-2D	10/04/88	NA	NA	NA	NA
11800	12		FB		NA	NA	NA	NA
11800	13	PACCAR	OSP-2S	10/06/88	10/12/88 6	10/12/88 6	10/18/88 12	10/26/88 20
11800	14	PACCAR	MW-10	10/06/88	NA	NA	NA	NA
11800	15	PACCAR	MW-10R	10/06/88	NA	NA	NA	NA
11800	16	PACCAR	OSP-3D	10/06/88	NA	NA	NA	NA
11800	17		FB		NA	NA	NA	NA
11800	18	PACCAR	OSP-4S	10/07/88	NA	NA	NA	NA
11800	19	PACCAR	OSP-4SR	10/07/88	NA	NA	NA	NA
11800	20	PACCAR	OSP-4D	10/07/88	NA	NA	NA	NA
11800	21		FB		NA	NA	NA	NA
11800	22	PACCAR	OSP-5S	10/10/88	NA	NA	NA	NA
11800	23	PACCAR	OSP-5D	10/10/88	NA	NA	NA	NA
11800	24	PACCAR	OSP-6S	10/10/88	NA	NA	NA	NA
11800	25	PACCAR	OSP-6D	10/10/88	NA	NA	NA	NA
11800	26	PACCAR	OSP-6DR	10/10/88	NA	NA	NA	NA
11800	27		FB		NA	NA	NA	NA
11800	28	PACCAR	OSP-7S	10/11/88	NA	NA	NA	NA
11800	29	PACCAR	OSP-7D	10/11/88	NA	NA	NA	NA
11800	30		FB		NA	NA	NA	NA

* Indicates procedure performed outside of holding time.

Table II: Analytical History (page 2 of 4)

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Hardness Anal.		Iron + Manganese Prep.		Iron + Manganese Anal.	
11800	1	PACCAR	OW-Blank	08/24/88	NA		NA		NA	
11800	2	PACCAR	MW-2D"R"	10/03/88	NA		NA		NA	
11800	3	PACCAR	OW-5S	10/03/88	NA		NA		NA	
11800	4	PACCAR	OW-4S	10/03/88	NA		NA		NA	
11800	5	PACCAR	OW-4D	10/03/88	NA		NA		NA	
11800	6		FB		NA		NA		NA	
11800	7	PACCAR	OW-5D	10/04/88	NA		NA		NA	
11800	8	PACCAR	DM-2D	10/04/88	NA		NA		NA	
11800	9	PACCAR	OSP-1S	10/04/88	NA		10/31/88	27	10/31/88	27
11800	10	PACCAR	OSP-1D	10/04/88	NA		NA		NA	
11800	11	PACCAR	OSP-2D	10/04/88	10/31/88	27	NA		NA	
11800	12		FB		NA		NA		NA	
11800	13	PACCAR	OSP-2S	10/06/88	10/31/88	25	10/31/88	25	10/31/88	25
11800	14	PACCAR	MW-10	10/06/88	NA		NA		NA	
11800	15	PACCAR	MW-10R	10/06/88	NA		NA		NA	
11800	16	PACCAR	OSP-3D	10/06/88	NA		NA		NA	
11800	17		FB		NA		NA		NA	
11800	18	PACCAR	OSP-4S	10/07/88	NA		NA		NA	
11800	19	PACCAR	OSP-4SR	10/07/88	NA		NA		NA	
11800	20	PACCAR	OSP-4D	10/07/88	NA		NA		NA	
11800	21		FB		NA		NA		NA	
11800	22	PACCAR	OSP-5S	10/10/88	10/31/88	21	10/31/88	21	10/31/88	21
11800	23	PACCAR	OSP-5D	10/10/88	10/31/88	21	NA		NA	
11800	24	PACCAR	OSP-6S	10/10/88	NA		NA		NA	
11800	25	PACCAR	OSP-6D	10/10/88	NA		NA		NA	
11800	26	PACCAR	OSP-6DR	10/10/88	NA		NA		NA	
11800	27		FB		NA		NA		NA	
11800	28	PACCAR	OSP-7S	10/11/88	NA		NA		NA	
11800	29	PACCAR	OSP-7D	10/11/88	NA		NA		NA	
11800	30		FB		NA		NA		NA	

* Indicates procedure performed outside of holding time.

Table II: Analytical History (page 3 of 4)

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	GC/MS VOA Anal.		GC/MS ABN Prep.			GC/MS ABN Anal.	
11800	1	PACCAR	OW-Blank	08/24/88	08/29/88	5	NA			NA	
11800	2	PACCAR	MW-2D"R"	10/03/88	10/06/88	3	10/05/88	2		11/01/88	27
11800	3	PACCAR	OW-5S	10/03/88	10/06/88	3	11/05/88	33	*	11/10/88	5
11800	4	PACCAR	OW-4S	10/03/88	10/06/88	3	10/05/88	2		11/03/88	29
11800	5	PACCAR	OW-4D	10/03/88	10/06/88	3	10/05/88	2		11/02/88	28
11800	6		FB		10/07/88	4	NA			NA	
11800	7	PACCAR	OW-5D	10/04/88	10/06/88	2	11/08/88	35	*	11/09/88	1
11800	8	PACCAR	DM-2D	10/04/88	NA		NA			NA	
11800	9	PACCAR	OSP-1S	10/04/88	10/06/88	2	10/05/88	1		11/02/88	28
11800	10	PACCAR	OSP-1D	10/04/88	10/06/88	2	10/05/88	1		11/02/88	28
11800	11	PACCAR	OSP-2D	10/04/88	10/06/88	2	10/05/88	1		11/02/88	28
11800	12		FB		10/07/88	3	NA			NA	
11800	13	PACCAR	OSP-2S	10/06/88	10/07/88	1	10/12/88	6		11/03/88	22
11800	14	PACCAR	MW-10	10/06/88	10/07/88	1	10/12/88	6		11/03/88	22
11800	15	PACCAR	MW-10R	10/06/88	NA		NA			NA	
11800	16	PACCAR	OSP-3D	10/06/88	10/07/88	1	10/12/88	6		11/03/88	22
11800	17		FB		10/07/88	1	NA			NA	
11800	18	PACCAR	OSP-4S	10/07/88	10/12/88	5	10/12/88	5		11/04/88	23
11800	19	PACCAR	OSP-4SR	10/07/88	10/12/88	5	10/12/88	5		11/04/88	23
11800	20	PACCAR	OSP-4D	10/07/88	10/12/88	5	11/09/88	33	*	11/10/88	1
11800	21		FB		10/13/88	6	NA			NA	
11800	22	PACCAR	OSP-5S	10/10/88	10/12/88	2	10/12/88	2		11/07/88	26
11800	23	PACCAR	OSP-5D	10/10/88	10/12/88	2	10/12/88	2		11/08/88	27
11800	24	PACCAR	OSP-6S	10/10/88	10/12/88	2	10/12/88	2		11/08/88	27
11800	25	PACCAR	OSP-6D	10/10/88	10/12/88	2	10/12/88	2		11/10/88	29
11800	26	PACCAR	OSP-6DR	10/10/88	10/12/88	2	10/12/88	2		11/10/88	29
11800	27		FB		10/13/88	3	NA			NA	
11800	28	PACCAR	OSP-7S	10/11/88	10/12/88	1	10/12/88	1		11/10/88	29
11800	29	PACCAR	OSP-7D	10/11/88	10/12/88	1	10/12/88	1		11/10/88	29
11800	30		FB		10/13/88	2	NA			NA	

* Indicates procedure performed outside of holding time.

Table II: Analytical History (page 4 of 4)

Quality Control Report
Summary of Findings

Arsenic

All Arsenic data generated for this project have been determined acceptable for use. No data qualification was required.

Hardness

All Hardness data generated for this project have been determined acceptable for use. No data qualification was required.

Metals

All metals data generated for this project have been determined acceptable for use. The following qualifications were applied to metals results:

- 15 data points in 22 samples were flagged "B" to indicate the compound of interest was detected in both the sample and the associated method blank.

- 6 data points in 22 samples were flagged "E" to indicate results are estimates due to sample analyte concentrations which are less than 10 times the blank concentration or serial dilutions which were outside specified control limits.

Volatile Organics

All volatile organics data generated for this project have been determined acceptable for use. No data qualification was required.

Semi-Volatile Organics

All semi-volatile organics data generated for this project have been determined acceptable for use with the following exceptions and qualifications:

- 189 data points in 21 samples were flagged "E" to indicate results are estimates as initial analysis or reanalysis was performed outside holding times.

- 15 data points in 21 samples were flagged "R" to indicate results are unuseable due to surrogate recoveries which were outside the specified control limits.

Completeness

Completeness represents the percentage of generated data points which are fully useable for intended purposes. A project goal of 80% completeness was set; the laboratory goal was 90% completeness.

There is no universally accepted method for measuring completeness. Two reasonable approaches are:

A) Compare the quantity of unuseable data points (those flagged "R") to the quantity of data points generated overall on submitted samples. By this approach, 15 points of 2584 (determined in 24 water and 6 volatile organics field blank samples) have been flagged "R", for a completeness percentage of 99.4.

B) More stringently, compare the quantity of qualified data points (those flagged "R", "E" "B", and "X") to the quantity of data points generated overall on submitted samples. For this project, 225 points of 2584 have been so flagged (including those which may bear more than one such flag), for a completeness percentage of 91.3.

By either approach, both project and laboratory goals for completeness have been achieved.

Total and Dissolved Arsenic
(Methods LX WM3-A / SW 7061)

This section provides an evaluation of the total and dissolved arsenic data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies the daily instrument calibration for Atomic Absorption (AA) analysis. It also specifies that a calibration blank and at least three standards must be used in establishing an analytical curve for AA analyses. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value, with the exception of tin and mercury for which the results must fall within control limits of 80-120% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For AA analyses, the continuing calibration results must fall within 90-110% of the true value, with the exception of tin and mercury for which the results must fall within the control limits 80-120% of the true value.

Initial and continuing calibrations for all analysis dates met all criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. A minimum of one method blank was prepared with each sample batch. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results were within control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not explicitly specify criteria for evaluating Atomic Absorption (AA) instrument performance. Per the U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganic Analysis, one atomic absorption standard at the CRDL concentration must be analyzed. All compounds must be detected in the CRDL standard. This guideline was applied to all AA analyses performed under the project Work Order.

All CRDL criteria were met for all analysis dates.

Sample Result Verification:

Functional Guidelines specifies that all data reduction, reporting and documentation must be performed in accordance with the appropriate Statement of Work. The project Work Order details detection limits in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits are acceptable based on criteria set forth in the project Work Order.

Other QC Issues:

Sample 11800-13 was analyzed for both total and dissolved metals. All remaining samples were analyzed for dissolved metals only. Per the project Work Order, samples for dissolved metal analysis will be filtered in the field prior to being placed in laboratory containers. Analytical procedures for total and dissolved metals were the same.

Hardness
(Method EP 130.2)

This section provides an evaluation of Hardness data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Functional Guidelines does not explicitly identify criteria for evaluating Hardness analyses. In concurrence with requirements set forth in the project Work Order, Hardness data quality has been evaluated in accordance with Functional Guidelines when applicable. Quality control procedures not addressed in Functional Guidelines were evaluated in accordance with Laucks Testing Laboratories' internal Quality Assurance procedures.

Sample Holding Time:

The project Work Order and Functional Guidelines do not specify a holding time for Hardness analysis. Per U.S.E.P.A guidelines specified in the Federal Register, Code of Federal Regulations 40, Parts 100 to 149, July, 1987, water samples should be analyzed for hardness within 6 months.

All samples were analyzed within the holding time specified in the Code of Federal Regulations.

Calibration:

Functional Guidelines specifies daily calibration for inorganic analyses. It does not delineate calibration criteria for Hardness analysis. Per Laucks Testing Laboratories' internal QA procedures, an EPA reference standard is titrated for initial calibration. Titration results must be within the control limits specified for the particular reference material.

All initial calibrations met criteria specified by Laucks Testing Laboratories' internal QA procedures.

Method Blank:

Functional Guidelines specifies that, for inorganic analyses, at least one method blank must be prepared and analyzed for every 20 samples or batch of samples, whichever is more frequent. It does not specify criteria for addressing blank contamination in this analysis. Blank contaminants should not be present at a level greater than the Contract Required Detection Limit (CRDL). CRDL criteria are detailed in Table 2, "Detection Limit Goals", attached herein as Appendix A.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch. No target compounds were detected in the method blanks.

Matrix Spike:

Functional Guidelines specifies that, for inorganic analyses, at least one spiked sample analysis must be performed for every 20 samples or batch of samples, whichever is more frequent. It does not explicitly specify matrix spike criteria for Hardness analysis. The project Work Order requires matrix spike/matrix spike duplicate/matrix spike triplicate analysis. Functional Guidelines indicates, for inorganic analyses, spike recovery results must be within control limits specified in the project Work Order. These control limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recoveries were within the control limits specified in the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify matrix spike duplicate and triplicate evaluation criteria for inorganic analyses. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits specified in the project Work Order.

Instrument Quality Control:

Neither Functional Guidelines nor the project Work Order specify quality control criteria for Hardness analysis. Precision and accuracy of titration apparatus is measured through the analysis of EPA reference materials.

Laboratory Quality Control:

Neither Functional Guidelines nor the project Work Order specify laboratory quality control criteria for Hardness analysis. Laboratory quality control is monitored through blank, calibration standard and matrix spike analysis.

Laboratory quality control was acceptable.

Other QC Issues:

None.

Total and Dissolved Metals
(Methods LX WM1 / SW 6010)

This section provides an evaluation of the total and dissolved metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency & Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Copper, Nickel, Lead, Chromium, Zinc
(Selected samples were also analyzed for Iron and Manganese)

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for ICP analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the CRDL. The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. A minimum of one method blank was prepared and analyzed with each batch. No target compounds were detected in the blanks with the following exception:

Blank ID	Compound	Concentration
B1018ICPW01	Zinc	.002 mg/l
B0131ICPW01	Iron	1.9 mg/l

Per Functional Guidelines, if the blank concentration is less than the CRDL, no corrective action is required. In addition, if the blank concentration is above the CRDL, the concentration of the least concentrated associated sample must be 10 times the blank concentration. All reported results which are less than 10 times the blank concentration have been flagged "E" to indicate the value is estimated due to blank contamination.

Functional Guidelines specifies that, should the sample concentration be less than 10 times the blank concentration, results are to be qualified. Laucks Testing Laboratories utilizes the "B" flag to indicate the compound was detected in both the sample(s) and associated blank. Per Functional Guidelines, positive results at a concentration greater than 10 times the blank concentration do not require qualification as estimates. However, all associated results in all associated samples, regardless of concentration, have been flagged "B" to indicate the analyte of interest was present in the method blank.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/-20% of the established mean value.

Interference check sample results for all analysis dates met criteria specified in Functional Guidelines.

In addition, a standard at the CRDL concentration must be analyzed and all compounds must be detected.

All compounds were detected in the CRDL standard for all analysis dates.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%.

Ten-fold serial dilutions were performed. All results were acceptable with the following exceptions:

Sample	Compound	Initial	Dilution*	% Difference	Comment
11800-22	Copper	.0275	.0039	42	(2)
11800-22	Lead	.0371	.0518	130	(1)
11800-22	Zinc	.1582	.0287	81	(1)

*Results reflect ten-fold dilution factor.

(1) Functional Guidelines specifies that, if the difference between the original and diluted results is not within 10%, interference effects should be suspected and data should be qualified. In accordance with Functional Guidelines, the result has been flagged "E" to indicate the result is estimated due to possible interferences.

(2) Functional Guidelines specifies that the 10% criteria apply only if the analyte concentration is minimally 10 times above the detection limit after dilution. The diluted result is less than 10 times the detection limit. No corrective action required.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits were acceptable per criteria specified in the project Work Order.

Other QC Issues:

Sample 11800-13 was analyzed for both total and dissolved metals. All remaining samples were analyzed for dissolved metals only. Per the project Work Order, samples for dissolved metals analysis will be filtered in the field prior to being placed in laboratory containers. Analytical procedures for total and dissolved metals were the same.

Volatile Organic Compounds
(Method SW 8240)

This section provides an evaluation of the volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988 and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be analyzed within 7 days of sample collection.

All samples were analyzed within holding times specified by Functional Guidelines and the project Work Order.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria have been established to ensure mass resolution, identification and, to some degree, sensitivity. It defines both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Bromofluorobenzene (BFB), as shown in Appendix C.

Ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05. Per Laucks Testing Laboratories' internal QA procedures and U.S.E.P.A. Contract Laboratory Program, Statement of Work for Organics Analysis, these must be greater than or equal to 0.300, with the exception of bromoform, which must be greater than or equal to 0.250. These criteria are more stringent than those in Functional Guidelines.

Calibration criteria specified in Functional Guidelines and U.S.E.P.A Contract Laboratory Program, Statement of Work for Organics Analysis were met for all analysis dates.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. A minimum of one method blank was analyzed with each sample batch. No target compounds were detected in the blanks.

Surrogate:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if one volatile surrogate is outside established control limies, or if one volatile surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented through sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

Based on criteria specified in Functional Guidelines and the project Work Order, all surrogate recoveries were in control.

Matrix Spike:

Functional Guidelines specifies that all spike recovery values must be within the advisory limits established in the appropriate Statement of Work. The project Work Order details the matrix spike recovery limits for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

In accordance with criteria specified in the project Work Order, all matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were in control

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were in control.

Instrument Quality Control:

Functional Guidelines specifies that internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. It further specifies that the retention time of the internal standard must not vary by more than +/- 30 seconds from the associated calibration standard.

Based on criteria specified in Functional Guidelines, all internal standards were acceptable.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

In accordance with criteria specified in Functional Guidelines, all reported compounds were correctly identified.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all reported results and detection limits were acceptable.

Other QC Issues:

Upon initial analysis, field blank sample 11800-27 contained 130 ug/l acetone. The sample was reanalyzed and similar results were obtained, confirming the presence of acetone in the field blank.

Semi-Volatile Organic Compounds
(Methods SW 3510 / SW 8270)

This section provides an evaluation of the semi-volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection.

The following samples were extracted outside specified holding times due to poor surrogate recoveries in the initial extraction:

11800-3
11800-7
11800-20

Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, all results for samples 11800-3, 11800-7 and 11800-20 have been flagged "E" to indicate the results are estimates based on extraction outside holding time.

The following samples were extracted outside specified holding times due to analysis request after expiration of holding time:

11800-2MS
11800-2MSD
11800-2MST

The above-referenced samples were for quality control purposes. While extraction of quality control samples was performed outside holding time requirements, the associated original sample was extracted within the holding time. Data qualification is not required.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. It details both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Decafluorotriphenylphosphine (DFTPP), as detailed in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and the Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch. No target analytes were detected in the blanks.

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if two base/neutral or acid surrogates are outside established control limits, or if one base/neutral or acid surrogate has a recovery of less than 10%, reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

The following surrogate recoveries were outside control limits:

Sample	Compound	% Recovery	Limits	Comments
B1108MSVWLC	d14-p-Terphenyl	32	33-141	(1)
11800-3	2-Fluorophenol	14	18- 75	(2)
11800-3	d5-Phenol	11	15- 49	(2)
11800-3	2-Bromophenol	29	36-113	(2)
11800-3	2,4,6-Tribromophenol	22	26-122	(2)
11800-3RE	d5-Nitrobenzene	10	45-105	(1)
11800-4	d14-p-Terphenyl	17	33-141	(1)
11800-5	d14-p-Terphenyl	29	33-141	(1)
11800-7	2-Fluorophenol	13	18- 75	(2)
11800-7	d5-Phenol	11	15- 49	(2)
11800-7	2-Bromophenol	30	36-113	(2)
11800-9	d14-p-Terphenyl	26	33-141	(1)
11800-10	d14-p-Terphenyl	14	33-141	(1)
11800-11	d14-p-Terphenyl	16	33-141	(1)
11800-14	d14-p-Terphenyl	28	33-141	(1)
11800-20	2-Fluorophenol	1	18- 75	(3)
11800-20	d5-Phenol	0	15- 49	(3)
11800-20	2-Bromophenol	0	36-113	(3)
11800-20	2,4,6-Tribromophenol	2	26-122	(3)
11800-20RE	2-Fluorophenol	3	18- 75	(3)(4)
11800-20RE	d5-Phenol	0	15- 49	(3)(4)
11800-20RE	2-Bromophenol	1	36-113	(3)(4)
11800-20RE	2,4,6-Tribromophenol	2	26-122	(3)(4)
11800-24	d5-Nitrobenzene	15	45-105	(1)
11800-28	d5-Nitrobenzene	29	45-105	(1)

(1) Per Functional Guidelines and the project Work Order, two acid or base/neutral surrogate compounds may be out of control and the analysis be considered in control. No corrective action required.

(2) Per the project Work Order, matrix effect is documented through sample reanalysis. The sample was reanalyzed and results were within the specified control limits. No further action required.

(3) Per the project Work Order, matrix effect is documented by sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The sample was reanalyzed (identified as "RE") with recovery values remaining outside control limits. These results

document matrix effect and are not indicative of laboratory error. No further corrective action required.

(4) Per Functional Guidelines, if any surrogate in an acid or base/neutral fraction shows less than 10% recovery, all positive results for that fraction should be flagged as estimated and all negative results should be flagged as unuseable. In accordance with Functional Guidelines, all positive acid results have been flagged "E" as estimates and all negative acid compound results have been flagged "R" to indicate the results are unuseable.

Matrix Spike:

Functional Guidelines specifies that all matrix spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details matrix spike/matrix spike duplicate/matrix spike triplicate control limits for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were in control.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines specifies internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. In addition, the retention time of the internal standard must not vary more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines with the following exceptions:

Sample	Compound
12727-2MSD	d12-perylene
12727-2MST	d12-perylene

Functional Guidelines specifies that, should internal standard recoveries fall outside specified limits, results associated with that internal standard are to be flagged as estimated. The above-referenced samples were for quality control purposes. While recoveries of matrix spike compounds associated with d12-perylene should be considered estimates, the matrix spike data have not been qualified.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

None.

FIELD REPLICATES

Field replicates are multiple samples taken sequentially and placed under identical circumstances, each of which is treated the same throughout the field and laboratory analytical procedures. The laboratory is unaware of which samples have been replicated. In general, field replicates can be most useful in evaluating variation attributable to the sampling, sub-sampling, handling, and storage aspects of an analysis. But the difference between analytical results for field replicates will also include variation attributable to laboratory factors such as extraction, analysts, reagents, instrumentation, etc.

Two (2) replicate groundwater samples were collected and analyzed for this project. The Hart Crowser station identifications are OSP-4S and OSP-6D. The replicate groundwater sample for an individual station is identified by the letter "R" (e.g., OSP-4SR). One replicate groundwater sample was analyzed per 20 groundwater samples received.

Inorganics

There is no specific review criteria for field replicate analyses comparability in Functional Guidelines. The functional guidelines specifies that at least one laboratory duplicate sample must be analyzed from each group of samples of a similar matrix type for each sampling event or for each 20 samples received, whichever is more frequent. If groundwater duplicate analysis results for a particular inorganic analyte fall outside the control windows of ± 20 percent for RPD (sample values greater than 5 times the CRDL) or ± CRDL (sample values less than 5 times the CRDL), whichever is appropriate, the results for that analyte in all other samples of the same matrix type should be flagged as estimated (J). The relative percent differences of field replicates were compared to the control windows specified for laboratory duplicate results. Listed below are the RPD values for sample replicates exceeding the control limit of ± 20 percent or ± CRDL, whichever is appropriate.

Sample Numbers	Compound	RPD	Limits (Percent)
11800-18,19	Zinc	86	± 50
11800-25,26	Zinc	55	± 50

Organics

There is no specific review criteria for field duplicate analyses comparability in the Functional Guidelines.

APPENDIX A
TABLE 2
(page 1)
DETECTION LIMIT GOALS

TEST	WATER MDL (mg/l)	WATER CRDL (mg/l)	SOIL MDL	SOIL CRDL
Hardness	1	1	NR	NR
METALS:	(mg/l)	(mg/l)	NR	NR
Iron	0.01	0.01	NR	NR
Manganese	0.001	0.001	NR	NR
TOTAL METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Cadmium	NR	NR	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST DISSOLVED METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST EP TOXICITY METALS:			(mg/l)	(mg/l)
Copper	NR	NR	NR	NR
Nickel	NR	NR	NR	NR
Cadmium	NR	NR	NR	NR
Lead	NR	NR	NR	NR
Chromium	NR	NR	NR	NR
Zinc	NR	NR	NR	NR
Arsenic	NR	NR	NR	NR

NR = analysis for this analyte in this matrix is Not Required
MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 2)
DETECTION LIMIT GOALS

	WATER		SOIL	
	MDL	CRDL	MDL	CRDL
TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/FID Screen, calculated as Phenanthrene	NR	NR	NR	NR
PCB's:				
Aroclor-1242	NR	NR	NR	NR
Aroclor-1248	NR	NR	NR	NR
Aroclor-1254	NR	NR	NR	NR
Aroclor-1260	NR	NR	NR	NR
TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/MS EXTRACTABLES:				
Phenol	2	2	NR	NR
Aniline	10	10	NR	NR
Bis(2-chloroethyl)ether	2	2	NR	NR
2-Chlorophenol	2	2	NR	NR
1,3-Dichlorobenzene	2	2	NR	NR
1,4-Dichlorobenzene	2	2	NR	NR
Benzyl alcohol	2	2	NR	NR
1,2-Dichlorobenzene	2	2	NR	NR
2-Methylphenol	2	2	NR	NR
Bis(2-chloroisopropyl)ether	2	2	NR	NR
4-Methylphenol	2	2	NR	NR
N-Nitroso-di-n-propylamine	2	2	NR	NR
Hexachloroethane	4	4	NR	NR
Nitrobenzene	2	2	NR	NR
Isophorone	2	2	NR	NR
2-Nitrophenol	4	4	NR	NR
2,4-Dimethylphenol	2	2	NR	NR
Benzoic Acid	50	50	NR	NR
Bis(2-chloroethoxy)methane	2	2	NR	NR
2,4-Dichlorophenol	4	4	NR	NR
1,2,4-Trichlorobenzene	2	2	NR	NR
Naphthalene	4	4	NR	NR
4-Chloroaniline	2	2	NR	NR
Hexachlorobutadiene	2	2	NR	NR
2-Methylnaphthalene	2	2	NR	NR
Hexachlorocyclopentadiene	4	4	NR	NR

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 3)
DETECTION LIMIT GOALS

	WATER		SOIL	
	MDL	CRDL	MDL	CRDL
TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/MS EXTRACTABLES(cont):				
2,4,6-Trichlorophenol	4	4	NR	NR
2,4,5-Trichlorophenol	4	4	NR	NR
2-Chloronaphthalene	2	2	NR	NR
2,6-Dinitrotoluene	4	4	NR	NR
3-Nitroaniline	10	10	NR	NR
Acenaphthene	2	2	NR	NR
2,4-Dinitrophenol	20	20	NR	NR
4-Nitrophenol	20	20	NR	NR
Dibenzofuran	2	2	NR	NR
2,4-Dinitrotoluene	4	4	NR	NR
Diethyl phthalate	2	2	NR	NR
4-Chlorophenyl phenylether	2	2	NR	NR
Fluorene	2	2	NR	NR
4-Nitroaniline	4	4	NR	NR
4,6-Dinitro-2-methylphenol	20	20	NR	NR
N-Nitrosodiphenylamine	1	1	NR	NR
1,2-Diphenylhydrazine	4	4	NR	NR
4-Bromophenyl phenylether	4	4	NR	NR
Hexachlorobenzene	2	2	NR	NR
Pentachlorophenol	20	20	NR	NR
Phenanthrene	2	2	NR	NR
Anthracene	2	2	NR	NR
Di-n-butyl phthalate	2	2	NR	NR
Fluoranthene	2	2	NR	NR
Pyrene	2	2	NR	NR
Benzidine	50	50	NR	NR
Butylbenzylphthalate	2	2	NR	NR
3,3'-Dichlorobenzidine	20	20	NR	NR
Benzo(a)anthracene	2	2	NR	NR
Chrysene	2	2	NR	NR
Bis(2-ethylhexyl)phthalate	2	2	NR	NR
Di-n-octyl phthalate	2	2	NR	NR
Benzo(b)fluoranthene	4	4	NR	NR
Benzo(k)fluoranthene	4	4	NR	NR
Benzo(a)pyrene	4	4	NR	NR
Indeno(1,2,3-cd)pyrene	4	4	NR	NR
Benzo(g,h,i)perylene	4	4	NR	NR

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 4)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS VOLATILES:				
Chloromethane	1	1	NR	NR
Bromomethane	1	1	NR	NR
Vinyl Chloride	1	1	NR	NR
Carbon Disulfide	1	1	NR	NR
1,1-Dichloroethene	1	1	NR	NR
1,1-Dichloroethane	1	1	NR	NR
trans-1,2-Dichloroethene	1	1	NR	NR
cis-1,2-Dichloroethene	1	1	NR	NR
total-1,2-Dichloroethene	1	1	NR	NR
Chloroform	1	1	NR	NR
2-Butanone	3	3	NR	NR
1,2-Dichloroethane	1	1	NR	NR
1,1,1-Trichloroethane	1	1	NR	NR
Carbon Tetrachloride	1	1	NR	NR
Vinyl Acetate	1	1	NR	NR
Bromodichloromethane	1	1	NR	NR
1,2-Dichloropropane	1	1	NR	NR
Trichloroethene	1	1	NR	NR
Benzene	1	1	NR	NR
Dibromochloromethane	3	3	NR	NR
1,1,2-Trichloroethane	1	1	NR	NR
Bromoform	1	1	NR	NR
4-Methyl-2-Pentanone	3	3	NR	NR
2-Hexanone	3	3	NR	NR
1,1,2,2-Tetrachloroethane	3	3	NR	NR
Tetrachloroethene	1	1	NR	NR
Toluene	1	1	NR	NR
Chlorobenzene	3	3	NR	NR
trans-1,3-Dichloropropene	3	3	NR	NR
Ethylbenzene	1	1	NR	NR
cis-1,3-Dichloropropene	3	3	NR	NR
Styrene	1	1	NR	NR
Total Xylenes	1	1	NR	NR

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 5)
DETECTION LIMIT GOALS

COMMENTS:

Actual reported Sample Detection Limits (SDLs) may vary from the target detection limits listed herein. There are several circumstances which can result in SDLs which are elevated above the CRDLs.
Typically, these are:

1) Insufficient sample volume submitted to perform preparation according to established methodology.

2) Dilution of a sample extract or digest for reasons of matrix interference or to bring another compound of interest within linear range.

3) Extraction of the sample at the "medium" or "high" levels, rather than a typical "low" level extraction. This involves employing a smaller sample size and is a decision made on visual appearance of the sample and/or odor.

In addition, it should be noted that the limits of detection shown for soil analysis have been normalized to reflect a total solids value of 100%. In fact, soil samples will generally have total solids of 75-80% and SDLs will be correspondingly increased.

APPENDIX B
TABLE 3
(page 1)
CONTROL LIMITS
(Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate)

	WATER		SOIL	
TEST	% Recovery	RPD	% Recovery	RPD
Hardness	79-114	0-5	NR	NR
TOTAL METALS:				
Copper	75-125*	0-7	NR	NR
Nickel	75-125*	0-5	NR	NR
Cadmium	NR	NR	NR	NR
Lead	75-125*	0-7	NR	NR
Chromium	75-125*	0-6	NR	NR
Zinc	75-125*	0-6	NR	NR
Arsenic	75-125*	0-7	NR	NR
GC/FID Screen, calculated as Phenanthrene	NR	NR	NR	NR
PCBs:				
Aroclor 1260	NR	NR	NR	NR
GC/MS EXTRACTABLES:				
Phenol	16-72	0-18	NR	NR
2-Chlorophenol	31-122	0-15	NR	NR
1,4-Dichlorobenzene	36-97*	0-16	NR	NR
N-Nitroso-di-n-propylamine	41-116*	0-17	NR	NR
1,2,4-Trichlorobenzene	50-105	0-14	NR	NR
4-Chloro-3-methylphenol	46-108	0-11	NR	NR
Acenaphthylene	44-110	0-12	NR	NR
4-Nitrophenol	10-78	0-21	NR	NR
2,4-Dinitrotoluene	43-109	0-15	NR	NR
Pentachlorophenol	35-120	0-11	NR	NR
Pyrene	26-127*	0-11	NR	NR
GC/MS VOLATILES:				
1,1-Dichloroethane	53-131	0-7	NR	NR
Trichloroethene	71-120*	0-7	NR	NR
Benzene	76-127*	0-8	NR	NR
Toluene	76-125*	0-13	NR	NR
Chlorobenzene	73-128	0-8	NR	NR

APPENDIX B
TABLE 3
(page 2)
CONTROL LIMITS
(Surrogate Spike)

TEST	WATER % Recovery	SOIL % Recovery
GC/FID Screen, calculated as Phenanthrene	NR	NR
PCBs:		
Dibutylchlorendate	NR	NR
Isodrin	NR	NR
GC/MS EXTRACTABLES:		
2-Fluorophenol	18-75	NR
d5-Phenol	15-49	NR
2-Bromophenol	36-113	NR
d5-Nitrobenzene	45-105	NR
2-Fluorobiphenyl	44-100	NR
d10-Azobenzene	48-116	NR
2,4,6-Tribromophenol	26-122	NR
d14-p-Terphenyl	33-141*	NR
GC/MS VOLATILES:		
d4-1,2-Dichloroethane	79-116	NR
d8-Toluene	88-110*	NR
p-Bromofluorobenzene	86-115*	NR

* = EPA Control Limits (all others are Laucks in-house)

APPENDIX B
TABLE 3
(page 3)
CONTROL LIMITS

COMMENTS:

Where a recovery exceeds the upper control limit, and that control limit was <100%, the recovery will be deemed in control to an upper limit of 120%.

In the case of GC/MS extractables up to two surrogates (one acid and/or one base/neutral compound) may be out of control and the analysis be deemed in control, with no requirement for re-analysis.

In the case of the PCB analysis, dibutylchlorendate (DBC) is the CLP surrogate and isodrin is a second surrogate added at Laucks' discretion. Should isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control.

COMPLETENESS:

Laboratory goal is 90% completeness. Matrix effect is documented through performance of a re-analysis. Should recoveries or RPDs remain out of control, no further corrective action is required. If data are 90% complete, outliers are regarded as anomalies.

APPENDIX C
Tuning and Performance Criteria

Decafluorotriphenylphosphine (DFTPP)

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988.

Hart Crowser
J-1639-09

QUALITY ASSURANCE DATA FOR SURFACE WATER SAMPLES COLLECTED ON OCTOBER 17, 1988

Sample Receipt

Two water samples were received on October 17, 1988. Both samples were received intact and in good condition.

Laboratory number 12727 was assigned to this project and each individual sample was given a discrete sub-sample number (i.e.,12727-1, 12727-2). The attached Table I details the identification of each sample and the date on which it was received.

There were no discrepancies between sample identification and the chain-of-custody documents.

The samples were held in cold storage at 4°C until removed for preparation and/or analysis.

Methods of Analysis

Samples were analyzed as specified in the communication of June 30, 1988 (letter from Barbara Gleason to Philip Spadaro) and Laboratory Work Order of July 7,1988.

Specific methods of analysis employed are shown on each sample result page. Two letter codes are used to indicate the volumes from which test methods are drawn. These codes are defined as shown below:

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986.

EP = Methods for Chemical Analysis of Water and Wastes, U.S.E.P.A., March, 1983.

LX = A Laucks Testing Laboratories in-house method or modification of a previously published method. LX methods are described below.

Laucks Testing Laboratories Methods

WM1: A modification of method SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM3-A: Modification of Standard Methods 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI and Laucks uses preserved, not digested, sample.

Reporting Conventions

The following abbreviations appear in these reports:

MDL = Method Detection Limit

SDL = Sample Detection Limit This figure can vary from sample to sample, dependent on sample size, matrix interferences, etc.

CRDL = Contract Recommended Detection Limit.

RE = Reported values are the results for a re-extracted and re-analyzed sample.

Sample results may be flagged with a one-letter code designed to provide additional information about the analysis or the value reported. The flags employed are defined below. Where no flag is present, the analyte was detected and the value reported is the measured concentration.

U = The analyte was not detected. The value reported is the greater of the SDL or the CRDL, if any.

B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. (If the sample result is U flagged, no B flag is applied.)

D = The value reported is based on analysis of a diluted sample or extract. The dilution was made to bring another compound of interest within linear range or because of matrix effect.

E = The reported value is qualified and should be considered an estimate. Comments on reasons for this qualification appear in the Quality Control Report accompanying these test results. (This is equivalent to the Functional Guidelines "J" flag.)

R = The flagged data point is not useable, for reasons discussed in the Quality Control Report.

By convention, if an analyte is not detected and if the SDL is less than the CRDL, the CRDL value is reported with a U flag. The implication is that no analyte was detected at the SDL level either. If the SDL is larger than the CRDL, it becomes the value which is U flagged.

Analytical History

Dates of analysis for every preparation and analytical procedure are shown on the data sheets provided for each sample. In addition, this information is summarized in attached Table II for all samples.

The value shown to the right of any date is the number of days which elapsed between sampling and either preparation or analysis. In the case of GC/MS ABN analysis, it is the number of elapsed days between sample preparation and analysis.

Any preparation or analytical procedure performed outside of holding times is marked (*) and appropriate comments appear in the Quality Control narrative included with this report.

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Date Rec'd	Interim Due Date
12727	1	PACCAR	SW-1	10/17/88	10/17/88	11/14/88
12727	2	PACCAR	SW-1R	10/17/88	10/17/88	11/14/88
12727	3		FB		10/17/88	11/14/88

Table I: Sample Identification

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	Dissolved Arsenic Prep.		Dissolved Arsenic Anal.		Dissolved ICAP Prep.		Dissolved ICAP Anal.	
12727	1	PACCAR	SW-1	10/17/88	10/19/88	2	10/19/88	2	11/03/88	17	11/03/88	17
12727	2	PACCAR	SW-1R	10/17/88	10/19/88	2	10/19/88	2	11/03/88	17	11/03/88	17
12727	3		FB		NA		NA		NA		NA	

Lab Number	Sample Number	HC Station	Sample I.D.	Date Sampled	GC/MS VOA Anal.		GC/MS ABN Prep.		GC/MS ABN Anal.	
12727	1	PACCAR	SW-1	10/17/88	10/18/88	1	10/18/88	1	11/07/88	20
12727	2	PACCAR	SW-1R	10/17/88	10/18/88	1	10/18/88	1	11/07/88	20
12727	3		FB		10/18/88	1	NA		NA	

* Indicates procedure performed outside of holding time.

Table II: Analytical History

Quality Control Report
Summary of Findings

Arsenic

All Arsenic data generated for this project have been determined acceptable for use. No data qualification was required.

Metals

All metals data generated for this project have been determined acceptable for use. No data qualification was required.

Volatile Organics

All volatile organics data generated for this project have been determined acceptable for use. No data qualification was required.

Semi-Volatile Organics

All semi-volatile organics data generated for this project have been determined acceptable for use. No data qualification was required.

Completeness

Completeness represents the percentage of generated data points which are fully useable for intended purposes. A project goal of 80% completeness was set; the laboratory goal was 90% completeness.

There is no universally accepted method for measuring completeness. Two reasonable approaches are:

A) Compare the quantity of unuseable data points (those flagged "R") to the quantity of data points generated overall on submitted samples. By this approach, 0 points of 256 (determined in 2 surface water and 1 volatile organics field blank samples) have been flagged "R", for a completeness percentage of 100.

B) More stringently, compare the quantity of qualified data points (those flagged "R", "E" and "B") to the quantity of data points generated overall on submitted samples. For this project, 0 points of 256 have been so flagged (including those which may bear more than one such flag), for a completeness percentage of 100.

By either approach, both project and laboratory goals for completeness have been achieved.

Dissolved Arsenic
(Methods LX WM3-A / SW 7061)

This section provides an evaluation of the dissolved arsenic data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies the daily instrument calibration for Atomic Absorption (AA) analysis. It also specifies that a calibration blank and at least three standards must be used in establishing an analytical curve for AA analyses. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value, with the exception of tin and mercury for which the results must fall within control limits of 80-120% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For AA analyses, the continuing calibration results must fall within 90-110% of the true value, with the exception of tin and mercury for which the results must fall within the control limits 80-120% of the true value.

Initial and continuing calibrations for all analysis dates met all criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. A minimum of one method blank was prepared with each sample batch. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results were within control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not explicitly specify criteria for evaluating Atomic Absorption (AA) instrument performance. Per the U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganic Analysis, one atomic absorption standard at the CRDL concentration must be analyzed. All compounds must be detected in the CRDL standard. This guideline was applied to all AA analyses performed under the project Work Order.

All CRDL criteria were met for all analysis dates.

Sample Result Verification:

Functional Guidelines specifies that all data reduction, reporting and documentation must be performed in accordance with the appropriate Statement of Work. The project Work Order details detection limits in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits are acceptable based on criteria set forth in the project Work Order.

Other QC Issues:

None.

Dissolved Metals
(Methods LX WM1 / SW 6010)

This section provides an evaluation of the dissolved metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency & Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Copper, Nickel, Lead, Chromium, Zinc

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for ICP analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within the control limits of 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the CRDL. The blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. A minimum of one method blank was prepared and analyzed with each batch. No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the

Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/- 20% of the established mean value.

Interference check sample results for all analysis dates met criteria specified in Functional Guidelines.

In addition, a standard at the CRDL concentration must be analyzed and all compounds must be detected.

All compounds were detected in the CRDL standard for all analysis dates.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%.

All serial dilution results were acceptable.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits were acceptable per criteria specified in the project Work Order.

Other QC Issues:

None.

Volatile Organic Compounds
(Method SW 8240)

This section provides an evaluation of the volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988 and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated June 15, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be analyzed within 7 days of sample collection.

All samples were analyzed within holding times specified by Functional Guidelines and the project Work Order.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria have been established to ensure mass resolution, identification and, to some degree, sensitivity. It defines both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Bromofluorobenzene (BFB), as shown in Appendix C.

Ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05. Per Laucks Testing Laboratories' internal QA procedures and U.S.E.P.A. Contract Laboratory Program, Statement of Work for Organics Analysis, these must be greater than or equal to 0.300, with the exception of bromoform, which must be greater than or equal to 0.250. These criteria are more stringent than those in Functional Guidelines.

Calibration criteria specified in Functional Guidelines and U.S.E.P.A Contract Laboratory Program, Statement of Work for Organics Analysis were met for all analysis dates.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. A minimum of one method blank was analyzed with each sample batch. No target compounds were detected in the blanks.

Surrogate:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if one volatile surrogate is outside established control limies, or if one volatile surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented through sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

Based on criteria specified in Functional Guidelines and the project Work Order, all surrogate recoveries were in control.

Matrix Spike:

Functional Guidelines specifies that all spike recovery values must be within the advisory limits established in the appropriate Statement of Work. The project Work Order details the matrix spike recovery limits for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

In accordance with criteria specified in the project Work Order, all matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were in control

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were in control.

Instrument Quality Control:

Functional Guidelines specifies that internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. It further specifies that the retention time of the internal standard must not vary by more than +/- 30 seconds from the associated calibration standard.

Based on criteria specified in Functional Guidelines, all internal standards were acceptable.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

In accordance with criteria specified in Functional Guidelines, all reported compounds were correctly identified.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the Contract Required Quantitation Limit (CRQL) must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

In accordance with criteria specified in Functional Guidelines and the project Work Order, all reported results and detection limits were acceptable.

Other QC Issues:

None.

Semi-Volatile Organic Compounds
(Methods SW 3510 / SW 8270)

This section provides an evaluation of the semi-volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988, pursuant to the Continuing Services Agreement dated June 13, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection.

All samples were extracted and analyzed within the holding times specified in Functional Guidelines and the project Work Order.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. It details both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Decafluorotriphenylphosphine (DFTPP), as detailed in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and the Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: Methylene chloride, Acetone, Toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared and analyzed with each sample batch. No target analytes were detected in the blanks.

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if two base/neutral or acid surrogates are outside established control limits, or if one base/neutral or acid surrogate has a recovery of less than 10%, reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

All surrogate recoveries were within control limits specified in the project Work Order.

Matrix Spike:

Functional Guidelines specifies that all matrix spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details matrix spike/matrix spike duplicate/matrix spike triplicate control limits for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were in control.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines specifies internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. In addition, the retention time of the internal standard must not vary more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

None.

FIELD REPLICATES

One replicate surface water sample was collected and analyzed for this project. The Hart Crowser station identification is SW-1. The replicate surface water sample is identified by the letter "R" (e.g., SW-1R).

Inorganics

There is no specific review criteria for field replicate analyses comparability in Functional Guidelines. The relative percent differences were compared to the control windows specified for laboratory duplicate results (see Groundwater Field Replicate section). Listed below are the RPD values for sample replicates exceeding the control limit of ± 20 percent or ± CRDL, whichever is appropriate.

Sample Numbers	Compound	RPD	Limits (Percent)
12727-1,2	Copper	32	± 20

Organics

There is no specific review criteria for field duplicate analyses comparability in the Functional Guidelines.

APPENDIX A
TABLE 2
(page 1)
DETECTION LIMIT GOALS

	WATER		SOIL	
TEST	MDL (mg/l)	CRDL (mg/l)	MDL	CRDL
Hardness	1	1	NR	NR
METALS:	(mg/l)	(mg/l)	NR	NR
Iron	0.01	0.01	NR	NR
Manganese	0.001	0.001	NR	NR
TOTAL METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Cadmium	NR	NR	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST DISSOLVED METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST EP TOXICITY METALS:			(mg/l)	(mg/l)
Copper	NR	NR	NR	NR
Nickel	NR	NR	NR	NR
Cadmium	NR	NR	NR	NR
Lead	NR	NR	NR	NR
Chromium	NR	NR	NR	NR
Zinc	NR	NR	NR	NR
Arsenic	NR	NR	NR	NR

NR = analysis for this analyte in this matrix is Not Required
MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 2)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/FID Screen, calculated as Phenanthrene	NR	NR	NR	NR
PCB's:				
Aroclor-1242	NR	NR	NR	NR
Aroclor-1248	NR	NR	NR	NR
Aroclor-1254	NR	NR	NR	NR
Aroclor-1260	NR	NR	NR	NR

TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/MS EXTRACTABLES:				
Phenol	2	2	NR	NR
Aniline	10	10	NR	NR
Bis(2-chloroethyl)ether	2	2	NR	NR
2-Chlorophenol	2	2	NR	NR
1,3-Dichlorobenzene	2	2	NR	NR
1,4-Dichlorobenzene	2	2	NR	NR
Benzyl alcohol	2	2	NR	NR
1,2-Dichlorobenzene	2	2	NR	NR
2-Methylphenol	2	2	NR	NR
Bis(2-chloroisopropyl)ether	2	2	NR	NR
4-Methylphenol	2	2	NR	NR
N-Nitroso-di-n-propylamine	2	2	NR	NR
Hexachloroethane	4	4	NR	NR
Nitrobenzene	2	2	NR	NR
Isophorone	2	2	NR	NR
2-Nitrophenol	4	4	NR	NR
2,4-Dimethylphenol	2	2	NR	NR
Benzoic Acid	50	50	NR	NR
Bis(2-chloroethoxy)methane	2	2	NR	NR
2,4-Dichlorophenol	4	4	NR	NR
1,2,4-Trichlorobenzene	2	2	NR	NR
Naphthalene	4	4	NR	NR
4-Chloroaniline	2	2	NR	NR
Hexachlorobutadiene	2	2	NR	NR
2-Methylnaphthalene	2	2	NR	NR
Hexachlorocyclopentadiene	4	4	NR	NR

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 3)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS EXTRACTABLES(cont):				
2,4,6-Trichlorophenol	4	4	67	67
2,4,5-Trichlorophenol	4	4	67	67
2-Chloronaphthalene	2	2	33	33
2-Nitroaniline	4	4	67	67
Dimethyl phthalate	2	2	33	33
Acenaphthylene	2	2	33	33
2,6-Dinitrotoluene	4	4	67	67
3-Nitroaniline	10	10	170	170
Acenaphthene	2	2	33	33
2,4-Dinitrophenol	20	20	330	330
4-Nitrophenol	20	20	330	330
Dibenzofuran	2	2	33	33
2,4-Dinitrotoluene	4	4	67	67
Diethyl phthalate	2	2	33	33
4-Chlorophenyl phenylether	2	2	33	33
Fluorene	2	2	33	33
4-Nitroaniline	4	4	67	67
4,6-Dinitro-2-methylphenol	20	20	330	330
N-Nitrosodiphenylamine	1	1	33	33
1,2-Diphenylhydrazine	4	4	67	67
4-Bromophenyl phenylether	4	4	67	67
Hexachlorobenzene	2	2	33	33
Pentachlorophenol	20	20	330	330
Phenanthrene	2	2	33	33
Anthracene	2	2	33	33
Di-n-butyl phthalate	2	2	33	33
Fluoranthene	2	2	33	33
Pyrene	2	2	33	33
Benzidine	50	50	830	830
Butylbenzylphthalate	2	2	33	33
3,3'-Dichlorobenzidine	20	20	330	330
Benzo(a)anthracene	2	2	33	33
Chrysene	2	2	33	33
Bis(2-ethylhexyl)phthalate	2	2	33	33
Di-n-octyl phthalate	2	2	33	33
Benzo(b)fluoranthene	4	4	67	67
Benzo(k)fluoranthene	4	4	67	67
Benzo(a)pyrene	4	4	67	67
Indeno(1,2,3-cd)pyrene	4	4	67	67
Dibenzo(a,h)anthracene	4	4	67	67
Benzo(g,h,i)perylene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 4)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS VOLATILES:				
Chloromethane	1	1	2	2
Bromomethane	1	1	2	2
Vinyl Chloride	1	1	2	2
Chloroethane	3	3	6	6
Methylene Chloride	1	1	2	2
Acetone	5	5	10	10
Carbon Disulfide	1	1	2	2
1,1-Dichloroethene	1	1	2	2
1,1-Dichloroethane	1	1	2	2
trans-1,2-Dichloroethene	1	1	2	2
cis-1,2-Dichloroethene	1	1	2	2
total-1,2-Dichloroethene	1	1	2	2
Chloroform	1	1	2	2
2-Butanone	3	3	6	6
1,2-Dichloroethane	1	1	2	2
1,1,1-Trichloroethane	1	1	2	2
Carbon Tetrachloride	1	1	2	2
Vinyl Acetate	1	1	2	2
Bromodichloromethane	1	1	2	2
1,2-Dichloropropane	1	1	2	2
Trichloroethene	1	1	2	2
Benzene	1	1	2	2
Dibromochloromethane	3	3	6	6
1,1,2-Trichloroethane	1	1	2	2
Bromoform	1	1	2	2
4-Methyl-2-Pentanone	3	3	6	6
2-Hexanone	3	3	6	6
1,1,2,2-Tetrachloroethane	3	3	6	6
Tetrachloroethene	1	1	2	2
Toluene	1	1	2	2
Chlorobenzene	3	3	6	6
trans-1,3-Dichloropropene	3	3	6	6
Ethylbenzene	1	1	2	2
cis-1,3-Dichloropropene	3	3	6	6
Styrene	1	1	2	2
Total Xylenes	1	1	2	2

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 5)
DETECTION LIMIT GOALS

COMMENTS:

Actual reported Sample Detection Limits (SDLs) may vary from the target detection limits listed herein. There are several circumstances which can result in SDLs which are elevated above the CRDLs. Typically, these are:

1) Insufficient sample volume submitted to perform preparation according to established methodology.

2) Dilution of a sample extract or digest for reasons of matrix interference or to bring another compound of interest within linear range.

3) Extraction of the sample at the "medium" or "high" levels, rather than a typical "low" level extraction. This involves employing a smaller sample size and is a decision made on visual appearance of the sample and/or odor.

In addition, it should be noted that the limits of detection shown for soil analysis have been normalized to reflect a total solids value of 100%. In fact, soil samples will generally have total solids of 75-80% and SDLs will be correspondingly increased.

APPENDIX B
TABLE 3
(page 1)
CONTROL LIMITS
(Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate)

	WATER		SOIL	
TEST	% Recovery	RPD	% Recovery	RPD
Hardness	79-114	0-5	NR	NR
TOTAL METALS:				
Copper	75-125*	0-7	NR	NR
Nickel	75-125*	0-5	NR	NR
Cadmium	NR	NR	NR	NR
Lead	75-125*	0-7	NR	NR
Chromium	75-125*	0-6	NR	NR
Zinc	75-125*	0-6	NR	NR
Arsenic	75-125*	0-7	NR	NR
GC/FID Screen, calculated as Phenanthrene	NR	NR	NR	NR
PCBs:				
Aroclor 1260	NR	NR	NR	NR
GC/MS EXTRACTABLES:				
Phenol	16-72	0-18	NR	NR
2-Chlorophenol	31-122	0-15	NR	NR
1,4-Dichlorobenzene	36-97*	0-16	NR	NR
N-Nitroso-di-n-propylamine	41-116*	0-17	NR	NR
1,2,4-Trichlorobenzene	50-105	0-14	NR	NR
4-Chloro-3-methylphenol	46-108	0-11	NR	NR
Acenaphthylene	44-110	0-12	NR	NR
4-Nitrophenol	10-78	0-21	NR	NR
2,4-Dinitrotoluene	43-109	0-15	NR	NR
Pentachlorophenol	35-120	0-11	NR	NR
Pyrene	26-127*	0-11	NR	NR
GC/MS VOLATILES:				
1,1-Dichloroethane	53-131	0-7	NR	NR
Trichloroethene	71-120*	0-7	NR	NR
Benzene	76-127*	0-8	NR	NR
Toluene	76-125*	0-13	NR	NR
Chlorobenzene	73-128	0-8	NR	NR

APPENDIX B
TABLE 3
(page 2)
CONTROL LIMITS
(Surrogate Spike)

TEST	WATER % Recovery	SOIL % Recovery
GC/FID Screen, calculated as Phenanthrene	NR	NR
PCBs:		
Dibutylchlorendate	NR	NR
Isodrin	NR	NR
GC/MS EXTRACTABLES:		
2-Fluorophenol	18-75	NR
d5-Phenol	15-49	NR
2-Bromophenol	36-113	NR
d5-Nitrobenzene	45-105	NR
2-Fluorobiphenyl	44-100	NR
d10-Azobenzene	48-116	NR
2,4,6-Tribromophenol	26-122	NR
d14-p-Terphenyl	33-141*	NR
GC/MS VOLATILES:		
d4-1,2-Dichloroethane	79-116	NR
d8-Toluene	88-110*	NR
p-Bromofluorobenzene	86-115*	NR

* = EPA Control Limits (all others are Laucks in-house)

APPENDIX B
TABLE 3
(page 3)
CONTROL LIMITS

COMMENTS:

Where a recovery exceeds the upper control limit, and that control limit was <100%, the recovery will be deemed in control to an upper limit of 120%.

In the case of GC/MS extractables up to two surrogates (one acid and/or one base/neutral compound) may be out of control and the analysis be deemed in control, with no requirement for re-analysis.

In the case of the PCB analysis, dibutylchlorendate (DBC) is the CLP surrogate and isodrin is a second surrogate added at Laucks' discretion. Should isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control.

COMPLETENESS:

Laboratory goal is 90% completeness. Matrix effect is documented through performance of a re-analysis. Should recoveries or RPDs remain out of control, no further corrective action is required. If data are 90% complete, outliers are regarded as anomalies.

APPENDIX C
Tuning and Performance Criteria

Decafluorotriphenylphosphine (DFTPP)

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988.

Hart Crowser
J-1639-09

QUALITY ASSURANCE DATA FOR GROUNDWATER SAMPLES COLLECTED DURING FEBRUARY 1989

Sample Receipt

Twenty one (21) water samples and two (2) volatile trip blanks were received between the dates of February 6 and February 9, 1989. All samples were received intact and in good condition, with the following exception:

Lab No.	Identification	Comment
14398-12	LW-13D	One of the volatile organics sample vials was received broken. The two remaining vials were sufficient for the analysis.

Laboratory number 14398 was assigned to this project and each individual sample was given a discrete sub-sample number (i.e., 14398-1, 14398-2, etc). The attached Table I details the identification of each sample and the date on which it was received.

There were no discrepancies between sample identification and the chain-of-custody documents.

Following directions on the chain-of-custody documents, selected samples (VOA and ABN fractions) were permitted to settle prior to analysis. The aqueous phase was decanted for testing and the sediment phase was avoided. Samples subject to this procedure were:

Lab No.	Identification
14398-8	OW-4S
14398-9	OW-4D
14398-14	LW-6D
14398-16	LW-9D
14398-18	OSP-7S
14398-19	OSP-7D
14398-21	OSP-2D

The samples were held in cold storage at 4°C until removed for preparation and/or analysis.

Methods of Analysis

Samples were analyzed as specified in the communication of January 23, 1989 (telephone conversation between Mark Herrenkohl and Kirk Hintzen) and Laboratory Work Order of July 7, 1988.

Specific methods of analysis employed are shown on each sample result page. Two letter codes are used to indicate the volumes from which test methods are drawn. These codes are defined as shown below:

SW = Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., November, 1986.

LX = A Laucks Testing Laboratories in-house method or modification of a previously published method. LX methods are described below.

Laucks Testing Laboratories Methods

WM1: A modification of method SW 3010. The volume is reduced once during digestion and diluted back up to 10X less than the starting volume. Both are HNO_3 and HCl digestions.

WM2: A modification of method SW 3020. The volume is reduced once during digestion with HNO_3 + H_2O_2 and diluted back to the starting volume.

WM3: Modification of Standard Methods 303E. Some of the volumes of reagents vary from Standard Methods, KI is used rather than NaI and Laucks uses preserved, not digested, sample.

Reporting Conventions

The following abbreviations appear in these reports:

MDL = Method Detection Limit

SDL = Sample Detection Limit This figure can vary from sample to sample, dependent on sample size, matrix interferences, etc.

CRDL = Contract Recommended Detection Limit.

RE = Reported values are the results for a re-extracted and re-analyzed sample.

Sample results may be flagged with a one-letter code designed to provide additional information about the analysis or the value reported. The flags employed are defined below. Where no flag is present, the analyte was detected and the value reported is the measured concentration.

U = The analyte was not detected. The value reported is the greater of the SDL or the CRDL, if any.

B = The analyte of interest was detected in the method blank associated with the sample, as well as in the sample itself. (If the sample result is U flagged, no B flag is applied.)

D = The value reported is based on analysis of a diluted sample or extract. The dilution was made to bring another compound of interest within linear range or because of matrix effect.

E = The reported value is qualified and should be considered an estimate. Comments on reasons for this qualification appear in the Quality Control Report accompanying these test results. (This is equivalent to the Functional Guidelines "J" flag.)

R = The flagged data point is not useable, for reasons discussed in the Quality Control Report.

By convention, if an analyte is not detected and if the SDL is less than the CRDL, the CRDL value is reported with a U flag. The implication is that no analyte was detected at the SDL level either. If the SDL is larger than the CRDL, it becomes the value which is U flagged.

Analytical History

Dates of analysis for every preparation and analytical procedure are shown on the data sheets provided for each sample. In addition, this information is summarized in attached Table II for all samples.

The value shown to the right of any date is the number of days which elapsed between sampling and either preparation or analysis. In the case of GC/MS ABN analysis, it is the number of elapsed days between sample preparation and analysis.

Any preparation or analytical procedure performed outside of holding times is marked (*) and appropriate comments appear in the Quality Control narrative included with this report.

Lab Number	Sample Number	H.C. Sample I.D.	Date Sampled	ICP Metals (Pb & Zn) Digestion	ICP Metals (Pb & Zn) Analysis		Arsenic (Hydride) Digestion	Arsenic (Hydride) Analysis	
14398	1	OW-5S	02/06/89	NA	NA		NA	NA	
14398	2	OW-5D	02/06/89	NA	NA		NA	NA	
14398	3	OSP-4D	02/06/89	NA	NA		02/13/89	02/13/89	7
14398	4	MW-3I	02/07/89	02/13/89	02/14/89	7	02/13/89	02/13/89	6
14398	5	LW-12S	02/07/89	02/13/89	02/14/89	7	02/13/89	02/13/89	6
14398	6	LW-12D	02/07/89	02/13/89	02/14/89	7	02/13/89	02/13/89	6
14398	7	LW-12DR	02/07/89	02/13/89	02/14/89	7	02/13/89	02/13/89	6
14398	8	OW-4S	02/07/89	NA	NA		NA	NA	
14398	9	OW-4D	02/07/89	NA	NA		NA	NA	
14398	10	LW-3S	02/07/89	02/13/89	02/14/89	7	02/13/89	02/13/89	6
14398	11	LW-3D	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	12	LW-13D	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	13	LW-6S	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	14	LW-6D	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	15	LW-9S	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	16	LW-9D	02/08/89	02/13/89	02/14/89	6	02/13/89	02/13/89	5
14398	17	VOA Trip Blk	02/08/89	NA	NA		NA	NA	
14398	18	OSP-7S	02/09/89	02/13/89	02/14/89	5	02/13/89	02/13/89	4
14398	19	OSP-7D	02/09/89	02/13/89	02/14/89	5	02/13/89	02/13/89	4
14398	20	OSP-5D	02/09/89	NA	NA		NA	NA	
14398	21	OSP-2D	02/09/89	02/13/89	02/14/89	5	02/13/89	02/13/89	4
14398	22	MW-10	02/09/89	NA	NA		02/13/89	02/13/89	4
14398	23	VOA Trip Blk	02/09/89	NA	NA		NA	NA	

Table II: Analytical History (page 1 of 3)

Lab Number	Sample Number	H.C. Sample I.D.	Date Sampled	Arsenic (Furnace) Digestion	Arsenic (Furnace) Analysis		GC/MS ABN Extraction		GC/MS ABN Analysis	
14398	1	OW-5S	02/06/89	NA	NA		02/10/89	4	02/16/89	6
14398	2	OW-5D	02/06/89	NA	NA		02/10/89	4	02/16/89	6
14398	3	OSP-4D	02/06/89	02/13/89	03/03/89	25	NA		NA	
14398	4	MW-3I	02/07/89	NA	NA		02/20/89	13 *	02/27/89	7
14398	5	LW-12S	02/07/89	02/13/89	03/03/89	24	02/20/89	13 *	02/27/89	7
14398	6	LW-12D	02/07/89	NA	NA		02/10/89	3	02/16/89	6
14398	7	LW-12DR	02/07/89	NA	NA		02/10/89	3	02/15/89	5
14398	8	OW-4S	02/07/89	NA	NA		02/10/89	3	02/16/89	6
14398	9	OW-4D	02/07/89	NA	NA		02/10/89	3	02/16/89	6
14398	10	LW-3S	02/07/89	NA	NA		02/10/89	3	02/16/89	6
14398	11	LW-3D	02/08/89	NA	NA		02/10/89	2	02/16/89	6
14398	12	LW-13D	02/08/89	NA	NA		02/12/89	4	02/17/89	5
14398	13	LW-6S	02/08/89	NA	NA		02/12/89	4	02/17/89	5
14398	14	LW-6D	02/08/89	NA	NA		02/12/89	4	02/17/89	5
14398	15	LW-9S	02/08/89	NA	NA		02/22/89	14 *	02/27/89	5
14398	16	LW-9D	02/08/89	NA	NA		02/12/89	4	02/17/89	5
14398	17	VOA Trip Blk	02/08/89	NA	NA		NA		NA	
14398	18	OSP-7S	02/09/89	NA	NA		02/12/89	3	02/17/89	5
14398	19	OSP-7D	02/09/89	NA	NA		02/12/89	3	02/17/89	5
14398	20	OSP-5D	02/09/89	NA	NA		NA		NA	
14398	21	OSP-2D	02/09/89	NA	NA		02/12/89	3	02/17/89	5
14398	22	MW-10	02/09/89	02/13/89	03/03/89	22	NA		NA	
14398	23	VOA Trip Blk	02/09/89	NA	NA		NA		NA	

Table II: Analytical History (page 2 of 3)

Lab Number	Sample Number	H.C. Sample I.D.	Date Sampled	GC/MS VOA Analysis	
14398	1	OW-5S	02/06/89	NA	
14398	2	OW-5D	02/06/89	NA	
14398	3	OSP-4D	02/06/89	NA	
14398	4	MW-3I	02/07/89	02/09/89	2
14398	5	LW-12S	02/07/89	02/09/89	2
14398	6	LW-12D	02/07/89	02/09/89	2
14398	7	LW-12DR	02/07/89	02/09/89	2
14398	8	OW-4S	02/07/89	NA	
14398	9	OW-4D	02/07/89	NA	
14398	10	LW-3S	02/07/89	02/09/89	2
14398	11	LW-3D	02/08/89	02/09/89	1
14398	12	LW-13D	02/08/89	02/09/89	1
14398	13	LW-6S	02/08/89	02/09/89	1
14398	14	LW-6D	02/08/89	02/13/89	5
14398	15	LW-9S	02/08/89	02/13/89	5
14398	16	LW-9D	02/08/89	02/13/89	5
14398	17	VOA Trip Blk	02/08/89	02/13/89	5
14398	18	OSP-7S	02/09/89	02/13/89	4
14398	19	OSP-7D	02/09/89	02/13/89	4
14398	20	OSP-5D	02/09/89	02/13/89	4
14398	21	OSP-2D	02/09/89	02/13/89	4
14398	22	MW-10	02/09/89	NA	
14398	23	VOA Trip Blk	02/09/89	02/13/89	4

Table II: Analytical History (page 3 of 3)

Quality Assurance Report

Metals

All total and dissolved metals data generated for this project have been determined acceptable for use. The following zinc results have been qualified:

Due to associated method blank contamination (B flag):

14398-4 through 14398-7
14398-10 through 14398-16
14398-18 through 14398-19
14398-21

Estimated since reanalysis due to blank contamination was required but not performed (E flag):

14398-4 through 14398-7
14398-10 through 14398-16
14398-18 through 14398-19
14398-21

Arsenic

All arsenic data generated for this project have been determined acceptable for use. No data qualification was required.

Volatile Organics

All volatile organics data generated for this project have been determined acceptable for use. The following results have been qualified:

Trichloroethene, 1,1-Dichloroethene, Toluene and Chlorobenzene results for the following samples have been qualified as estimated due to RPD values outside the specified control limits (E flag):

14398-4 through 14398-7
14398-10 through 14398-13

Semivolatile Organics

All semivolatile organics data generated for this project have been determined acceptable for use with the following exceptions and qualifications:

All negative acid results for the following samples have been qualified as unuseable due to surrogate recoveries of less than 10% (R flag):

14398-5
14398-15

All base/neutral results for the following samples have been qualified as estimated due to extraction outside the specified holding time (E flag):

14398-4
14398-5
14398-15

Bis(2-ethylhexyl)phthalate results for the following samples have been qualified due to method blank contamination (B flag):

14398-4
14398-5
14398-15

Completeness

Completeness represents the percentage of generated data points deemed fully useable for intended purposes. A project goal of 80% completeness was set; the laboratory goal was 90% completeness.

There is no universally accepted method for measuring completeness. Two reasonable approaches are:

A) Compare the quantity of unuseable data points (those flagged "R") to the quantity of data points generated overall on submitted samples. By this approach, 30 points of 1883 have been "R" flagged, for a completeness percentage of 98.4.

B) More stringently, compare the quantity of qualified data points (those flagged "R", "E" and "B") to the quantity of data points generated overall on submitted samples. For this project, 267 points of 1883 have been so flagged (including those which are double-flagged), for a completeness percentage of 85.8.

By either approach, project goals for completeness have been achieved.

Metals
(Methods LX WM1 / SW 6010)

This section provides an evaluation of the metals* data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency & Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

*Includes Lead and Zinc.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies daily instrument calibration for ICP analysis. It also specifies that a calibration blank and at least one standard must be used in establishing an analytical curve for ICP analysis. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results must fall within 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). A blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For ICP analyses, the continuing calibration results must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. One method blank was prepared with each batch for a total of 2 blanks. No target compounds were detected in the blanks with the following exception:

Blank ID	Compound	Concentration
B0213ICPW01	Zinc	0.001 mg/l

Per Functional Guidelines, if the blank concentration is less than the CRDL, no corrective action is required. In addition, if the blank concentration is above the CRDL, the concentration of the least concentrated associated sample must be 10 times the blank concentration or the results must be qualified. Laucks Testing Laboratories utilizes the "B" flag to indicate the compound was detected in both the sample(s) and the associated blank. All samples associated with the method blank have been flagged "B" per the aforementioned criteria, regardless of the sample concentration. In addition, the results have been "E" flagged as an estimate, as the sample was not redigested or reanalyzed.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within the established control limits of 80-120%.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery values were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for evaluating matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within control limits specified in the project Work Order.

Instrument Quality Control:

ICP Interference Check Sample - Functional Guidelines specifies ICP interference check samples must be run at the beginning and end of each sample analysis run or, at minimum, twice per 8 hour shift, whichever is more frequent. It further specifies the check sample results must be within +/- 20% of the established mean value.

Interference check sample results for all analysis dates met criteria specified in Functional Guidelines.

In addition, a standard at the CRDL concentration must be analyzed and all compounds must be detected.

All compounds were detected in the CRDL standard for all analysis dates.

Serial Dilutions - Functional Guidelines specifies that, for ICP analysis, one sample from a group of samples with a similar matrix or a group of 20 samples, whichever is more frequent, must undergo at least one serial dilution. The difference between the original and diluted sample cannot exceed 10%.

One serial dilution was performed. All results were in control with the following exception:

Sample	Compound	Initial	Dilution	% Difference
14398-7	Lead	.065 mg/l	.235 mg/l	113

Serial dilution samples were analyzed at a 5X dilution. U.S.E.P.A Contract Laboratory Program, Statement of Work for Inorganics Analysis specifies that initial and serial dilution results must agree within 10% if the analyte concentration is minimally a factor of 50 above the instrumental detection limit (IDL) in the original sample. Functional Guidelines specifies that the 10% criteria apply only if the analyte concentration is minimally a factor of 10 above the IDL after dilution. Both criteria represent the same concept. By either criteria, all diluted and undiluted sample results were below the minimum concentration factors, so the 10% criteria does not apply. No corrective action or data qualification is required.

Sample Result Verification:

Functional Guidelines specifies that data reduction, reporting and documentation is to be performed in accordance with the appropriate Statement of Work. Detection limits are detailed in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits were acceptable per criteria specified in the project Work Order.

Other QC Issues:

None.

Arsenic
(Methods LX WM2 / SW 7060 and LX WM3 / SW 7061))

This section provides an evaluation of arsenic data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses, U.S.E.P.A., Office of Emergency and Remedial Response, undated, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that nitric acid preserved water samples must be digested and analyzed within 180 days of sample collection.

All samples were digested and analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

Calibration:

Functional Guidelines specifies the daily instrument calibration for Atomic Absorption (AA) analysis. It also specifies that a calibration blank and at least three standards must be used in establishing an analytical curve for AA analyses. Functional Guidelines further specifies the initial calibration shall be verified using EPA Quality Control Solutions or an independent standard at a concentration other than that used for initial calibration, but still within the calibration range. In addition, initial calibration verification results for arsenic must fall within 90-110% of the true value.

For continuing calibration verification, Functional Guidelines specifies that continuing calibration checks and calibration blanks must be analyzed at a minimum frequency of 10% or every two hours during the analysis, whichever is more frequent. The calibration blank result must be less than the Contract Required Detection Limit (CRDL). A blank and calibration check must also be analyzed after the last analytical sample. It further specifies that continuing calibration checks must be performed at or near the mid-range level of the curve using one of the following standards: EPA QC, Standard Reference Materials or a contractor prepared standard prepared from a source other than that used for initial calibration standards. For AA analyses, the continuing calibration results for arsenic must fall within 90-110% of the true value.

Initial and continuing calibrations for all analysis dates met all criteria specified in Functional Guidelines.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). It further specifies that one blank must be prepared for every 20 samples or batch of samples, whichever is more frequent. Should a compound be detected in the blank, no action is required if the concentration is below the CRDL. If a compound is detected in the blank at a level greater than the CRDL, for any group of samples associated with that blank, the concentration of the sample with the least concentrated analyte must be 10 times the blank concentration or all associated samples that are less than 10 times the blank concentration must be redigested and reanalyzed.

Samples were batched for analytical purposes. One method blank was prepared with each sample batch. . No target compounds were detected in the blanks.

Laboratory Control:

Functional Guidelines specifies one aqueous Laboratory Control Standard (LCS) shall be analyzed for each sample digestion batch or 20 samples, whichever is more frequent. The aqueous LCS must be an EPA QC solution or a standard that meets internal calibration standard criteria. It further specifies that aqueous LCS results must fall within 80-120% of the true value.

All laboratory control standard results were within control limits specified in Functional Guidelines.

Matrix Spike:

Functional Guidelines specifies at least one matrix spike shall be performed for each group of similar matrix samples or for each 20 samples received, whichever is more frequent. Field blanks cannot be used for matrix spikes. Functional Guidelines further specifies that the spike must be added prior to digestion and that the spike recovery must be within the control limits of 75-125%. The project Work Order details the same matrix spike recovery control limits in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within control limits specified in Functional Guidelines and the project Work Order.

Matrix Spike Duplicate/Triplicate:

Functional Guidelines does not specify any criteria for the evaluation of matrix spike duplicates and triplicates. The project Work Order specifies the Relative Percent Difference (RPD) between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results cannot exceed the control limits set forth in the project Work Order. The required limits are detailed in Table 3, "Control Limits", attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recovery results were within control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines does not explicitly specify criteria for evaluating Atomic Absorption (AA) instrument performance. Per the U.S.E.P.A. Contract Laboratory Program, Statement of Work for Inorganic Analysis, one atomic absorption standard at the CRDL concentration must be analyzed. All compounds must be detected in the CRDL standard. This guideline was applied to all AA analyses performed under the project Work Order.

CRDL criteria were met for all analysis dates.

Furnace Atomic Absorption Quality Control:

Functional Guidelines specifies that duplicate injections are required for all furnace analyses except during analysis by Methods of Standard Addition. It further specifies that, for each sample, a minimum of one analytical spike shall be analyzed. The analytical spike recovery should fall between the limits of 85-115%.

All analytical spikes were within the required limits.

Sample Result Verification:

Functional Guidelines specifies that all data reduction, reporting and documentation must be performed in accordance with the appropriate Statement of Work. The project Work Order details detection limits in Table 2, "Detection Limit Goals", attached herein as Appendix A.

All reported results and detection limits are acceptable based on criteria set forth in the project Work Order.

Other QC Issues:

None.

Volatile Organic Compounds
(Method SW 8240)

This section provides an evaluation of the volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Time:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be analyzed within 7 days of sample collection.

All volatile organics samples were analyzed within the prescribed holding times specified in Functional Guidelines and the project Work Order.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria have been established to ensure mass resolution, identification and, to some degree, sensitivity. It defines both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Bromofluorobenzene (BFB), as shown in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05. Per Laucks Testing Laboratories' internal QA procedures, and U.S.E.P.A.'s Statement of Work for the Contract Laboratory Program, these must be greater than or equal to 0.300, with the exception of bromoform, which must be greater than or equal to 0.250. These criteria are more stringent than those in Functional Guidelines.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in

Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in both Functional Guidelines and Laucks Testing Laboratories' internal quality assurance procedures.

Method Blank:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: methylene chloride, acetone, toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was analyzed with each sample batch, for a total of 2 method blanks. No target compounds were detected in either method blank.

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project Work Order details the surrogate recovery criteria for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if one volatile surrogate is outside established control limits, or if one volatile surrogate has a recovery of less than 10%, then reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

Surrogate recovery values for all samples and blanks were within control limits specified in the project Work Order.

Matrix Spikes:

Functional Guidelines specifies that all spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details the matrix spike recoveries for volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recoveries were within the control limits specified in the project Work Order with the following exception:

Sample	Compound	% Recovery	Limits
14398-4MS	Trichloroethene	122	71-120

Per the project Work Order, matrix effect can be documented by sample reanalysis. Sample 14398-4MS was reanalyzed and all spike recoveries were within the specified control limits. No further corrective action required.

Matrix Spike Duplicates/Triplicates:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike and matrix spike duplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order with the following exceptions:

Sample	Compound	MS	MSD/T	RPD	Limits
14398-4MS/MSD	Trichloroethene	122	112	9	0- 7
14398-4MS/MSD	Benzene	85	78	9	0- 8
14398-4MS/MSDRE	1,1-Dichloroethene	107	126	16	0- 7
14398-4MS/MSDRE	Trichloroethene	91	115	23	0- 7
14398-4MS/MSDRE	Toluene	77	89	15	0-13
14398-4MS/MSDRE	Chlorobenzene	84	95	12	0- 8
14398-4MS/MSTRE	1,1-Dichloroethene	107	130	19	0- 7
14398-4MS/MSTRE	Trichloroethene	91	114	22	0- 7
14398-4MS/MSTRE	Toluene	77	94	20	0-13
14398-4MS/MSTRE	Chlorobenzene	84	100	18	0- 8

Per the project Work Order, matrix effect can be documented by sample reanalysis. Should RPDs remain outside established control limits, no further corrective action is required. Samples 14398-4MS and 14398-4MSD were reanalyzed. RPD values between samples 14398-4MS and 14398-4MSD remained outside the control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action is required.

RPD values between 14398-4MS and 14398-4MST in the initial analysis were within the specified control limits. Although not required, 14398-4MST was reanalyzed in addition to 14398-4MS and 14398-4MSD. Upon reanalysis, RPD values between 14398-4MS and 14398-4MST were outside the control limits. As all matrix spike recoveries were within the control limits and all initial RPDs were in control, the out-of-control RPD values should be considered an anomaly; no further corrective action taken.

Functional Guidelines specifies that no action is taken on matrix spike/matrix spike duplicate/matrix spike triplicate data alone to qualify an entire case. Functional Guidelines further specifies that if it can be determined that the results of the MS/MSD/MST affect only the sample spiked, qualification should be limited to that sample alone. It does not specify the manner in which data should be qualified. Laucks Testing Laboratories has chosen to qualify as estimated the data for all associated compounds in all associated samples when QC sample results are outside RPD control limits, using the "E" flag. All associated results have been flagged "E" to indicate the results are estimates due to RPDs outside control limits. Results associated with the out-of-control RPDs between 14398-4MS and 14398-4MST were not qualified since the original analysis was in control and reanalysis, although performed, was not required.

Instrument Quality Control:

Functional Guidelines specifies that internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. It further specifies that the retention time of the internal standard must not vary by more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met the identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", and attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

<u>Other QC Issues</u>:

None.

Semi-Volatile Organic Compounds
(Methods SW 3510 / SW 8270)

This section provides an evaluation of the semi-volatile organic compounds data by criteria found in Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988, and criteria specified in the Work Order between Hart Crowser, Inc. and Laucks Testing Laboratories, Inc., dated July 7, 1988. Samples were batched for analytical and reporting purposes and data validation remarks are similarly appropriate to the batch.

Sample Holding Times:

The project Work Order and Functional Guidelines each specify that unpreserved water samples must be extracted within 7 days and analyzed within 40 days of sample collection.

All samples were extracted and analyzed within the holding times specified in Functional Guidelines with the following exceptions:

Sample	Date Sampled	Date Extracted	Reason
14398-4	2/9/89	2/20/89	Reextraction required
14398-5	2/9/89	2/20/89	Reextraction required
14398-15	2/8/89	2/22/89	Reextraction required

Samples 14398-4 and 14398-5 were reextracted due to low surrogate recoveries in the initial extraction. Sample 14398-15 was reextracted due to a laboratory accident involving the original extract. Functional Guidelines specifies that, should sample holding times be exceeded, all results should be flagged as estimated. Following these guidelines, all results for the above-referenced samples have been flagged "E" to indicate the results are estimated due to extraction outside the specified holding time.

GC/MS Tuning:

Functional Guidelines specifies that tuning and performance criteria are established to ensure mass resolution, identification, and, to some degree, sensitivity. It details both basic and expanded (appropriate under some circumstances) ion abundance criteria for tuning of the mass spectrometer with Decafluorotriphenylphosphine (DFTPP), as detailed in Appendix C.

Basic ion abundance criteria specified in Functional Guidelines were met for all analysis dates.

Calibration:

Following Functional Guidelines, the Percent Relative Standard Deviation (%RSD) for the Calibration Check Compounds (CCCs) in the Initial Calibration cannot exceed 30%. The Percent Difference (%D) between the response factor for the continuing calibration standard and the Initial Calibration cannot exceed 25%.

For calibration, the mass spectrometer monitors the average RRFs for the system performance check compounds (SPCCs). Per Functional Guidelines, these must be equal to or greater than 0.05.

Initial and continuing calibrations for all analysis dates met Percent Relative Standard Deviation and Percent Difference criteria as specified in Functional Guidelines. In addition, system performance check compounds for all analysis dates met criteria set forth in Functional Guidelines.

Method Blanks:

Functional Guidelines specifies that no contaminants should be present in the blank(s). Should a compound be detected in the blank, no action is taken unless the compound is also detected in the sample(s). If a common laboratory contaminant is detected in both the sample and the associated blank, the results are qualified by elevating the detection limit when the sample concentration is less than 10 times the blank concentration. Compounds considered to be common laboratory contaminants are: methylene chloride, acetone, toluene, 2-butanone and common phthalate esters. Should a compound other than a common contaminant be detected in the sample and associated blank, the results must be qualified when the sample concentration is less than 5 times the blank concentration.

Samples were batched for analytical purposes. One method blank was prepared with each batch for a total of five blanks. No target analytes were detected in the blanks with the following exception:

Sample	Compound	Concentration
B0220MSVWLI	Bis(2-ethylhexyl)phthalate	4.0 ug/l
B0222MSVWLK	Bis(2-ethylhexyl)phthalate	3.0 ug/l

Functional Guidelines specifies that when a common laboratory contaminant is detected in both the sample(s) and the blank, results must be qualified when the sample concentration is less than 10 times the blank concentration. Compound concentrations in the associated samples were less than 10 times the blank concentration. All reported results for Bis(2-ethylhexyl)phthalate in the samples of concern have been flagged "B" to indicate the analyte of interest was detected in both the method blank and associated sample(s).

Surrogates:

Functional Guidelines specifies that sample and blank surrogate recoveries must be within limits as per the applicable Statement of Work. The project

Work Order details the surrogate recovery criteria for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

Functional Guidelines further specifies that if two base/neutral or acid surrogates are outside established control limits, or if one base/neutral or acid surrogate has a recovery of less than 10%, reanalysis should be performed. It also acknowledges that the sample itself may produce interference effects that are outside laboratory control. The project Work Order specifies that matrix effect should be documented by sample reanalysis. Should recoveries remain outside the established control limits, no further corrective action is required.

All surrogate recoveries were within the established control limits with the following exceptions:

Sample	Compound	% Recovery	Limits	Comments
14398-1	2-Fluorophenol	17	18-75	(1)
14398-1	d5-Nitrobenzene	38	45-105	(1)
14398-4	2-Fluorophenol	16	18-75	(2)
14398-4	d5-Phenol	13	15-49	(2)
14398-4	2-Bromophenol	34	36-113	(2)
14398-5	2-Fluorophenol	0	18-75	(3)
14398-5	d5-Phenol	0	15-49	(3)
14398-5	2-Bromophenol	0	36-113	(3)
14398-5	d5-Nitrobenzene	0	45-105	(3)
14398-5	2-Fluorobiphenyl	0	44-100	(3)
14398-5	d10-Azobenzene	0	48-116	(3)
14398-5	2,4,6-Tribromophenol	0	26-122	(3)
14398-5	d14-p-Terphenyl	0	33-141	(3)
14398-5RE	2-Fluorophenol	3	18-75	(3) (4)
14398-5RE	d5-Phenol	2	15-49	(3) (4)
14398-5RE	2-Bromophenol	3	36-113	(3) (4)
14398-5RE	2,4,6-Tribromophenol	6	26-122	(3) (4)
14398-15	2-Fluorophenol	7	18-75	(3)
14398-15	d5-Phenol	5	15-49	(3)
14398-15	2-Bromophenol	20	36-113	(3)
14398-15	2,4,6-Tribromophenol	22	26-122	(3)
14398-15RE	2-Fluorophenol	10	18-75	(3) (4)
14398-15RE	d5-Phenol	8	15-49	(3) (4)
14398-15RE	2-Bromophenol	26	36-113	(3) (4)
14398-15RE	2,4,6-Tribromophenol	22	26-122	(3) (4)
14398-18	d5-Nitrobenzene	40	45-105	(1)

(1) Per Functional Guidelines and the project Work Order, one acid and/or one base/neutral surrogate recovery may be outside the control limits and the analysis be considered in control. No corrective action required.

(2) Per the project Work Order, matrix effect is documented through sample reanalysis. As surrogate recoveries in the initial analysis were outside the

control limits, the sample was reanalyzed. Upon reanalysis, all surrogate recoveries were within the required control limits. No further corrective action required.

(3) Per the project Work Order, matrix effect is documented through sample reanalysis. Should recoveries remain outside established control limits, no further corrective action is required. The sample was reanalyzed (identified as "RE") with surrogates remaining outside the control limits. These results document matrix effect and are not indicative of laboratory error. No further corrective action required.

(4) Functional Guidelines specifies that, if at least two acid or base/neutral surrogate recoveries are outside the control limits but above 10%, all results in that acid or base/neutral fraction should be qualified as estimated. It further specifies that, if any surrogate in an acid or base/neutral fraction shows less than 10% recovery, all positive results for that fraction should be flagged as estimated and all negative results should be flagged as unuseable. Acid surrogate recovery value(s) of less than 10% were reported. No positive acid results were reported. In accordance with Functional Guidelines, negative results have been flagged "R" to indicate the results are unuseable due to surrogate recoveries of less than 10%.

Matrix Spikes:

Functional Guidelines specifies that all matrix spike recoveries must be within the advisory limits established in the appropriate document governing the work. The project Work Order details matrix spike/matrix spike duplicate/matrix spike triplicate control limits for semi-volatile organics analysis in Table 3, "Control Limits", attached herein as Appendix B.

All matrix spike/matrix spike duplicate/matrix spike triplicate recovery results were within the control limits set forth in the project Work Order.

Matrix Spike Duplicates/Triplicates:

Functional Guidelines specifies that Relative Percent Differences (RPDs) between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within advisory limits in the appropriate document governing the work. The project Work Order specifies that all RPDs between matrix spike/matrix spike duplicate/matrix spike triplicate recoveries must be within the limits set forth in the project Work Order, detailed in Table 3, "Control Limits", and attached herein as Appendix B.

All RPD values between matrix spike/matrix spike duplicate and matrix spike/matrix spike triplicate recoveries were within the control limits set forth in the project Work Order.

Instrument Quality Control:

Functional Guidelines specifies internal standard area counts must not vary by more than a factor of two (-50% to +100%) from the associated calibration standard. In addition, the retention time of the internal standard must not vary more than +/- 30 seconds from the associated calibration standard.

Instrument quality control procedures for all analysis dates met criteria set forth in Functional Guidelines.

Sample Result Verification:

Compound Identification - Functional Guidelines specifies that each compound must be within +/- 0.06 relative retention time (RRT) units of the standard RRT. It also specifies, for any sample compound, all ions present in the standard mass spectrum at a relative intensity greater than 10% must be present in the sample spectrum. Additionally, the difference of the ion relative intensities between the sample and standard spectra cannot exceed 20% and all ions greater than 10% in the sample spectrum but not present in the standard spectrum must be addressed.

Reported compounds in all samples met identification criteria set forth in Functional Guidelines.

Compound Quantitation - Functional Guidelines specifies that compound quantitation and adjustment of the CRQL must be calculated as per the applicable Statement of Work. The project Work Order details detection limit criteria in Table 2, "Detection Limit Goals", attached herein as Appendix A.

Reported compounds in all samples were correctly quantified. Detection limits for all samples met criteria specified in the project Work Order.

Other QC Issues:

None.

APPENDIX A
TABLE 2
(page 1)
DETECTION LIMIT GOALS

	WATER		SOIL	
TEST	MDL	CRDL	MDL (% AR)	CRDL (% AR)
Total Solids	NR	NR	0.1	0.1
TEST	(mg/l)	(mg/l)	(mg/kg DB)	(mg/kg DB)
Petroleum Hydrocarbons (O & G)	0.1	0.1	20	20
TOTAL METALS:	(mg/l)	(mg/l)		
Copper	NR	NR	1	1
Nickel	NR	NR	2	2
Cadmium	NR	NR	0.5	0.5
Lead	NR	NR	5	5
Chromium	NR	NR	1	1
Zinc	NR	NR	1	1
Arsenic	NR	NR	0.5	0.5
TEST DISSOLVED METALS:	(mg/l)	(mg/l)		
Copper	0.001	0.001	NR	NR
Nickel	0.002	0.002	NR	NR
Lead	0.005	0.005	NR	NR
Chromium	0.001	0.001	NR	NR
Zinc	0.001	0.001	NR	NR
Arsenic	0.005	0.005	NR	NR
TEST EP TOXICITY METALS:			(mg/l)	(mg/l)
Copper	NR	NR	0.1	0.1
Nickel	NR	NR	0.1	0.1
Cadmium	NR	NR	0.01	0.01
Lead	NR	NR	0.1	0.1
Chromium	NR	NR	0.1	0.1
Zinc	NR	NR	0.1	0.1
Arsenic	NR	NR	0.2	0.2

NR = analysis for this analyte in this matrix is Not Required
MDL = Method Detection Limit

APPENDIX A
TABLE 2
(page 2)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/FID Screen, calculated as Phenanthrene	400	400	10 000	10 000
PCB's:				
Aroclor-1016	0.5	0.5	33	33
Aroclor-1221	0.5	0.5	33	33
Aroclor-1232	0.5	0.5	33	33
Aroclor-1242	0.5	0.5	33	33
Aroclor-1248	0.5	0.5	33	33
Aroclor-1254	1	1	67	67
Aroclor-1260	1	1	67	67

TEST	(ug/l)	(ug/l)	(ug/kg DB)	(ug/kg DB)
GC/MS EXTRACTABLES:				
Phenol	2	2	33	33
Aniline	10	10	170	170
Bis(2-chloroethyl)ether	2	2	33	33
2-Chlorophenol	2	2	33	33
1,3-Dichlorobenzene	2	2	33	33
1,4-Dichlorobenzene	2	2	33	33
Benzyl alcohol	2	2	33	33
1,2-Dichlorobenzene	2	2	33	33
2-Methylphenol	2	2	33	33
Bis(2-chloroisopropyl)ether	2	2	33	33
4-Methylphenol	2	2	33	33
N-Nitroso-di-n-propylamine	2	2	33	33
Hexachloroethane	4	4	67	67
Nitrobenzene	2	2	33	33
Isophorone	2	2	33	33
2-Nitrophenol	4	4	67	67
2,4-Dimethylphenol	2	2	33	33
Benzoic Acid	50	50	830	830
Bis(2-chloroethoxy)methane	2	2	33	33
2,4-Dichlorophenol	4	4	67	67
1,2,4-Trichlorobenzene	2	2	33	33
Naphthalene	4	4	67	67
4-Chloroaniline	2	2	33	33
Hexachlorobutadiene	2	2	33	33
4-Chloro-3-methylphenol	4	4	67	67
2-Methylnaphthalene	2	2	33	33
Hexachlorocyclopentadiene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 3)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS EXTRACTABLES(cont):				
2,4,6-Trichlorophenol	4	4	67	67
2,4,5-Trichlorophenol	4	4	67	67
2-Chloronaphthalene	2	2	33	33
2-Nitroaniline	4	4	67	67
Dimethyl phthalate	2	2	33	33
Acenaphthylene	2	2	33	33
2,6-Dinitrotoluene	4	4	67	67
3-Nitroaniline	10	10	170	170
Acenaphthene	2	2	33	33
2,4-Dinitrophenol	20	20	330	330
4-Nitrophenol	20	20	330	330
Dibenzofuran	2	2	33	33
2,4-Dinitrotoluene	4	4	67	67
Diethyl phthalate	2	2	33	33
4-Chlorophenyl phenylether	2	2	33	33
Fluorene	2	2	33	33
4-Nitroaniline	4	4	67	67
4,6-Dinitro-2-methylphenol	20	20	330	330
N-Nitrosodiphenylamine	1	1	33	33
1,2-Diphenylhydrazine	4	4	67	67
4-Bromophenyl phenylether	4	4	67	67
Hexachlorobenzene	2	2	33	33
Pentachlorophenol	20	20	330	330
Phenanthrene	2	2	33	33
Anthracene	2	2	33	33
Di-n-butyl phthalate	2	2	33	33
Fluoranthene	2	2	33	33
Pyrene	2	2	33	33
Benzidine	50	50	830	830
Butylbenzylphthalate	2	2	33	33
3,3'-Dichlorobenzidine	20	20	330	330
Benzo(a)anthracene	2	2	33	33
Chrysene	2	2	33	33
Bis(2-ethylhexyl)phthalate	2	2	33	33
Di-n-octyl phthalate	2	2	33	33
Benzo(b)fluoranthene	4	4	67	67
Benzo(k)fluoranthene	4	4	67	67
Benzo(a)pyrene	4	4	67	67
Indeno(1,2,3-cd)pyrene	4	4	67	67
Dibenzo(a,h)anthracene	4	4	67	67
Benzo(g,h,i)perylene	4	4	67	67

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 4)
DETECTION LIMIT GOALS

TEST	WATER MDL (ug/l)	WATER CRDL (ug/l)	SOIL MDL (ug/kg DB)	SOIL CRDL (ug/kg DB)
GC/MS VOLATILES:				
Chloromethane	1	1	2	2
Bromomethane	1	1	2	2
Vinyl Chloride	1	1	2	2
Chloroethane	3	3	6	6
Methylene Chloride	1	1	2	2
Acetone	5	5	10	10
Carbon Disulfide	1	1	2	2
1,1-Dichloroethene	1	1	2	2
1,1-Dichloroethane	1	1	2	2
trans-1,2-Dichloroethene	1	1	2	2
cis-1,2-Dichloroethene	1	1	2	2
total-1,2-Dichloroethene	1	1	2	2
Chloroform	1	1	2	2
2-Butanone	3	3	6	6
1,2-Dichloroethane	1	1	2	2
1,1,1-Trichloroethane	1	1	2	2
Carbon Tetrachloride	1	1	2	2
Vinyl Acetate	1	1	2	2
Bromodichloromethane	1	1	2	2
1,2-Dichloropropane	1	1	2	2
Trichloroethene	1	1	2	2
Benzene	1	1	2	2
Dibromochloromethane	3	3	6	6
1,1,2-Trichloroethane	1	1	2	2
Bromoform	1	1	2	2
4-Methyl-2-Pentanone	3	3	6	6
2-Hexanone	3	3	6	6
1,1,2,2-Tetrachloroethane	3	3	6	6
Tetrachloroethene	1	1	2	2
Toluene	1	1	2	2
Chlorobenzene	3	3	6	6
trans-1,3-Dichloropropene	3	3	6	6
Ethylbenzene	1	1	2	2
cis-1,3-Dichloropropene	3	3	6	6
Styrene	1	1	2	2
Total Xylenes	1	1	2	2

MDL = Method Detection Limit
CRDL = Contract Recommended Detection Limit

APPENDIX A
TABLE 2
(page 5)
DETECTION LIMIT GOALS

COMMENTS:

Actual reported Sample Detection Limits (SDLs) may vary from the target detection limits listed herein. There are several circumstances which can result in SDLs which are elevated above the CRDLs.
Typically, these are:

1) Insufficient sample volume submitted to perform preparation according to established methodology.

2) Dilution of a sample extract or digest for reasons of matrix interference or to bring another compound of interest within linear range.

3) Extraction of the sample at the "medium" or "high" levels, rather than a typical "low" level extraction. This involves employing a smaller sample size and is a decision made on visual appearance of the sample and/or odor.

In addition, it should be noted that the limits of detection shown for soil analysis have been normalized to reflect a total solids value of 100%. In fact, soil samples will generally have total solids of 75-80% and SDLs will be correspondingly increased.

APPENDIX B
TABLE 3
(page 1)
CONTROL LIMITS
(Matrix Spike/Matrix Spike Duplicate/Matrix Spike Triplicate)

	WATER		SOIL	
TEST	% Recovery	RPD	% Recovery	RPD
Petroleum Hydrocarbons (O & G)	74-126	0-11	82-114	0-13
TOTAL METALS:				
Copper	75-125*	0-7	75-125*	0-5
Nickel	75-125*	0-5	75-125*	0-6
Cadmium	75-125*	0-5	75-125*	0-7
Lead	75-125*	0-7	75-125*	0-6
Chromium	75-125*	0-6	75-125*	0-8
Zinc	75-125*	0-6	75-125*	0-5
Arsenic	75-125*	0-7	69-118	0-8
(water control limits apply to EP Toxicity Metals)				
GC/FID Screen, calculated as Phenanthrene	@	@	@	@
PCBs:				
Aroclor 1260	20-150#	0-30#	20-150#	0-41#
GC/MS EXTRACTABLES:				
Phenol	16-72	0-18	39-95	0-13
2-Chlorophenol	31-122	0-15	25-102*	0-15
1,4-Dichlorobenzene	36-97*	0-16	38-103	0-10
N-Nitroso-di-n-propylamine	41-116*	0-17	41-126*	0-16
1,2,4-Trichlorobenzene	50-105	0-14	43-110	0-9
4-Chloro-3-methylphenol	46-108	0-11	47-113	0-11
Acenaphthylene	44-110	0-12	45-116	0-8
4-Nitrophenol	10-78	0-21	11-114*	0-13
2,4-Dinitrotoluene	43-109	0-15	28-89*	0-9
Pentachlorophenol	35-120	0-11	17-109*	0-26
Pyrene	26-127*	0-11	23-115	0-11
GC/MS VOLATILES:				
1,1-Dichloroethane	53-131	0-7	59-129	0-8
Trichloroethene	71-120*	0-7	76-145	0-9
Benzene	76-127*	0-8	66-142*	0-9
Toluene	76-125*	0-13	59-139*	0-8
Chlorobenzene	73-128	0-8	68-139	0-7

= This is an estimated limit and is not based on experimentally derived data.

APPENDIX B
TABLE 3
(page 2)
CONTROL LIMITS
(Surrogate Spike)

TEST	WATER % Recovery	SOIL % Recovery
GC/FID Screen, calculated as Phenanthrene	@	@
PCBs:		
Dibutylchlorendate	43-152	24-154
Isodrin	32-96	20-112
GC/MS EXTRACTABLES:		
2-Fluorophenol	18-75	30-99
d5-Phenol	15-49	27-105
2-Bromophenol	36-113	30-107
d5-Nitrobenzene	45-105	45-100
2-Fluorobiphenyl	44-100	54-103
d10-Azobenzene	48-116	34-123
2,4,6-Tribromophenol	26-122	19-122*
d14-p-Terphenyl	33-141*	29-130
GC/MS VOLATILES:		
d4-1,2-Dichloroethane	79-116	74-125
d8-Toluene	88-110*	81-117*
p-Bromofluorobenzene	86-115*	75-115

* = EPA Control Limits (all others are Laucks in-house)

@ = Addition of spiking and/or surrogate compounds to an extract of what is anticipated to be a contaminated sample prepared for screening analysis is not meaningful. The spiking and/or surrogate compounds will interfere with, and most probably enhance, sample results. Therefore, the laboratory will perform duplicate and triplicate sample analyses on one per twenty (or one per batch, if fewer than twenty) screens, with an RPD goal of 30% between the replicates.

APPENDIX B
TABLE 3
(page 3)
CONTROL LIMITS

COMMENTS:

Where a recovery exceeds the upper control limit, and that control limit was <100%, the recovery will be deemed in control to an upper limit of 120%.

In the case of GC/MS extractables up to two surrogates (one acid and/or one base/neutral compound) may be out of control and the analysis be deemed in control, with no requirement for re-analysis.

In the case of the PCB analysis, dibutylchlorendate (DBC) is the CLP surrogate and isodrin is a second surrogate added at Laucks' discretion. Should isodrin recovery be outside control limits, the analysis is deemed in control as long as DBC is in control.

COMPLETENESS:

Laboratory goal is 90% completeness. Matrix effect is documented through performance of a re-analysis. Should recoveries or RPDs remain out of control, no further corrective action is required. If data are 90% complete, outliers are regarded as anomalies.

APPENDIX C
Tuning and Performance Criteria

Decafluorotriphenylphosphine (DFTPP)

m/z	Ion Abundance Criteria
51	30.0 - 60.0% of m/z 198
68	less than 2.0% of m/z 69
70	less than 2.0% of m/z 69
127	40.0 - 60.0% of m/z 198
197	less than 1.0% of m/z 198
198	base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198
365	greater than 1.00% of m/z 198
441	present, but less than m/z 443
442	greater than 40.0% of m/z 198
443	17.0 - 23.0% of m/z 442

Bromofluorobenzene (BFB)

m/z	Ion Abundance Criteria
50	15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak
95	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak
173	less than 2.0% of m/z 174
174	greater than 50.0% of the base peak
175	5.0 - 9.0% of m/z 174
176	greater than 95.0%, but less than 101.0% of m/z 174
177	5.0 - 9.0% of m/z 176

Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analyses, Hazardous Site Evaluation Division, U.S.E.P.A., February 1, 1988.

APPENDIX G
SELECTED SOIL QUALITY DATA

CONTENTS

TOTAL METALS DATA

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
T13/HT01	2	15	14	< 0.5	< 5	13	35	3.1	80.1
A7/HT01	2	14	29	< 0.5	< 5	26	32	2.7	103.7
T11/HB01	1	17	9	< 0.5	20	21	21	18	106
T5/HB01	0.4	34	8	< 0.5	6	14	29	15	106
C7/HT01	1.5	15	32	< 0.5	< 5	27	33	2.3	109.3
T8/HB01	1.2	18	27	< 0.5	< 5	24	41	2.9	112.9
V1/HB01	0.3	17	27	< 0.5	7	23	47	2.7	123.7
M3/HT01	2	62	8	< 0.5	21	10	37	3.4	141.4
W11/HB01	2	24	30	< 0.5	< 5	34	56	4.8	148.8
S2/HB01	1.2	29	27	< 0.5	9	30	60	3.3	158.3
S5/HB01	0.1	32	14	< 0.5	18	16	66	14	160
H13/HT01	2	22	43	< 0.5	5	44	48	4.4	166.4
B13/HB01	0.2	22	50	0.7	< 5	46	48	3.8	170.5
L12/HT01	2	27	41	< 0.5	< 5	43	57	4.8	172.8
M6/HB01	0.6	55	26	< 0.5	9	20	60	2.9	172.9
A12/HB01	0.2	22	57	< 0.5	< 5	54	44	5.2	182.2
F8/HT01	2	24	36	< 0.5	10	46	60	6.9	182.9
V5/HB01	0.2	39	21	< 0.5	39	23	59	5.8	186.8
C12/HT01	2	40	43	< 0.5	11	43	59	5.9	201.9
L3/HT01	2	96	8	< 0.5	42	9	47	2	204
Q3/HB01	0.5	40	37	< 0.5	23	34	72	5.3	211.3
U3/HB01	0	39	28	< 0.5	40	29	72	16	224
H7/HT01	1	38	13	1.2	29	26	79	56	242.2
I3/HB01	0.5	39	7	< 0.5	110	28	44	20	248
N1/HB01	0.6	110	31	0.6	40	28	59	4.7	273.3
W3/HB01	0.2	35	27	< 0.5	100	59	61	5.2	287.2
R4/HB01	0.5	71	34	0.6	120	22	81	6.1	334.7
R9/HB01	0.4	48	16	0.8	140	17	120	4.1	345.9
D11/HT01	1.5	63	39	0.7	59	56	120	39	376.7
Q8/HB01	1	92	23	< 0.5	92	14	160	17	398
R6/HB01	0.2	60	23	0.9	140	18	110	58	409.9
H5/HB01	0.3	37	22	< 0.5	220	32	110	6	427
O4/HB01	1.5	64	19	0.8	240	13	120	4.2	461

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
K11/HT01	2	40	4	0.5	350	8	80	18	500.5
R7/HB01	0.6	62	20	< 0.5	340	18	57	6.2	503.2
G9/HB01	0.7	110	21	< 0.5	190	22	170	12	525
G6/HB01	0.1	50	21	< 0.5	310	27	130	5.6	543.6
P2/HB01	1.9	77	20	0.6	290	21	130	6.3	544.9
E6/HT01	2	270	34	0.7	47	41	180	4.8	577.5
J4/HT01	2	84	27	< 0.5	210	36	230	24	611
U7/HT01	1	100	21	< 0.5	170	28	290	12	621
J6/HB01	0.5	260	42	< 0.5	180	41	130	15	668
P6/HB01	0.5	84	23	0.8	100	19	460	9.1	695.9
L9/HB01	0.5	35	21	1	440	24	180	5.5	706.5
K5/HB01	0.5	470	41	< 0.5	57	56	81	3.8	708.8
H8/HB01	0.9	81	30	< 0.5	320	43	180	180	834
P7/HB01	0.7	120	37	1.1	280	12	520	15	985.1
O6/HB01	0.5	90	43	0.8	550	29	280	14	1006.8
L7/HB01	0.6	97	24	2.8	610	44	290	23	1090.8
V9/HB01	0.6	170	32	7.9	580	44	220	100	1153.9
H1/HT01	1	420	68	1.3	230	130	310	9.2	1168.5
P10/HB01	1	46	28	< 0.5	1100	30	86	8.1	1298.1
B1/HB01	0.2	860	160	< 0.5	46	140	89	9	1304
I9/HB01	0.4	190	26	2.1	690	45	280	90	1323.1
O9/HB01	0.7	48	24	1.2	1100	33	300	4.5	1510.7
B9/HT01	2	250	39	1.9	590	56	590	66	1592.9
I11/HT01	2	1500	87	0.7	27	83	45	2.1	1744.8
J8/HB01	0.7	97	32	< 0.5	630	94	890	46	1789
M10/HB01	0.6	99	26	5.7	1100	44	480	89	1843.7
G4/HB01	0.3	1600	150	0.9	72	170	97	5.5	2095.4
E9/HB01	1.1	340	62	2.6	1300	85	1100	23	2912.6
M8/HB01	0.7	100	13	5	940	41	1700	120	2919
F1/HT01	2	530	70	7.2	870	140	1300	18	2935.2
P11/HT01	2	76	45	< 0.5	2600	15	330	7.1	3073.1
N8/HB01	0.6	220	49	8.5	1900	190	1900	110	4377.5
O2/HB01	2	120	45	1.2	79	32	4100	17	4394.2
F10/HB01	0.7	870	130	9.7	8400	220	3200	32	12861.7

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>2-4.5)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
G3/HT01	4	10	29	< 0.5	< 5	28	31	1.9	99.9
O5/HB01	2.5	9	31	< 0.5	< 5	28	31	1.5	100.5
K7/HB01	3.5	12	24	< 0.5	< 5	27	36	1.6	100.6
N7/HB01	2.5	11	31	< 0.5	< 5	29	33	1.2	105.2
W7/HB01	2.5	19	20	< 0.5	< 5	24	42	1.8	106.8
L10/HB01	2.5	12	33	< 0.5	5	25	31	1.2	107.2
L4/HT01	3.5	12	33	< 0.5	< 5	30	34	1.2	110.2
P4/HB01	2.5	14	31	< 0.5	5	27	32	1.4	110.4
A11/HT01	4	13	28	< 0.5	< 5	32	37	7.3	117.3
L6/HB01	2.5	14	28	< 0.5	< 5	28	52	1	123
T2/HB01	2.5	23	29	0.5	< 5	29	47	3.5	132
D5/HT01	4	15	32	< 0.5	< 5	38	45	3.3	133.3
N13/HT01	3	20	34	< 0.5	< 5	33	44	4.4	135.4
Q9/HB01	2.5	42	24	< 0.5	< 5	19	50	3.7	138.7
I7/HB01	2.5	23	31	< 0.5	< 5	33	49	4.1	140.1
V3/HB01	2.5	26	25	< 0.5	< 5	32	53	4.3	140.3
S8/HB01	2.5	27	26	< 0.5	< 5	34	50	3.5	140.5
O10/HB01	2.5	35	28	0.7	< 5	32	55	4.4	155.1
G7/HT01	4	28	31	< 0.5	< 5	38	53	8.9	158.9
S7/HT01	4	29	31	< 0.5	< 5	42	59	3.6	164.6
I10/HB01	2.5	29	36	< 0.5	< 5	41	60	4.1	170.1
B3/HB01	2.5	64	26	< 0.5	9	24	49	2.6	174.6
R12/HT01	3	33	6	< 0.5	53	14	59	19	184
F3/HT01	4	30	36	< 0.5	12	42	59	5.3	184.3
E11/HT01	4	75	6	0.5	5	10	71	18	185.5
H12/HT01	4	31	48	< 0.5	< 5	52	56	4.5	191.5
C13/HT01	4	31	50	< 0.5	< 5	50	59	3.9	193.9
J5/HB01	2.5	53	14	< 0.5	8	11	100	8.2	194.2
S4/HB01	2.5	35	34	< 0.5	7	46	68	4.9	194.9
I4/HB01	2.5	40	39	< 0.5	< 5	48	67	4.3	198.3
F12/HT01	3	28	49	< 0.5	10	51	57	4.6	199.6
K3/HT01	4	43	33	< 0.5	6	45	69	4.5	200.5
Q6/HB01	3	34	36	< 0.5	10	39	73	9.6	201.6
D13/HT01	3	30	50	< 0.5	5	53	60	5.2	203.2
A5/HT01	4	31	24	0.6	13	30	100	4.6	203.2
C11/HT01	4	59	10	< 0.5	14	12	100	14	209
Q5/HT01	4	44	37	< 0.5	< 5	44	87	6	218
R1/HB01	2.5	37	27	0.9	23	31	100	8.8	227.7
E7/HT01	2.5	60	21	< 0.5	36	34	98	16	265
M1/HB01	2.5	54	33	< 0.5	46	41	77	34	285
E8/HT01	4	12	21	0.6	5	26	230	1.8	296.4
R3/HB01	2.5	140	31	< 0.5	35	36	56	7	305
G10/HT01	3	180	16	0.8	100	47	110	4.4	458.2
N2/HB01	2.5	130	19	0.8	180	17	120	4.8	471.6
C5/HT01	4	120	41	0.9	130	45	180	30	546.9
B5/HT01	3	270	130	0.8	130	60	100	11	701.8
N12/HT01	4	940	330	1.1	66	130	120	22	1609.1
N9/HB01	2.5	82	26	0.8	630	22	850	7.9	1618.7
L11/HB01	2.5	39	33	1.6	1300	42	230	4	1649.6
D3/HT01	3	570	87	7.3	450	180	1000	8.8	2303.1
E10/HT01	4	430	49	4.8	2200	110	1800	13	4606.8

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>7)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
F7/HB01	7.5	19	18	< 0.5	< 5	20	45	2.2	104.2
T4/HB01	7.5	18	17	< 0.5	< 5	21	46	2.3	104.3
E5/HT01	8	14	27	< 0.5	< 5	26	35	2.7	104.7
T3/HB01	7.5	17	21	0.6	< 5	22	45	2.2	107.8
L13/HT01	9	20	23	< 0.5	< 5	27	43	2.2	115.2
R11/HB01	7.5	18	24	< 0.5	< 5	27	46	1.8	116.8
O7/HB01	7.5	20	24	< 0.5	< 5	26	46	3.5	119.5
K9/HB01	7.5	17	38	< 0.5	< 5	29	33	3.1	120.1
S9/HB01	7.5	20	25	0.5	< 5	26	48	2.5	122
M5/HB01	7.5	19	27	< 0.5	7	26	41	3.1	123.1
S6/HB01	7.5	19	22	< 0.5	< 5	31	49	2.9	123.9
W5/HB01	7.5	23	24	< 0.5	< 5	29	47	3.3	126.3
Q4/HB01	7.5	23	24	< 0.5	< 5	30	48	2.5	127.5
P8/HB01	7.5	24	24	0.5	< 5	28	49	4.2	129.7
B11/HT01	8	20	23	< 0.5	< 5	31	48	7.8	129.8
Q10/HB01	7.5	25	24	< 0.5	< 5	29	53	3.7	134.7
K6/HB01	7.5	23	22	< 0.5	< 5	28	60	3	136
W12/HB01	7.5	22	25	< 0.5	6	32	49	2.8	136.8
I5/HT01	8	27	25	< 0.5	< 5	31	51	3.3	137.3
O11/HB01	7.5	21	24	< 0.5	10	31	48	3.6	137.6
V11/HB01	7.5	27	29	< 0.5	< 5	30	51	3.4	140.4
S3/HB01	7.5	23	24	< 0.5	11	30	52	3.4	143.4
N3/HB01	7.5	28	26	< 0.5	< 5	32	55	3	144
R2/HB01	7.5	19	38	< 0.5	9	32	44	4.6	146.6
M4/HT01	8	26	24	< 0.5	11	31	52	4.5	148.5
U1/HB01	7.5	29	30	0.6	< 5	33	57	5.1	154.7
C1/HT01	9	34	25	< 0.5	< 5	37	54	4.8	154.8
J1/HB01	7.5	32	23	< 0.5	8	31	57	4.4	155.4
F13/HT01	8	23	42	< 0.5	< 5	41	46	3.7	155.7
G5/HB01	7.5	35	31	< 0.5	< 5	35	57	5.4	163.4
O3/HB01	7.5	35	29	< 0.5	9	34	53	5.2	165.2
N10/HB01	7.5	30	31	0.6	6	36	59	5.2	167.8
W9/HB01	7.5	32	31	< 0.5	< 5	36	64	7.7	170.7
N6/HB01	7.5	27	27	< 0.5	11	33	71	4.1	173.1
A13/HB01	7.5	22	56	< 0.5	< 5	51	48	5.9	182.9
F4/HT01	8	32	32	0.5	10	40	65	9.7	189.2
H4/HB01	7.5	34	38	< 0.5	15	42	67	3.7	199.7
A1/HT01	9	27	39	3.1	6	53	70	5.4	203.5
L8/HB01	7.5	16	17	< 0.5	5	19	240	1.5	298.5
P9/HB01	7.5	16	32	< 0.5	51	25	250	3.7	377.7
C9/HT01	8	32	23	< 0.5	80	60	210	3.5	408.5
P13/HT01	* 11	45	2	< 0.5	11	12	13	0.8	83.8
D9/HT01	* 11	15	24	< 0.5	< 5	28	34	4.4	105.4
N3/HB01	* 11	24	23	0.6	< 5	26	49	2.5	125.1
S8/HB01	* 11	25	27	< 0.5	< 5	32	50	3.5	137.5
L1/HB01	* 11	31	32	< 0.5	< 5	36	62	4.1	165.1
R1/HB01	* 11	37	27	0.6	22	30	89	11	216.6
L8/HB01	* 11	15	21	< 0.5	8	22	240	2.2	308.2
A3/HT01	* 11	130	30	< 0.5	18	40	95	5.1	318.1
R8/HB01	* 11	42	42	0.6	170	30	73	34	391.6
P9/HB01	* 11	29	34	< 0.5	150	34	350	3.8	600.8
H1/HT01	* 11	130	29	1.1	510	40	270	9.4	989.5

* Replicate samples

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
LW12S	1				16				16
LW15S	1.5		29		16			4.3	49.3
LW4S	1.5				23	38			61
DM1	0	26		0.1	13	31		3.2	73.3
MW3S	0	28		0.1	24	37		5	94.1
SB1	0	43		0.17	< 0.5	40		11	94.17
SB27	0	37		0.13	9.2	48		3.9	98.23
LB17	1.5		10		22	8	64		104
LB19	0.5		6		67	8	27		108
LS11	0.5		28		29	20	47		124
LB8	1.5				79	36		13	128
SB19	0	48		0.33	39	40		9.5	136.83
SB5	0	37		0.12	57	42		3.9	140.02
LW1S	0		39		21	23	52	6.1	141.1
LS2	0.5		42		20	34	55		151
LB4	1.5		49		21	36	48		154
LW11VS	2	37	41		32		50		160
SB13	0	56		0.17	61	46		4.4	167.57
DITCH NOR	0	32	7	0.6	14	76	46		175.6
LS6	0.5		44		31	38	64		177
LB23	0.5		25		58	30	65		178
SB28	0	46		0.09	66	55		13	180.09
LB20	1.5				34		150		184
LS10	0	34	16	2.5	54	< 5	84		190.5
LB13	0				77	28	87		192
LW8S	1.5					32	180		212
MW2S	0	110		0.16	41	56		8.4	215.56
S1	0	40	30	< 0.5	26	37	77	8.4	218.4
LB12	1.5		34		150	37			221
LW1S	1.5		43		43	31	110		227
ES2	0	35	19	< 2.8	61	23	88	26	252
LS13	0.5		16		59	29	150		254
ES3	0	73	< 11	3.9	83	19	78	< 6	256.9
SB18	0	74		0.48	140	43		6.1	263.58
ES1	0	41	39	< 2.8	61	30	84	12	267
LB10	1.5		20		210	40			270
MW1S	1	110		0.33	86	74		14	284.33
LB1	1.5	140	140			42			322
LB9	0				290	40			330
LB15	1.5		79	1.1	140	110			330.1
SB10	0	69		0.3	130	130		9.5	338.8
SB20	0	120		1	190	61		32	404
SB15	0	130		0.83	210	58		19	417.83
LW2S	1.5				240		180		420
S1 S2	0	70	24	0.5	110	50	160	32	446.5
LS8	0	69	30	2.2	203	< 5	150		454.2
SB6	0	140		0.15	120	190		12	462.15
LSD4	0		49	0.7	110	38	270		467.7
LS1	0.5		126		120	137	90		473
LW13S	0		28		350	20	79		477
SB12	0	120		0.69	290	74		12	496.69
SB16	0	94		1.2	290	61		52	498.2

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL - CONTINUED
HISTORIC DATA

Site	Depth-ft (0-2)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
LW11S	0				430			89	519
SB11	0	110		0.82	300	75		56	541.82
SB2	0	190		2.1	220	120		10	542.1
LW10S	0				80	14	460		554
SB8	0	140		0.5	280	120		30	570.5
DITCH SOU	0	91	9	3.1	43	340	97		583.1
SB9	0	180		0.94	310	82		20	592.94
LB26	1.5	170	23	0.5	250	28	120	11	602.5
LS3	0.5		37		280	55	250		622
LW5VS	1.5		42	< 0.5	380	48	170		640
LB25	0		45		300	36	280		661
LW2S	0		62		250	41	350		703
LS9	0	270	83	3	140	120	95		711
LW8S	0		32				680		712
LW6S	1.5		61		440		230		731
SB7	0	620		0.29	53	51		16	740.29
LB16	0		18	0.6	640	21	110		789.6
LW7S	0				590	51	220		861
SB24	0	710		0.22	43	96		15	864.22
SB3	0	320		2.2	410	140		18	890.2
SB14	0	150		3.1	640	82		56	931.1
LB22	0		40		550	24	320		934
SB4	0	540		3.9	210	180		22	955.9
DM2	0	60.4	39.7	0.9	505	71.3	236	56.4	969.7
SB25	0	200		1.3	530	220		31	982.3
SB22	0	400		1.1	660	120		12	1193.1
LS5	0.5		42	3.2	520	77	580		1222.2
LB27	1.5	790	76		130	98	160		1254
SB23	0	400		2.9	780	110		16	1308.9
LB7	1.5				1000	79	360	19	1458
SB17	0	190		1.8	970	200		110	1471.8
DM4	0	139	25.6	1.9	610	31.7	742	8.67	1558.87
LB13	1.5		17	0.7	1400	20	160		1597.7
DM2	0	91		0.9	1700	88		27	1906.9
LSD1	0		44		560	200	1200		2004
LB18	1.5		18	0.9	1800	21	180		2019.9
LB6	1.5			35	150	150	1800		2135
SB26	0	340		0.6	1500	610		21	2471.6
LW5S	1.5				940	120	1600	27	2687
LB21	0.5		51		2400	39	450		2940
LB3	1.5	640	140		1600	330	590		3300
LB28	1.5	260	230	3.5	1200	580	1200	6.9	3480.4
LB11	0				2300	88	1500		3888
LS7	0.5		71		1900	650	2900		5521
LS4	0.5		140		4900	92	550		5682
SB21	0	370		3.5	4800	770		36	5979.5
LW5S	0				3200	560	2500		6260
LB24	1.5		28	3.3	19000	790	1100	36	20957.3
LW9S	0		43	4	19000	780	1300	36	21163

TOTAL COPPER, NICKEL, CADMIUM, LEAD, CHROMIUM, ZINC, & ARSENIC IN SOIL - CONTINUED
HISTORIC DATA

Site	Depth-ft (>2)	Total Copper	Total Nickel	Total Cadmium	Total Lead	Total Chromium	Total Zinc	Total Arsenic	TOTAL METALS
LW4S	4.5				27	41			68
LB14	3		36	0.1	44	32			112.1
LB5	3		39	0.4	350	58			447.4
LB2	3	160			220	77			457
LW2S	3				43		850		893
LB3	3	360	130	1.1	750	120	360	42	1763.1
LW3S	3				1200		1100		2300

EP TOXICITY METALS DATA

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
F8/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L12/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
U3/HB01	0	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S5/HB01	0.1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P7/HB01	0.7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V5/HB01	0.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R7/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P2/HB01	1.9	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M3/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
W3/HB01	0.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I11/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G4/HB01	0.3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G9/HB01	0.7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R9/HB01	0.4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A7/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T5/HB01	0.4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R6/HB01	0.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R4/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P11/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P6/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
B13/HB01	0.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L3/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H8/HB01	0.9	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K5/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H7/HT01	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N1/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T11/HB01	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V9/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q8/HB01	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A12/HB01	0.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P10/HB01	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V1/HB01	0.3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
U7/HT01	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q3/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (0-2)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
W11/HB01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C12/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J4/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H13/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S2/HB01	1.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L7/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T8/HB01	1.2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I9/HB01	0.4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O4/HB01	1.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T13/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D11/HT01	1.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H5/HB01	0.3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M6/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I3/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C7/HT01	1.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J8/HB01	0.7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
G6/HB01	0.1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
J6/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
O6/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.2
L9/HB01	0.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.2
E6/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.2
B9/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.4	0.4
E9/HB01	1.1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.4	0.4
H1/HT01*	1	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.45	0.45
N8/HB01	0.6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	1.2	1.2
M10/HB01	0.6	< 0.2	0.02	< 0.1	< 0.1	0.2	< 0.1	1	1.22
O9/HB01	0.7	< 0.2	< 0.01	< 0.1	< 0.1	0.3	< 0.1	1.1	1.4
B1/HB01	0.2	< 0.2	< 0.01	< 0.1	0.7	< 0.1	0.6	0.3	1.6
K11/HT01	2	< 0.2	< 0.01	< 0.1	< 0.1	1.5	< 0.1	0.4	1.9
M8/HB01	0.7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	4.1	4.1
Q2/HB01	2	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	4.2	4.2
F1/HT01	2	< 0.2	0.03	< 0.1	0.3	0.1	0.8	3.5	4.73
F10/HB01	0.7	< 0.2	0.08	< 0.1	0.1	23	0.2	12	35.38

* Values reflect the average of replicate samples

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>2-4.5)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
R12/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F12/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q9/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D13/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N7/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I4/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N13/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R1/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N2/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P4/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J5/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H12/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S7/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S4/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L10/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
E8/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S8/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q6/HB01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O5/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G7/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L6/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K7/HB01	3.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V3/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L4/HT01	3.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N9/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G3/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L11/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C11/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I7/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A5/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T2/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C13/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O10/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A11/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K3/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F3/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I10/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
E11/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
W7/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M1/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
B3/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D5/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
E7/HT01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
C5/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
Q5/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.1
R3/HB01	2.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.2
B5/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	0.3	0.2	0.5
G10/HT01	3	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.6	0.6
N12/HT01	4	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	0.5	0.1	0.6
D3/HT01	3	< 0.2	0.04	< 0.1	< 0.1	0.1	0.2	3.9	4.24
E10/HT01	4	< 0.2	0.02	< 0.1	< 0.1	0.4	< 0.1	9.5	9.92

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>4.5-7)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
R8/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N4/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D9/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P13/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I8/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D1/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H3/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C3/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V7/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L1/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L5/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
B12/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q11/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I6/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q7/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H6/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A3/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P1/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P12/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N11/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H11/HT01	5.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T12/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J13/HT01	6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T9/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R13/HT01	6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O2/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P5/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F5/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V12/HT01	6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M7/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V13/HT01	6	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K8/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H10/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G11/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R5/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D7/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A9/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M9/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
B7/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P3/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F9/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F11/HT01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T7/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F6/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K4/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T6/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
D12/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J11/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M11/HT01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G8/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J3/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J7/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H9/HB01	7	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>4.5-7)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
R10/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	0.2	< 0.1	0.2	0.4
O8/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	0.4	0.4
J9/HB01	5	< 0.2	< 0.01	< 0.1	< 0.1	0.5	< 0.1	< 0.1	0.5
U2/HB01	5	< 0.2	< 0.01	< 0.1	0.1	< 0.1	< 0.1	2.1	2.2
J12/HT01	6.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	2.8	2.8
N5/HB01	5	< 0.2	0.02	< 0.1	0.1	0.1	< 0.1	2.9	3.12

EPTOX ARSENIC, CADMIUM, CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC IN SOILS
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>7)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
F7/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
H4/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
Q4/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T4/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
W12/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
T3/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P9/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K6/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N6/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S3/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M4/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O11/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
I5/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O7/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F4/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N3/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
B11/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R2/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
E5/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O3/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
F13/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L8/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C9/HT01	8	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A13/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
C1/HT01	9	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
U1/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
L13/HT01	9	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S6/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
A1/HT01	9	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
V11/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
W5/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
P8/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
N10/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
S9/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
O10/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
G5/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
J1/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
W9/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
K9/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
R11/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND
M5/HB01	7.5	< 0.2	< 0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	ND

EPTOX COPPER, NICKEL CADMIUM, LEAD, CHROMIUM, ZINC, ARSENIC IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
LS1	0.5			< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW2S	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LS2	0.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LB27	1.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW1S	0	< 0.2	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW14S	0			< 0.1			< 0.1		ND
LB23	0.5			< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW2S	0	< 0.5		< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW15S	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW11S	0				< 0.1	< 0.5	< 0.1	< 0.1	ND
LS8	0		< 0.1	< 0.1	< 0.1		< 0.1	< 0.1	ND
LW4S	1.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LS6	0.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
S1	0	< 0.2	< 0.01	< 0.1		< 0.1			ND
S1 S2	0	< 0.2	< 0.01	< 0.1		< 0.1			ND
ES1	0	< 0.001	0.0006	< 0.001		< 0.001			0.0006
ES2	0	< 0.001	0.001	< 0.001		< 0.001			0.001
ES3	0	< 0.001	0.0027	< 0.001		< 0.001			0.0027
LW13S	0			< 0.1	< 0.1	< 0.5	< 0.1	0.1	0.1
LS3	0.5	< 0.5		< 0.1	< 0.1	< 0.5	< 0.1	0.1	0.1
LB12	1.5			< 0.1	< 0.1	< 0.5	< 0.1	0.1	0.1
LW7S	0			< 0.1		< 0.5		0.1	0.1
LB13	0			< 0.1	< 0.1	< 0.5	< 0.1	0.1	0.1
LW5VS	1.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LS4	0.5	< 0.5		< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LS10	0	< 0.5	< 0.1	< 0.1	< 0.1		< 0.1	0.2	0.2
LB18	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LB1	1.5			< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LB17	1.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LB20	1.5			< 0.1		< 0.5		0.2	0.2
LW11VS	2				< 0.1	< 0.5	< 0.1	0.2	0.2
LS13	0.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2

EPTOX COPPER, NICKEL CADMIUM, LEAD, CHROMIUM, ZINC, ARSENIC IN SOIL
HISTORIC DATA - CONTINUED

Site	Depth-ft (0-2)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
LB18	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LW9S	0	< 0.5	< 0.1	< 0.1		< 0.5	< 0.1	0.2	0.2
LB19	0.5			< 0.1	< 0.1	< 0.5	< 0.1	0.2	0.2
LW10S	0				< 0.1	< 0.5	< 0.1	0.3	0.3
LB25	0			< 0.1	< 0.1	< 0.5	< 0.1	0.3	0.3
LW12S	1				< 0.1	< 0.5	< 0.1	0.3	0.3
LB22	0			< 0.1	< 0.1	< 0.5	< 0.1	0.3	0.3
LW8S	1.5				< 0.1		< 0.1	0.3	0.3
LS9	0		< 0.1	< 0.1	< 0.1		0.1	0.2	0.3
LW6S	1.5			< 0.1	< 0.1	< 0.5	0.1	0.2	0.3
LB10	1.5	< 0.5	< 0.1	< 0.1		< 0.5	< 0.1	0.4	0.4
LB8	1.5	< 0.5		< 0.1	< 0.1	< 0.5	< 0.1	0.4	0.4
LB16	0		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.4	0.4
LB15	1.5		< 0.1	< 0.1		< 0.5	< 0.1	0.4	0.4
LW8S	0						< 0.1	0.4	0.4
LW6S	1.5			< 0.1	< 0.1	< 0.5	< 0.1	0.5	0.5
LS5	0.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.6	0.6
LB21	0.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.6	0.6
LS11	0.5		< 0.1	< 0.1	< 0.1	0.7	< 0.1	< 0.1	0.7
LSD1	0	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	0.8	0.8
LB9	0			< 0.1	< 0.1	< 0.5	< 0.1	1	1
LB26	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	1.2	1.2
LB3	1.5		< 0.1	< 0.1	< 0.1	< 0.5	0.5	1	1.5
LS7	0.5	< 0.5		1.1	< 0.1	< 0.5	< 0.1	0.4	1.5
LB7	1.5	< 0.5		< 0.1	< 0.1	< 0.5	0.3	1.6	1.9
LB28	1.5	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	2.4	2.4
LB11	0	< 0.5		< 0.1	< 0.1	< 0.5	< 0.1	3.8	3.8
LB6	1.5		0.2	< 0.1	< 0.1	< 0.5	0.4	4.6	5.2
LW5S	0	< 0.5	< 0.1	< 0.1	< 0.1	0.6	< 0.1	10	10.6
LB24	1.5			< 0.1	< 0.1	15	< 0.1	2.2	17.2

Site	Depth-ft (>2)	EPTOX Arsenic	EPTOX Cadmium	EPTOX Chromium	EPTOX Copper	EPTOX Lead	EPTOX Nickel	EPTOX Zinc	TOTAL EPTOX METALS
LW5VS	4.5			< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW4S	4.5		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LW2S	3			< 0.1	< 0.1	< 0.5	< 0.1	< 0.1	ND
LB14	3		< 0.1	< 0.1		< 0.5	< 0.1	0.1	0.1
LB2	3			< 0.1	< 0.1	< 0.5	0.1	0.4	0.5
LB5	3		< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	1	1
LW3S	3	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	< 0.1	1.4	1.4
LB3	3	< 0.5	< 0.1	< 0.1	< 0.1	< 0.5	0.7	2	2.7

BTEX DATA

BTEX CONCENTRATIONS IN SOIL
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl- benzene	Total Xylenes	TOTAL BTEX
G6/HB01	0.1		< 0.072	< 0.072	< 0.072				ND
R6/HB01	0.2		< 0.080	< 0.080	< 0.080				ND
B1/HB01	0.2		< 0.076	< 0.076	< 0.076				ND
B13/HB01	0.2		< 0.039	< 0.039	< 0.039				ND
W3/HB01	0.2		< 0.160	< 0.160	< 0.160				ND
V1/HB01	0.3		< 0.180	< 0.180	< 0.180				ND
G4/HB01	0.3		< 0.037	< 0.037	< 0.037				ND
I9/HB01	0.4		< 0.200	< 0.200	< 0.200				ND
R9/HB01	0.4	< 0.007				< 0.007	< 0.007	< 0.007	ND
I3/HB01	0.5	< 0.003				< 0.003	< 0.003	< 0.003	ND
J6/HB01	0.5		< 0.040	< 0.040	< 0.040				ND
Q3/HB01	0.5		< 0.038	< 0.038	< 0.038				ND
L9/HB01	0.5		< 0.038	< 0.038	< 0.038				ND
N8/HB01	0.6		< 0.220	< 0.220	< 0.220				ND
V9/HB01	0.6		< 0.083	< 0.083	< 0.083				ND
L7/HB01	0.6		< 0.190	< 0.190	< 0.190				ND
F10/HB01	0.7	< 0.002				< 0.002	< 0.002	< 0.002	ND
M8/HB01	0.7	< 0.002	< 0.100	< 0.100	< 0.100	< 0.002	< 0.002	< 0.002	ND
P7/HB01	**0.7**		**< 0.200**	**< 0.200**	**< 0.200**				**ND**
J8/HB01	0.7	< 0.002	< 2.600	< 2.600	< 2.600	< 0.002	< 0.002	< 0.002	ND
O9/HB01	0.7		< 0.160	< 0.160	< 0.160				ND
H8/HB01	0.9	< 0.002				< 0.002	< 0.002	< 0.002	ND
U7/HT01	1		< 0.045	< 0.045	< 0.045				ND
H1/HT01	1	< 0.002				< 0.002	< 0.002	< 0.002	ND
H7/HT01	1		< 0.091	< 0.091	< 0.091				ND
T11/HB01	1		< 0.790	< 0.790	< 0.790				ND
P10/HB01	1	< 0.003	< 0.210	< 0.210	< 0.210	< 0.003	< 0.003	< 0.003	ND
E9/HB01	1.1		< 0.077	< 0.077	< 0.077				ND
F1/HT01	2		< 0.073	< 0.073	< 0.073				ND

BTEX CONCENTRATIONS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (0-2)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl-benzene	Total Xylenes	TOTAL BTEX
T8/HB01	1.2	< 0.002				< 0.002	< 0.002	< 0.002	ND
U3/HB01	0		< 0.073	< 0.073	< 0.073				ND
S2/HB01	1.2		< 0.068	< 0.068	< 0.068				ND
V5/HB01	0.2		< 0.160	< 0.160	< 0.160				ND
Q4/HB01	1.5	< 0.002	< 0.080	< 0.080	< 0.080	< 0.002	< 0.002	< 0.002	ND
T5/HB01	0.4		< 0.083	< 0.083	< 0.083				ND
D11/HT01	1.5		< 0.037	< 0.037	< 0.037				ND
R4/HB01	0.5	< 0.008	< 2.300	< 2.300	< 2.300	< 0.008	< 0.008	< 0.008	ND
P2/HB01	1.9		< 0.080	< 0.080	< 0.080				ND
Q6/HB01	0.5	< 0.012				< 0.012	< 0.012	< 0.012	ND
Q2/HB01	2		< 0.084	< 0.084	< 0.084				ND
M10/HB01	0.6	< 0.002	< 0.039	< 0.039	< 0.039	< 0.002	< 0.002	< 0.002	ND
F8/HT01	2	< 0.002				< 0.002	< 0.002	< 0.002	ND
R7/HB01	0.6	< 0.002	< 0.091	< 0.091	< 0.091	< 0.002	< 0.002	< 0.002	ND
C12/HT01	2		< 0.075	< 0.075	< 0.075				ND
L3/HT01	2		< 0.037	< 0.037	< 0.037				ND
I11/HT01	2		< 0.180	< 0.180	< 0.180				ND
B9/HT01	2	< 0.002	< 0.200	< 0.200	< 0.200	< 0.002	< 0.002	< 0.002	ND
J4/HT01	2		< 0.089	< 0.089	< 0.089				ND
M6/HB01	0.6		< 0.035	< 0.035	< 0.035				ND
K11/HT01	2	< 0.002	< 0.074	< 0.074	< 0.074	< 0.002	< 0.002	< 0.002	ND
K5/HB01	0.5		< 0.036	< 0.036	< 0.036				ND
S5/HB01	0.1		< 0.077	< 0.077	< 0.077				ND
N1/HB01	0.6		< 0.072	< 0.072	< 0.072				ND
M3/HT01	2		< 0.038	< 0.038	< 0.038				ND
H5/HB01	0.3	< 0.002				< 0.002	< 0.002	0.002	0.002
Q8/HB01	1	< 0.002	< 2.600	< 2.600	< 2.600	< 0.002	< 0.002	0.002	0.002
E6/HT01	2	< 0.002	< 0.077	< 0.077	< 0.077	0.006	< 0.002	< 0.002	0.006
P6/HB01	0.5	< 0.002	< 0.230	< 0.230	< 0.230	0.039	< 0.002	< 0.002	0.039
P11/HT01	2	< 0.300	< 4.900	< 4.900	< 4.900	< 0.300	1.1	1.3	2.4

BTEX CONCENTRATIONS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>2-4.5)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl- benzene	Total Xylenes	TOTAL BTEX
Q6/HB01	3		< 0.120	< 0.120	< 0.120				ND
S8/HB01	2.5	< 0.002				< 0.002	< 0.002	< 0.002	ND
G10/HT01	3		< 0.038	< 0.038	< 0.038				ND
Q5/HT01	4	< 0.010	< 0.270	< 0.270	< 0.270	< 0.010	< 0.010	< 0.010	ND
C5/HT01	4		< 0.200	< 0.200	< 0.200				ND
F3/HT01	4	< 0.002				< 0.002	< 0.002	< 0.002	ND
W7/HB01	2.5		< 0.035	< 0.035	< 0.035				ND
L10/HB01	2.5		< 0.040	< 0.040	< 0.040				ND
M1/HB01	2.5		< 0.093	< 0.093	< 0.093				ND
I4/HB01	2.5		< 0.056	< 0.056	< 0.056				ND
R1/HB01	2.5		< 0.083	< 0.083	< 0.083				ND
R3/HB01	2.5	< 0.002				< 0.002	< 0.002	< 0.002	ND
B3/HB01	2.5	< 0.005	< 0.180	< 0.180	< 0.180	< 0.005	< 0.005	< 0.005	ND
R12/HT01	3		< 0.740	< 0.740	< 0.740				ND
E7/HT01	2.5	< 0.002	< 0.380	< 0.380	< 0.380	< 0.002	< 0.002	< 0.002	ND
S7/HT01	4		< 0.053	< 0.053	< 0.053				ND
N2/HB01	2.5		< 0.083	< 0.083	< 0.083				ND
A5/HT01	4	< 0.002				< 0.002	< 0.002	< 0.002	ND
A11/HT01	4		< 0.040	< 0.040	< 0.040				ND
G3/HT01	4	< 0.002				< 0.002	< 0.002	< 0.002	ND
C11/HT01	4		< 0.110	< 0.110	< 0.110				ND
D5/HT01	4	< 0.003				< 0.003	< 0.003	< 0.003	ND
I7/HB01	2.5	< 0.002				< 0.002	< 0.002	< 0.002	ND
K3/HT01	4		< 0.055	< 0.055	< 0.055				ND
L11/HB01	2.5	< 0.003	< 0.100	< 0.100	< 0.100	< 0.003	< 0.003	< 0.003	ND
N12/HT01	4	< 0.002				< 0.002	< 0.002	< 0.002	ND
V3/HB01	2.5		< 0.043	< 0.043	< 0.043				ND
E11/HT01	4	< 0.002	< 0.220	< 0.220	< 0.220	< 0.002	< 0.002	< 0.002	ND
O10/HB01	2.5		< 0.048	< 0.048	< 0.048				ND
G7/HT01	4	< 0.008				< 0.008	< 0.008	< 0.008	ND
D3/HT01	3	< 0.002				0.004	< 0.002	< 0.002	0.004
B5/HT01	3	< 0.002				< 0.002	< 0.002	0.006	0.006
E10/HT01	4	< 0.002				0.008	< 0.002	< 0.002	0.008
N13/HT01	3	< 0.002				< 0.002	0.002	0.007	0.009
Q9/HB01	2.5	< 0.009	< 5.400	< 5.400	< 5.400	< 0.009	< 0.009	0.012	0.012
T2/HB01	2.5	< 0.130				< 0.130	0.51	0.51	1.02
O5/HB01	2.5	< 0.230				< 0.230	0.58	0.73	1.31
J5/HB01	2.5	< 0.160	< 0.230	< 0.230	< 0.230	< 0.160	0.98	2.2	3.18

BTEX CONCENTRATIONS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>4.5-7)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl- benzene	Total Xylenes	TOTAL BTEX
D9/HT01	5		< 0.041	< 0.041	< 0.041				ND
Q11/HB01	5		< 0.042	< 0.042	< 0.042				ND
D12/HT01	7		< 0.740	< 0.740	< 0.740				ND
R13/HT01	6		< 0.190	< 0.190	< 0.190				ND
O8/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
J3/HB01	5		< 0.047	< 0.047	< 0.047				ND
M9/HB01	5		< 0.051	< 0.051	< 0.051				ND
N4/HT01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
D1/HT01	5		< 0.260	< 0.260	< 0.260				ND
I6/HB01	5		< 0.043	< 0.043	< 0.043				ND
R8/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
N5/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
L1/HB01	5		< 0.049	< 0.049	< 0.049				ND
F5/HT01	5		< 0.044	< 0.044	< 0.044				ND
F9/HT01	7	< 0.002				< 0.002	< 0.002	< 0.002	ND
Q7/HB01	5	< 0.009	< 0.170	< 0.170	< 0.170	< 0.009	< 0.009	< 0.009	ND
R10/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
P3/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
J11/HT01	7		< 0.043	< 0.043	< 0.043				ND
C3/HT01	5		< 0.180	< 0.180	< 0.180				ND
P1/HB01	5		< 0.049	< 0.049	< 0.049				ND
V7/HB01	5		< 0.042	< 0.042	< 0.042				ND
J9/HB01	5		< 0.100	< 0.100	< 0.100				ND
I8/HB01	5	< 0.002				< 0.002	< 0.002	< 0.002	ND
P13/HT01	5	< 0.002				< 0.002	< 0.002	0.003	0.003
J12/HT01	6.5	< 0.002				< 0.002	< 0.002	0.01	0.01
F6/HB01	5	< 0.002	< 0.040	< 0.040	< 0.040	< 0.002	0.016	0.094	0.11
H11/HT01	5.5	< 0.016	< 0.340	< 0.340	< 0.340	< 0.016	0.057	0.11	0.167
U2/HB01	5	< 0.097	< 0.150	< 0.150	< 0.150	0.14	0.52	0.79	1.45
A3/HT01	5	< 0.130	< 0.086	< 0.086	< 0.086	< 0.130	1	1.1	2.1
R5/HT01	7	< 0.330	< 0.082	< 0.082	< 0.082	< 0.330	1.2	1.7	2.9

BTEX CONCENTRATIONS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>7)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl- benzene	Total Xylenes	TOTAL BTEX
A13/HB01	7.5		< 0.041	< 0.041	< 0.041				ND
K6/HB01	7.5		< 0.043	< 0.043	< 0.043				ND
N3/HB01	7.5		< 0.044	< 0.044	< 0.044				ND
S9/HB01	7.5		< 0.042	< 0.042	< 0.042				ND
Q4/HB01	7.5		< 0.044	< 0.044	< 0.044				ND
W12/HB01	7.5		< 0.042	< 0.042	< 0.042				ND
J1/HB01	7.5	< 0.002				< 0.002	< 0.002	< 0.002	ND
T3/HB01	7.5	< 0.005	< 0.200	< 0.200	< 0.200	< 0.005	< 0.005	< 0.005	ND
P9/HB01	7.5		< 0.091	< 0.091	< 0.091				ND
R2/HB01	7.5		< 0.095	< 0.095	< 0.095				ND
M5/HB01	7.5	< 0.004				< 0.004	< 0.004	< 0.004	ND
N6/HB01	7.5		< 0.043	< 0.043	< 0.043				ND
V11/HB01	7.5	< 0.002				< 0.002	< 0.002	< 0.002	ND
B11/HT01	8		< 0.100	< 0.100	< 0.100				ND
O3/HB01	7.5		< 0.046	< 0.046	< 0.046				ND
A1/HT01	9		< 0.057	< 0.057	< 0.057				ND
W5/HB01	7.5		< 0.043	< 0.043	< 0.043				ND
F13/HT01	8	< 0.002				0.005	< 0.002	< 0.002	0.005
U1/HB01	7.5	< 0.005	< 0.041	< 0.041	< 0.041	< 0.005	< 0.005	0.01	0.01
C9/HT01	8	< 0.130				< 0.130	0.97	2	2.97
G5/HB01	7.5	< 0.140	< 0.049	< 0.049	< 0.049	< 0.140	1.9	5.4	7.3
P9/HB01	* 11		< 0.087	< 0.087	< 0.087				ND
L1/HB01	* 11		< 0.049	< 0.049	< 0.049				ND
R1/HB01	* 11		< 0.084	< 0.084	< 0.084				ND
H1/HT01	* 11	< 0.002				< 0.002	< 0.002	< 0.002	ND
N3/HB01	* 11		< 0.043	< 0.043	< 0.043				ND
S8/HB01	* 11	< 0.002				< 0.002	< 0.002	< 0.002	ND
R8/HB01	* 11	< 0.002				< 0.002	< 0.002	< 0.002	ND
P13/HT01	* 11	< 0.002				< 0.002	< 0.002	0.006	0.006
A3/HT01	* 11	< 0.120	< 0.079	< 0.079	< 0.079	< 0.120	0.95	1	1.95

* Replicate samples

BTEX CONCENTRATIONS IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl- benzene	Total Xylenes	TOTAL BTEX
LS2	0.5		< 0.238	< 0.203	< 0.266				ND
LS7	0.5	< 0.003	< 0.277	< 0.236	< 0.309	< 0.003	< 0.004	< 0.004	ND
LB16	0	< 0.002	< 0.531	< 0.453	< 0.594	< 0.002	< 0.003	< 0.003	ND
LB8	0		< 0.479	< 0.408	< 0.535				ND
LB21	0.5	< 0.011	< 1.404	< 1.197	< 1.569	< 0.009	< 0.013	< 0.015	ND
LW9S	0		< 0.233	< 0.199	< 0.26				ND
LS11	0.5		< 0.231	< 0.197	< 0.259				ND
LW5VS	0		< 0.263	< 0.224	< 0.293				ND
LS6	0.5		< 0.23	< 0.196	< 0.257				ND
LS10	0		< 0.243	< 0.207	< 0.271				ND
LB23	0.5		< 0.712	< 0.607	< 0.796				ND
LS9	0		< 0.222	< 0.19	< 0.248				ND
LB19	0.5		< 0.624	< 0.532	< 0.697				ND
LSD4	0	< 0.007	< 0.693	< 0.591	< 0.775	< 0.006	< 0.009	< 0.01	ND
LB22	1.5		< 0.439	< 0.374	< 0.49				ND
LB11	0		< 0.496	< 0.423	< 0.555				ND
LB9	1.5		< 0.258	< 0.22	< 0.288				ND
LB9	0		< 0.27	< 0.23	< 0.302				ND
LW2S	0		< 0.218	< 0.186	< 0.244				ND
LB25	0		< 0.449	< 0.383	< 0.502				ND
LB18	1.5	< 0.05	< 1.899	< 1.62	< 2.123	< 0.044	< 0.062	< 0.071	ND
LB27	0		< 0.453	< 0.387	< 0.507				ND
LB20	1.5		< 2.558	< 2.181	< 2.858				ND
LB28	0		< 0.439	< 0.374	< 0.49				ND
LW13S	0	< 0.01	< 0.324	< 0.276	< 0.362	< 0.009	< 0.013	< 0.015	ND
LB1	1.5		< 0.455	< 0.388	< 0.508				ND
LS3	0.5		< 0.272	< 0.232	< 0.304				ND
LB13	1.5		< 1.079	< 0.921	< 1.206				ND
LS5	0.5	< 0.002	< 0.246	< 0.21	< 0.275	< 0.001	< 0.002	< 0.002	ND
S1 S2	0		< 0.05	< 0.05	< 0.05				ND
LB18	1.5	< 0.057	< 0.948	< 0.809	< 1.06	< 0.05	< 0.07	< 0.08	ND
LB6	0		< 0.242	< 0.206	< 0.27				ND
LSD3	0		< 0.504	< 0.43	< 0.563				ND
LB26	1.5	< 0.003	< 0.701	< 0.598	< 0.784	< 0.003	< 0.004	< 0.005	ND
LW11S	1.5		< 5.667	< 4.833	< 6.333				ND
LW7S	0		< 0.24	< 0.205	< 0.269				ND
LB24	1.5		< 0.591	< 0.504	< 0.661				ND
ES1	0	< 0.001	< 0.03	< 0.025	< 0.026	< 0.001	< 0.001	< 0.002	ND
LW5S	1.5		< 0.265	< 0.226	< 0.296				ND
LW6S	1.5	< 0.002	< 0.504	< 0.43	< 0.563	< 0.001	< 0.002	< 0.002	ND
LW8S	0	< 0.002	< 0.255	< 0.217	< 0.285	< 0.001	< 0.002	< 0.002	ND
LS1	0.5		< 0.243	< 0.207	< 0.271				ND
LB17	1.5		< 0.507	< 0.433	< 0.567				ND
LW5S	1.5	0.001	< 0.286	< 0.244	< 0.319	< 0.003	< 0.005	< 0.006	0.001
ES2	0	< 0.001	< 0.03	< 0.002	< 0.026	0.0025	< 0.001	< 0.002	0.0025
LB28	1.5	< 0.003	< 0.519	< 0.443	< 0.58	< 0.003	< 0.004	0.004	0.004
LW15S	1.5	< 0.001				< 0.001	< 0.002	0.005	0.005
LW6S	1.5	< 0.002	< 0.54	< 0.46	< 0.603	0.001	0.001	0.005	0.007
LB3	1.5	< 0.004	< 0.258	< 0.22	< 0.288	0.002	0.001	0.006	0.009
LSD1	0	< 0.035	< 0.752	< 0.642	< 0.841	< 0.031	< 0.044	0.02	[illegible]
LB3	1.5	< 0.006	< 0.68	< 0.58	< 0.76	0.008	< 0.007	0.077	[illegible]
LW11S	0	< 0.045	< 2.376	< 2.026	< 2.655	< 0.039	0.062	0.15	[illegible]
LB12	1.5	< 0.053	< 0.677	< 0.577	< 0.756	< 0.047	0.3	0.23	0.53
LW11VS	2	< 0.034	< 6.253	< 5.333	< 6.989	0.035	0.22	0.4	0.655

BTEX CONCENTRATIONS IN SOIL
HISTORIC DATA - CONTINUED

Site	Depth-ft (>2-4.5)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl-benzene	Total Xylenes	TOTAL BTEX
LB7	3	< 0.053	< 0.768	< 0.655	< 0.859	< 0.047	< 0.066	< 0.075	ND
LW12S	2.5	< 0.051	< 0.382	< 0.326	< 0.427	< 0.054	< 0.075	< 0.086	ND
LW5VS	3	< 0.005	< 0.274	< 0.234	< 0.306	< 0.004	< 0.006	< 0.007	ND
LW3S	3	< 0.003	< 1.071	< 0.913	< 1.197	< 0.002	< 0.003	< 0.004	ND
LB14	3		< 0.607	< 0.518	< 0.679				ND
LW11S	3		< 5.156	< 4.398	< 5.763				ND
LW2S	3		< 0.264	< 0.225	< 0.295				ND
LW1S	4.5		< 0.239	< 0.204	< 0.268				ND
LB5	3	< 0.047	< 0.525	< 0.448	< 0.587	< 0.042	< 0.058	< 0.067	ND
LB2	4.5		< 0.256	< 0.218	< 0.286				ND
LB2	3	< 0.008				< 0.007	< 0.01	< 0.012	ND
LW10S	3	< 0.033	< 0.41	< 0.349	< 0.458	< 0.029	< 0.04	< 0.046	ND
LB10	3	< 0.003	< 0.256	< 0.218	< 0.286	< 0.002	0.013	< 0.004	0.013
LB4	3	< 0.013	< 1.106	< 0.943	< 1.236	< 0.011	< 0.016	0.02	0.02

Site	Depth-ft (>4.5-7)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl-benzene	Total Xylenes	TOTAL BTEX
LW1S	6	< 0.005	< 0.439	< 0.374	< 0.49	< 0.004	< 0.006	< 0.007	ND
LW7S	6	< 0.002	< 0.239	< 0.204	< 0.268	< 0.002	< 0.003	< 0.003	ND
LW11S	6		< 0.305	< 0.26	< 0.341				ND
LB4	6	< 0.004				0.003	0.004	0.018	0.025
LB2	6	< 0.01	< 0.356	< 0.304	< 0.398	< 0.009	< 0.013	0.026	0.026

Site	Depth-ft (>7)	Benzene	1,4-Dichloro benzene	1,3-Dichloro benzene	1,2-Dichloro benzene	Toluene	Ethyl-benzene	Total Xylenes	TOTAL BTEX
LB9	10.5	< 0.007	< 1.271	< 1.084	< 1.421	< 0.007	0.007	0.008	0.015
LW11S	9	< 0.043	< 1.084	< 0.924	< 1.211	< 0.038	< 0.053	0.06	0.06
LW11S	7.5	< 0.043	< 2.15	< 1.834	< 2.403	< 0.038	0.063	0.095	0.158
B-3: NW C	10	< 0.005				0.0001	0.0001	0.19	0.1902

Hart Crowser
J-1639-09

VINYL CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND TRANS-1,2-DICHLOROETHENE CONCENTRATIONS IN SOIL

VINYL CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND TRANS-1,2-DICHLOROETHENE CONCENTRATIONS IN SOIL

HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloroethene	Trichloroethene	TOTAL
H5/HB01	0.3	< 0.002	< 0.002	< 0.002	< 0.002	ND
R9/HB01	0.4	< 0.007	< 0.007	< 0.007	< 0.007	ND
I3/HB01	0.5	< 0.003	< 0.003	< 0.003	< 0.003	ND
R4/HB01	0.5	< 0.008	< 0.008	< 0.008	< 0.008	ND
O6/HB01	0.5	< 0.012	< 0.012	< 0.012	< 0.012	ND
P6/HB01	0.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
M10/HB01	0.6	< 0.002	< 0.002	< 0.002	< 0.002	ND
R7/HB01	0.6	< 0.002	< 0.002	< 0.002	< 0.002	ND
F10/HB01	0.7	< 0.002	< 0.002	< 0.002	< 0.002	ND
J8/HB01	0.7	< 0.002	< 0.002	< 0.002	< 0.002	ND
M8/HB01	0.7	< 0.002	< 0.002	< 0.002	< 0.002	ND
H8/HB01	0.9	< 0.002	< 0.002	< 0.002	< 0.002	ND
H1/HT01	1	< 0.002	< 0.002	< 0.002	< 0.002	ND
P10/HB01	1	< 0.003	< 0.003	< 0.003	< 0.003	ND
Q8/HB01	1	< 0.002	< 0.002	< 0.002	< 0.002	ND
T8/HB01	1.2	< 0.002	< 0.002	< 0.002	< 0.002	ND
O4/HB01	1.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
F8/HT01	2	< 0.002	< 0.002	< 0.002	< 0.002	ND
K11/HT01	2	< 0.002	< 0.002	< 0.002	< 0.002	ND
P11/HT01	2	< 0.300	< 0.300	< 0.300	< 0.300	ND
E6/HT01	2	< 0.002	< 0.002	< 0.002	< 0.002	ND
B9/HT01	2	< 0.002	< 0.002	< 0.002	< 0.002	ND

Site	Depth-ft (>2-4.5)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloroethene	Trichloroethene	TOTAL
I7/HB01	2.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
B3/HB01	2.5	< 0.005	< 0.005	< 0.005	< 0.005	ND
Q9/HB01	2.5	< 0.009	< 0.009	< 0.009	< 0.009	ND
S8/HB01	2.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
E7/HT01	2.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
O5/HB01	2.5	< 0.230	< 0.230	< 0.230	< 0.230	ND
L11/HB01	2.5	< 0.003	< 0.003	< 0.003	< 0.003	ND
J5/HB01	2.5	< 0.160	< 0.160	< 0.160	< 0.160	ND
R3/HB01	2.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
T2/HB01	2.5	< 0.130	< 0.130	< 0.130	< 0.130	ND
N13/HT01	3	< 0.002	< 0.002	< 0.002	< 0.002	ND
D3/HT01	3	< 0.002	< 0.002	< 0.002	< 0.002	ND
B5/HT01	3	< 0.002	< 0.002	< 0.002	< 0.002	ND
D5/HT01	4	< 0.003	< 0.003	< 0.003	< 0.003	ND
F3/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND
Q5/HT01	4	< 0.010	< 0.010	< 0.010	< 0.010	ND
E11/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND
G3/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND
N12/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND
G7/HT01	4	< 0.008	< 0.008	< 0.008	< 0.008	ND
E10/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND
A5/HT01	4	< 0.002	< 0.002	< 0.002	< 0.002	ND

VINYL CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND
TRANS-1,2-DICHLOROETHENE CONCENTRATIONS IN SOIL

HART CROWSER 1988 DATA - CONTINUED

Site	Depth-ft (>4.5-7)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
R8/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
P3/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
P13/HT01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
R5/HT01	7	< 0.330	< 0.330	< 0.330	< 0.330	ND
F6/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
O8/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
N4/HT01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
R10/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
U2/HB01	5	< 0.097	< 0.097	< 0.097	< 0.097	ND
I8/HB01	5	< 0.002	< 0.002	< 0.002	< 0.002	ND
A3/HT01	5	< 0.130	< 0.130	< 0.130	< 0.130	ND
Q7/HB01	5	< 0.009	< 0.009	< 0.009	< 0.009	ND
H11/HT01	5.5	< 0.016	< 0.016	< 0.016	< 0.016	ND
J12/HT01	6.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
F9/HT01	7	< 0.002	< 0.002	< 0.002	< 0.002	ND
N5/HB01	5	< 0.002	< 0.002	< 0.002	0.003	0.003

Site	Depth-ft (>7)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
G5/HB01	7.5	< 0.140	< 0.140	< 0.140	< 0.140	ND
M5/HB01	7.5	< 0.004	< 0.004	< 0.004	< 0.004	ND
U1/HB01	7.5	< 0.005	< 0.005	< 0.005	< 0.005	ND
V11/HB01	7.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
T3/HB01	7.5	< 0.005	< 0.005	< 0.005	< 0.005	ND
J1/HB01	7.5	< 0.002	< 0.002	< 0.002	< 0.002	ND
F13/HT01	8	< 0.002	< 0.002	< 0.002	< 0.002	ND
C9/HT01	8	< 0.130	< 0.130	< 0.130	< 0.130	ND

VINYL CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND TRANS-1,2-DICHLOROETHENE CONCENTRATIONS IN SOIL

HISTORIC DATA

Site	Depth-ft (0-2)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
LB18	1.5	< 0.109	< 0.079	< 0.035	< 0.041	ND
LB28	1.5	< 0.006	< 0.005	< 0.002	< 0.002	ND
LB16	0	< 0.005	< 0.004	< 0.002	< 0.002	ND
LW6S	1.5	< 0.004	< 0.003	< 0.001	< 0.002	ND
ES2	0	< 0.0011	< 0.0016	< 0.0021	< 0.002	ND
LB12	1.5	< 0.116	< 0.084	< 0.038	< 0.044	ND
LW11S	0	< 0.097	< 0.071	< 0.032	< 0.037	ND
LW5S	1.5	< 0.008	< 0.006	< 0.003	< 0.003	ND
LS5	0.5	< 0.003	< 0.002	< 0.001	< 0.001	ND
LW6S	1.5	< 0.004	< 0.003	< 0.001	< 0.001	ND
LS7	0.5	< 0.006	< 0.005	< 0.002	< 0.002	ND
LW15S	1.5	< 0.003	< 0.002	< 0.001	< 0.001	ND
LW13S	0	< 0.023	< 0.017	< 0.007	< 0.009	ND
LB26	1.5	< 0.007	< 0.005	< 0.002	< 0.003	ND
LSD4	0	< 0.015	< 0.011	< 0.005	< 0.006	ND
LB18	1.5	< 0.123	< 0.09	< 0.04	< 0.053	ND
LW11VS	2	< 0.074	< 0.054	< 0.024	< 0.028	ND
LB3	1.5	< 0.012	< 0.009	< 0.004	< 0.005	ND
LB3	1.5	< 0.008	< 0.006	< 0.003	< 0.003	ND
LB21	0.5	< 0.023	< 0.017	< 0.008	< 0.009	ND
LSD1	0	< 0.077	< 0.056	< 0.025	< 0.029	ND
LW8S	0	< 0.004	< 0.003	0.002	< 0.001	0.002
ES1	0	< 0.001	< 0.0016	0.0032	< 0.002	0.0032

Site	Depth-ft (>2-4.5)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
LW12S	2.5	< 0.132	< 0.096	< 0.043	< 0.05	ND
LB4	3	< 0.028	< 0.02	< 0.009	< 0.011	ND
LB10	3	< 0.006	< 0.004	< 0.002	< 0.002	ND
LB2	3	< 0.018	< 0.013	< 0.006	< 0.007	ND
LB7	3	< 0.116	< 0.084	< 0.038	< 0.044	ND
LW5VS	3	< 0.011	< 0.008	< 0.004	< 0.004	ND
LB5	3	< 0.103	< 0.075	< 0.033	< 0.039	ND
LW3S	3	< 0.006	< 0.004	< 0.002	< 0.002	ND
LW10S	3	< 0.071	< 0.052	< 0.023	< 0.027	ND

VINYL CHLORIDE, TETRACHLOROETHENE, TRICHLOROETHENE, AND TRANS-1,2-DICHLOROETHENE CONCENTRATIONS IN SOIL

HISTORIC DATA

Site	Depth-ft (>4.5-7)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
LW7S	6	< 0.005	< 0.003	< 0.002	< 0.002	ND
LW1S	6	< 0.011	< 0.008	< 0.003	< 0.004	ND
LB2	6	< 0.022	< 0.016	< 0.007	< 0.008	ND
LB4	6	0.01	0.022	< 0.003	0.006	0.038

Site	Depth-ft (>7)	Vinyl Chloride	Trans-1,2-dichloroethene	Tetrachloro-ethene	Trichloro-ethene	TOTAL
LW11S	7.5	< 0.093	< 0.068	< 0.03	< 0.035	ND
LW11S	9	< 0.093	< 0.068	< 0.03	< 0.035	ND
B-3: NW C	10	< 0.005	< 0.005	< 0.005	< 0.005	ND
LB9	10.5	< 0.016	< 0.012	< 0.005	< 0.006	ND

LPAH DATA

LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
V1/HB01	0.3	< 0.180	< 0.370	< 0.180	< 0.180	< 0.180	< 0.180	ND
M6/HB01	0.6	< 0.035	< 0.070	< 0.035	< 0.035	< 0.035	< 0.035	ND
T11/HB01	1	< 0.790	< 1.600	< 0.790	< 0.790	< 0.790	< 0.790	ND
S2/HB01	1.2	< 0.068	< 0.140	< 0.068	< 0.068	< 0.068	< 0.068	ND
R4/HB01	0.5	< 2.300	< 4.600	< 2.300	< 2.300	< 2.300	< 2.300	ND
U3/HB01	0	< 0.073	< 0.140	< 0.073	< 0.073	< 0.073	< 0.073	ND
Q3/HB01	0.5	< 0.038	< 0.076	< 0.038	< 0.038	< 0.038	< 0.038	ND
C12/HT01	2	< 0.075	< 0.150	< 0.075	< 0.075	< 0.075	< 0.075	ND
W3/HB01	0.2	< 0.160	< 0.330	< 0.160	< 0.160	< 0.160	< 0.160	ND
B13/HB01	0.2	< 0.039	< 0.077	< 0.039	< 0.039	< 0.039	< 0.039	ND
D11/HT01	1.5	< 0.037	< 0.074	< 0.037	< 0.037	0.039	< 0.037	0.039
L3/HT01	2	< 0.037	< 0.073	< 0.037	< 0.037	0.056	< 0.037	0.056
B1/HB01	0.2	< 0.076	< 0.150	< 0.076	< 0.076	0.088	< 0.076	0.088
Q2/HB01	2	< 0.084	< 0.170	< 0.084	< 0.084	0.1	< 0.084	0.1
M8/HB01	0.7	< 0.100	< 0.200	< 0.100	< 0.100	0.11	< 0.100	0.11
K11/HT01	2	< 0.074	< 0.150	< 0.074	< 0.074	0.13	< 0.074	0.13
P2/HB01	1.9	< 0.080	< 0.160	< 0.080	< 0.080	0.14	< 0.080	0.14
R7/HB01	0.6	< 0.091	< 0.180	< 0.091	< 0.091	0.17	< 0.091	0.17
O9/HB01	0.7	< 0.160	< 0.310	< 0.160	< 0.160	0.19	< 0.160	0.19
T5/HB01	0.4	< 0.083	< 0.170	< 0.083	< 0.083	0.22	< 0.083	0.22
S5/HB01	0.1	< 0.077	< 0.150	< 0.077	< 0.077	0.26	< 0.077	0.26
H7/HT01	1	< 0.091	< 0.180	< 0.091	< 0.091	0.29	< 0.091	0.29
F1/HT01	2	< 0.073	< 0.150	< 0.073	< 0.073	0.31	< 0.073	0.31
J4/HT01	2	< 0.089	< 0.180	< 0.089	< 0.089	0.33	< 0.089	0.33
V5/HB01	0.2	< 0.160	< 0.310	< 0.160	< 0.160	0.34	< 0.160	0.34
L9/HB01	0.5	< 0.038	0.12	< 0.038	< 0.038	0.18	0.043	0.343
U7/HT01	1	< 0.045	< 0.090	< 0.045	< 0.045	0.35	< 0.045	0.35
J6/HB01	0.5	< 0.040	0.097	< 0.040	< 0.040	0.27	< 0.040	0.367
P7/HB01	0.7	< 0.200	< 0.410	< 0.200	< 0.200	0.46	< 0.200	0.46
V9/HB01	0.6	< 0.083	0.19	< 0.083	< 0.083	0.28	< 0.083	0.47
N1/HB01	0.6	< 0.072	< 0.140	< 0.072	0.18	0.27	0.086	0.536
M10/HB01	0.6	< 0.039	< 0.077	< 0.039	0.061	0.46	0.062	0.583
I9/HB01	0.4	< 0.200	< 0.400	< 0.200	< 0.200	0.67	< 0.200	0.67
M3/HT01	2	< 0.038	0.092	0.053	< 0.038	0.47	0.1	0.715
E6/HT01	2	< 0.077	0.22	0.1	< 0.077	0.41	0.097	0.827
E9/HB01	1.1	0.079	< 0.150	< 0.077	< 0.077	0.61	0.14	0.829
P6/HB01	0.5	< 0.230	< 0.470	< 0.230	< 0.230	0.98	< 0.230	0.98
R6/HB01	0.2	0.12	0.29	< 0.080	< 0.080	0.93	0.13	1.47
G4/HB01	0.3	0.11	0.18	0.18	< 0.037	1	0.16	1.63
G6/HB01	0.1	0.22	0.18	0.23	< 0.072	0.98	0.095	1.705
I11/HT01	2	< 0.180	< 0.360	0.24	< 0.180	1.2	0.28	1.72
P10/HB01	1	0.78	0.94	< 0.210	< 0.210	1.5	< 0.210	3.22
Q8/HB01	1	< 2.600	< 5.100	< 2.600	< 2.600	3.4	< 2.600	3.4
K5/HB01	0.5	0.19	0.14	0.27	< 0.036	4.8	0.47	5.87
P11/HT01	2	< 4.900	< 9.900	< 4.900	< 4.900	6.8	< 4.900	6.8
L7/HB01	0.6	0.46	< 0.370	< 0.190	0.86	6.3	0.49	8.11
O4/HB01	1.5	0.39	1.2	0.82	< 0.080	5.3	0.66	8.37
B9/HT01	2	1.9	1.8	1.6	< 0.200	5.7	0.95	11.95
N8/HB01	0.6	1.3	0.46	< 0.220	0.6	12	15	29.36
J8/HB01	0.7	16	< 5.200	< 2.600	24	150	32	222

LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>2-4.5)	Fluorene	Naphthalene	Acenaphthene	Acenaph- thylene	Phenanthrene	Anthracene	TOTAL LPAHs
V3/HB01	2.5	< 0.043	< 0.086	< 0.043	< 0.043	< 0.043	< 0.043	ND
I4/HB01	2.5	< 0.056	< 0.110	< 0.056	< 0.056	< 0.056	< 0.056	ND
S7/HT01	4	< 0.053	< 0.110	< 0.053	< 0.053	< 0.053	< 0.053	ND
W7/HB01	2.5	< 0.035	< 0.071	< 0.035	< 0.035	< 0.035	< 0.035	ND
A11/HT01	4	< 0.040	< 0.080	< 0.040	< 0.040	< 0.040	< 0.040	ND
Q9/HB01	2.5	< 5.400	< 1.000	< 5.400	< 5.400	< 5.400	< 5.400	ND
E7/HT01	2.5	< 0.380	< 0.760	< 0.380	< 0.380	< 0.380	< 0.380	ND
R12/HT01	3	< 0.740	< 1.500	< 0.740	< 0.740	< 0.740	< 0.740	ND
Q6/HB01	3	< 0.120	< 0.250	< 0.120	< 0.120	< 0.120	< 0.120	ND
L10/HB01	2.5	< 0.040	< 0.080	< 0.040	< 0.040	< 0.040	< 0.040	ND
K3/HT01	4	< 0.055	< 0.110	< 0.055	< 0.055	< 0.055	< 0.055	ND
O10/HB01	2.5	< 0.048	< 0.096	< 0.048	< 0.048	< 0.048	< 0.048	ND
R1/HB01	2.5	< 0.083	< 0.170	< 0.083	< 0.083	0.13	< 0.083	0.13
G10/HT01	3	< 0.038	< 0.077	< 0.038	< 0.038	0.15	< 0.038	0.15
B3/HB01	2.5	< 0.180	< 0.370	< 0.180	< 0.180	0.2	< 0.180	0.2
L11/HB01	2.5	< 0.100	< 0.210	< 0.100	< 0.100	0.27	< 0.100	0.27
N2/HB01	2.5	< 0.083	< 0.170	< 0.083	< 0.083	0.34	< 0.083	0.34
C5/HT01	4	< 0.200	< 0.400	< 0.200	< 0.200	0.34	< 0.200	0.34
C11/HT01	4	< 0.110	< 0.210	< 0.110	< 0.110	0.35	< 0.110	0.35
E11/HT01	4	< 0.220	< 0.440	< 0.220	< 0.220	0.55	< 0.220	0.55
M1/HB01	2.5	0.14	< 0.190	< 0.093	0.52	1.1	0.3	2.06
Q5/HT01	4	1.2	0.55	0.48	< 0.270	0.96	< 0.270	3.19
J5/HB01	2.5	20	22	12	< 0.230	49	< 0.230	103

Site	Depth-ft (>4.5-7)	Fluorene	Naphthalene	Acenaphthene	Acenaph- thylene	Phenanthrene	Anthracene	TOTAL LPAHs
P1/HB01	5	< 0.049	< 0.098	< 0.049	< 0.049	< 0.049	< 0.049	ND
J11/HT01	7	< 0.043	< 0.086	< 0.043	< 0.043	< 0.043	< 0.043	ND
R13/HT01	6	< 0.190	< 0.370	< 0.190	< 0.190	< 0.190	< 0.190	ND
F5/HT01	5	< 0.044	< 0.088	< 0.044	< 0.044	< 0.044	< 0.044	ND
L1/HB01	5	< 0.049	< 0.098	< 0.049	< 0.049	< 0.049	< 0.049	ND
D12/HT01	7	< 0.740	< 1.500	< 0.740	< 0.740	< 0.740	< 0.740	ND
J3/HB01	5	< 0.047	< 0.094	< 0.047	< 0.047	< 0.047	< 0.047	ND
F6/HB01	5	< 0.040	< 0.080	< 0.040	< 0.040	< 0.040	< 0.040	ND
V7/HB01	5	< 0.042	< 0.084	< 0.042	< 0.042	< 0.042	< 0.042	ND
D1/HT01	5	< 0.260	< 0.510	< 0.260	< 0.260	< 0.260	< 0.260	ND
Q11/HB01	5	< 0.042	< 0.084	< 0.042	< 0.042	< 0.042	< 0.042	ND
C3/HT01	5	< 0.180	< 0.350	< 0.180	< 0.180	< 0.180	< 0.180	ND
M9/HB01	5	< 0.051	< 0.100	< 0.051	< 0.051	< 0.051	< 0.051	ND
D9/HT01	5	< 0.041	< 0.083	< 0.041	< 0.041	< 0.041	< 0.041	ND
I6/HB01	5	0.047	< 0.087	< 0.043	< 0.043	0.16	< 0.043	0.207
R5/HT01	7	0.25	< 0.160	< 0.082	< 0.082	0.57	< 0.082	0.82
Q7/HB01	5	0.35	< 0.340	< 0.170	< 0.170	1	< 0.170	1.35
J9/HB01	5	0.15	< 0.210	< 0.100	0.14	1.7	0.11	2.1
A3/HT01	5	1.3	0.75	0.78	< 0.086	2.1	< 0.086	4.93
U2/HB01	5	2	< 0.310	0.68	< 0.150	3.4	< 0.150	6.08
H11/HT01	5.5	2.7	9.9	2.5	< 0.340	5.8	0.65	21.55

LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>7')	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
A13/HB01	7.5	< 0.041	< 0.082	< 0.041	< 0.041	< 0.041	< 0.041	ND
S9/HB01	7.5	< 0.042	< 0.084	< 0.042	< 0.042	< 0.042	< 0.042	ND
R2/HB01	7.5	< 0.095	< 0.190	< 0.095	< 0.095	< 0.095	< 0.095	ND
Q4/HB01	7.5	< 0.044	< 0.088	< 0.044	< 0.044	< 0.044	< 0.044	ND
N3/HB01	7.5	< 0.044	< 0.088	< 0.044	< 0.044	< 0.044	< 0.044	ND
N6/HB01	7.5	< 0.043	< 0.086	< 0.043	< 0.043	< 0.043	< 0.043	ND
W5/HB01	7.5	< 0.043	< 0.086	< 0.043	< 0.043	< 0.043	< 0.043	ND
W12/HB01	7.5	< 0.042	< 0.083	< 0.042	< 0.042	< 0.042	< 0.042	ND
B11/HT01	8	< 0.100	< 0.200	< 0.100	< 0.100	< 0.100	< 0.100	ND
O3/HB01	7.5	< 0.046	< 0.093	< 0.046	< 0.046	< 0.046	< 0.046	ND
K6/HB01	7.5	< 0.043	< 0.085	< 0.043	< 0.043	< 0.043	< 0.043	ND
P9/HB01	7.5	< 0.091	< 0.180	< 0.091	< 0.091	0.18	< 0.091	0.18
G5/HB01	7.5	< 0.049	< 0.098	< 0.049	< 0.049	0.25	< 0.049	0.25
A1/HT01	9	< 0.057	0.78	< 0.057	< 0.057	< 0.057	< 0.057	0.78
U1/HB01	7.5	0.8	1.3	0.29	< 0.041	1.3	< 0.041	3.69
T3/HB01	7.5	2.5	< 0.400	1.2	< 0.200	3.2	< 0.200	6.9
P9/HB01	* 11	< 0.087	< 0.170	< 0.087	< 0.087	< 0.087	< 0.087	ND
N3/HB01	* 11	< 0.043	< 0.087	< 0.043	< 0.043	< 0.043	< 0.043	ND
L1/HB01	* 11	< 0.049	< 0.099	< 0.049	< 0.049	< 0.049	< 0.049	ND
R1/HB01	* 11	< 0.084	< 0.170	< 0.084	< 0.084	0.15	< 0.084	0.15
A3/HT01	* 11	< 0.079	0.3	0.48	< 0.079	1.4	0.21	2.39

*Replicate samples

LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2)	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
LB19	0.5	< 0.532	< 0.55	< 1.376	< 0.147	< 0.789	< 0.624	ND
LS11	0.5	< 0.197	< 0.204	< 0.51	< 0.054	< 0.293	< 0.231	ND
LS6	0.5	< 0.196	< 0.203	< 0.507	< 0.054	< 0.291	< 0.23	ND
LB9	1.5	< 0.22	< 0.227	< 0.568	< 0.061	< 0.326	< 0.258	ND
LSD4	0	< 0.591	< 0.612	< 1.529	< 0.163	< 0.877	< 0.693	ND
LS3	0.5	< 0.232	< 0.24	< 0.6	< 0.064	< 0.344	< 0.272	ND
LS5	0.5	< 0.21	< 0.217	< 0.543	< 0.058	< 0.312	< 0.246	ND
LB9	0	< 0.23	< 0.238	< 0.595	< 0.063	< 0.341	< 0.27	ND
LB1	1.5	< 0.388	< 0.401	< 1.003	< 0.107	< 0.575	< 0.455	ND
LB24	1.5	< 0.504	< 0.522	< 1.304	< 0.139	< 0.748	< 0.591	ND
LW2S	0	< 0.186	< 0.192	< 0.481	< 0.051	< 0.276	< 0.218	ND
LB20	1.5	< 2.181	< 2.257	< 5.642	< 0.602	< 3.235	< 2.558	ND
LSD3	0	< 0.43	< 0.444	< 1.111	< 0.119	< 0.637	< 0.504	ND
ES1	0	< 0.025	< 0.026	< 0.16	< 0.035	< 0.018	< 0.075	ND
LS2	0.5	< 0.203	< 0.21	< 0.524	< 0.056	0.05	< 0.238	0.05
LS1	0.5	< 0.207	< 0.214	< 0.536	< 0.057	0.055	< 0.243	0.055
LB27	0	< 0.387	< 0.4	< 1	< 0.107	0.07	< 0.453	0.07
LB28	0	< 0.374	< 0.387	< 0.968	< 0.103	0.085	< 0.439	0.085
ES2	0	< 0.025	< 0.026	< 0.16	< 0.035	0.098	< 0.073	0.098
S1 S2	0	< 0.05	< 0.05	< 0.05	< 0.05	0.12	< 0.05	0.12
LB16	0	< 0.453	< 0.469	< 1.172	< 0.125	0.16	< 0.531	0.16
LW9S	0	< 0.199	< 0.205	< 0.514	< 0.055	0.14	0.033	0.173
LB6	0	< 0.206	0.08	< 0.534	< 0.057	0.1	< 0.242	0.18
LW6S	1.5	< 0.46	< 0.476	< 1.19	< 0.127	0.21	< 0.54	0.21
LB22	1.5	< 0.374	< 0.387	< 0.968	< 0.103	0.22	< 0.439	0.22
LB18	1.5	< 0.809	< 0.837	< 20.92	< 0.223	0.24	< 0.948	0.24
LW6S	1.5	< 0.43	< 0.444	< 1.111	< 0.119	0.26	< 0.504	0.26
LW7S	0	< 0.205	< 0.212	< 0.53	< 0.057	0.21	0.14	0.35
LB18	1.5	< 1.62	< 1.676	< 4.19	< 0.447	0.36	< 1.899	0.36
LB11	0	< 0.423	< 0.438	< 1.095	< 0.117	0.36	< 0.496	0.36
LS10	0	< 0.207	< 0.214	< 0.536	< 0.057	0.34	0.062	0.402
LW5S	1.5	< 0.244	< 0.252	< 0.63	< 0.067	0.49	0.04	0.53
LB13	1.5	< 0.921	< 0.952	< 2.381	< 0.254	0.54	< 1.079	0.54
LB26	1.5	< 0.598	< 0.619	< 1.546	< 0.165	0.52	0.08	0.6
LB28	1.5	< 0.443	0.23	< 1.145	< 0.122	0.41	0.075	0.715
LS9	0	0.11	< 0.196	0.089	< 0.052	0.42	0.14	0.759
LB8	0	< 0.408	0.38	< 1.056	< 0.113	0.42	< 0.479	0.8
LW5S	1.5	< 0.226	0.2	< 0.584	< 0.062	0.65	0.047	0.897
LB23	0.5	< 0.607	0.79	< 1.571	< 0.168	0.29	< 0.712	1.08
LSD1	0	< 0.642	< 0.664	< 1.659	< 0.177	1.2	< 0.752	1.2
LB21	0.5	< 1.197	0.41	< 3.096	< 0.33	0.87	< 1.404	1.28
LB17	1.5	< 0.433	0.78	< 1.119	< 0.119	0.9	0.1	1.78
LW5VS	0	< 0.224	< 0.232	< 0.579	0.061	1.8	0.54	2.401
LW8S	0	0.095	0.25	0.038	0.12	2.2	0.23	2.933
LB25	0	< 0.383	0.23	< 0.99	< 0.106	3.1	0.71	4.04
LW13S	0	0.45	0.1	< 0.714	< 0.076	3.8	0.38	4.73
LB12	1.5	< 0.577	5.7	< 1.493	< 0.159	0.22	< 0.677	5.92
LS7	0.5	0.65	< 0.244	0.48	< 0.065	4.9	0.39	6.92
LB3	1.5	0.94	1.2	1.1	< 0.061	3.3	0.49	7.03
LB3	1.5	0.94	2.6	1.3	< 0.16	6.8	1.2	12.84
LW11S	0	6.8	1	2.8	1.5	18	1	31.1
LW11S	1.5	27	56	8.6	5.9	76	8	181.5
LW11VS	2	30	72	11	84	81	4.5	282.5

LOW MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HISTORIC DATA

Site	Depth-ft (>2-4.5)	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
LB10	3	< 0.218	< 0.226	< 0.564	< 0.06	< 0.323	< 0.256	ND
LB4	3	< 0.943	< 0.976	< 2.439	< 0.26	< 1.398	< 1.106	ND
LW1S	4.5	< 0.204	< 0.211	< 0.528	< 0.056	< 0.303	< 0.239	ND
LB14	3	< 0.518	< 0.536	< 1.339	< 0.143	0.22	< 0.607	0.22
LW10S	3	0.25	< 0.361	< 0.904	< 0.096	< 0.518	< 0.41	0.25
LW2S	3	< 0.225	0.25	< 0.581	< 0.062	< 0.333	< 0.264	0.25
LW5VS	3	< 0.234	< 0.242	< 0.605	< 0.065	0.24	0.03	0.27
LB5	3	< 0.448	0.19	< 1.158	< 0.124	0.32	< 0.525	0.51
LB2	4.5	< 0.218	0.34	< 0.564	< 0.06	0.28	0.04	0.66
LB7	3	< 0.655	0.45	< 1.695	< 0.181	1.6	0.1	2.15
LW3S	3	0.43	0.52	0.48	< 0.252	2.8	0.34	4.57
LW12S	2.5	7.8	6.2	2	5	20	< 0.382	41
LW11S	3	34	76	10	6.9	83	2	211.9

Site	Depth-ft (>4.5-7)	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
LW1S	6	< 0.374	< 0.387	< 0.968	< 0.103	< 0.555	< 0.439	ND
LW7S	6	< 0.204	< 0.211	< 0.528	< 0.056	< 0.303	< 0.239	ND
LB2	6	< 0.304	< 0.314	< 0.785	< 0.084	0.18	< 0.356	0.18
LW11S	6	3.1	8.1	0.76	2.1	11	0.19	25.25

Site	Depth-ft (>7)	Fluorene	Naphthalene	Acenaphthene	Acenaph-thylene	Phenanthrene	Anthracene	TOTAL LPAHs
LB9	10.5	< 1.084	< 1.121	< 2.804	< 0.299	< 1.607	< 1.271	0
LW11S	9	3.7	8	13	11	11	0.42	47.12
LW11S	7.5	7.4	18	3.1	1.2	23	1.2	53.9

HPAH DATA

HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
HART CROWSER 1988 DATA

Site	Depth-ft (0-2)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
T5/HB01	0.4	< 0.083	< 0.083	< 0.083	< 0.083	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	ND
V1/HB01	0.3	< 0.180	< 0.180	< 0.180	< 0.180	< 0.370	< 0.370	< 0.370	< 0.370	< 0.370	< 0.370	ND
M8/HB01	0.7	< 0.100	< 0.100	< 0.100	< 0.100	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	ND
L3/HT01	2	< 0.037	< 0.037	< 0.037	< 0.037	< 0.073	< 0.073	< 0.073	< 0.073	< 0.073	< 0.073	ND
B13/HB01	0.2	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	< 0.077	< 0.077	< 0.077	< 0.077	ND
O3/HB01	0.5	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	< 0.076	< 0.076	< 0.076	< 0.076	ND
D8/HB01	1	< 2.600	< 2.600	< 2.600	< 2.600	< 5.100	< 5.100	< 5.100	< 5.100	< 5.100	< 5.100	ND
O2/HB01	2	< 0.084	< 0.084	< 0.084	< 0.084	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	ND
R4/HB01	0.5	< 2.300	< 2.300	< 2.300	< 2.300	< 4.600	< 4.600	< 4.600	< 4.600	< 4.600	< 4.600	ND
C12/HT01	2	< 0.075	< 0.075	< 0.075	< 0.075	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	ND
W3/HB01	0.2	< 0.160	< 0.160	< 0.160	< 0.160	< 0.330	< 0.330	< 0.330	< 0.330	< 0.330	< 0.330	ND
B1/HB01	0.2	0.088	< 0.076	< 0.076	< 0.076	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	0.088
H7/HT01	1	< 0.091	< 0.091	< 0.091	< 0.091	0.22	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	0.22
S2/HB01	1.2	< 0.068	< 0.068	< 0.068	< 0.068	0.28	< 0.140	< 0.140	< 0.140	< 0.140	< 0.140	0.28
D11/HT01	1.5	0.037	0.043	0.053	< 0.037	< 0.074	0.09	0.09	< 0.031	< 0.074	< 0.074	0.313
R7/HB01	0.6	0.13	0.11	0.13	< 0.091	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	0.37
S5/HB01	0.1	0.082	0.088	< 0.077	< 0.077	0.2	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	0.37
M6/HB01	0.6	< 0.035	< 0.035	< 0.035	< 0.035	0.07	0.07	0.07	0.07	0.07	0.07	0.42
U3/HB01	0	0.16	0.15	0.14	0.098	< 0.140	< 0.140	< 0.140	< 0.140	< 0.140	< 0.140	0.548
P2/HB01	1.9	0.15	0.16	0.16	0.12	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	0.59
P7/HB01	0.7	< 0.200	< 0.200	0.45	0.21	< 0.410	< 0.410	< 0.410	< 0.410	< 0.410	< 0.410	0.66
O9/HB01	0.7	0.29	0.26	0.23	0.21	< 0.310	< 0.310	< 0.310	< 0.310	< 0.310	< 0.310	0.99
V9/HB01	0.6	0.28	0.2	0.2	0.17	< 0.170	0.17	< 0.170	< 0.170	< 0.170	< 0.170	1.02
P10/HB01	1	< 0.210	0.43	0.65	< 0.210	< 0.420	< 0.420	< 0.420	< 0.420	< 0.420	< 0.420	1.08
L9/HB01	0.5	0.17	0.23	0.29	0.18	0.2	0.24	0.17	0.14	< 0.076	0.18	1.8
J4/HT01	2	0.34	0.3	0.3	0.19	0.24	0.37	0.28	< 0.180	< 0.180	< 0.180	2.02
U7/HT01	1	0.27	0.28	0.26	0.19	0.23	0.45	0.24	0.16	< 0.090	0.16	2.24
T11/HB01	1	< 0.790	< 0.790	< 0.790	< 0.790	2.3	< 1.600	< 1.600	< 1.600	< 1.600	< 1.600	2.3
G6/HB01	0.1	0.44	0.37	0.39	0.24	0.23	0.31	0.21	0.18	< 0.140	0.24	2.61
V5/HB01	0.2	0.64	0.47	0.4	0.29	0.37	0.49	0.32	< 0.310	< 0.310	< 0.310	2.98
I9/HB01	0.4	0.89	0.77	0.6	0.33	< 0.400	0.61	< 0.400	< 0.400	< 0.400	< 0.400	3.2
P6/HB01	0.5	0.28	0.35	0.66	0.44	< 0.470	0.77	0.77	< 0.470	< 0.470	< 0.470	3.27
N1/HB01	0.6	0.34	0.9	0.53	0.41	0.32	0.22	0.23	0.18	< 0.140	0.19	3.32
J6/HB01	0.5	0.28	0.23	0.19	0.31	0.27	0.75	0.75	0.34	0.081	0.33	3.531
E9/HB01	1.1	0.81	0.59	0.39	0.4	0.37	0.43	0.27	0.22	< 0.150	0.19	3.67
R6/HB01	0.2	0.48	0.68	0.73	0.43	0.2	0.69	0.69	0.16	< 0.160	< 0.160	4.06
M10/HB01	0.6	0.65	0.75	0.63	0.42	0.55	0.61	0.5	0.3	0.077	0.29	4.777
B9/HT01	2	1.8	1.5	0.53	0.52	< 0.410	0.46	0.46	< 0.410	< 0.410	< 0.410	5.27
P11/HT01	2	< 4.900	< 4.900	5.3	< 4.900	< 9.900	< 9.900	< 9.900	< 9.900	< 9.900	< 9.900	5.3
K11/HT01	2	0.74	1.1	1.4	1.1	2.3	4.1	4.1	1.6	0.66	1.7	18.8
E6/HT01	2	1.2	1.2	2.4	1.8	2.6	3.8	1.7	3.1	1.1	2.6	21.5
F1/HT01	2	0.95	1.7	2.2	2.1	2	5.6	5.6	2.4	0.92	2.4	25.87
M3/HT01	2	1.4	2	2.3	2.4	2.3	6.1	6.1	2.1	1.3	2	28
L7/HB01	0.6	7.5	5.1	3.4	2.1	3	3	2.2	1.5	< 0.370	1.3	29.1
N8/HB01	0.6	3.4	·3.3	20	7.1	2	1.7	1.8	0.88	< 0.430	0.88	41.06
D4/HB01	1.5	8.2	5.1	4.8	6.7	4.6	10	2.6	3.3	1.2	3.1	49.6
G4/HB01	0.3	2.4	2.5	3.4	3.4	4.9	12	12	4.4	1.4	4.3	50.7
K5/HB01	0.5	13	12	6.4	12	9.3	21	21	6.3	2.8	5.2	109
I11/HT01	2	3	5	11	9.5	16	28	28	10	3.9	9.8	124.2
J8/HB01	0.7	200	280	88	120	98	78	66	75	16	64	1085

HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>2-4.5)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
V3/HB01	2.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	ND
L10/HB01	2.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	ND
B3/HB01	2.5	< 0.180	< 0.180	< 0.180	< 0.180	< 0.370	< 0.370	< 0.370	< 0.370	< 0.370	< 0.370	ND
A11/HT01	4	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	ND
W7/HB01	2.5	< 0.035	< 0.035	< 0.035	< 0.035	< 0.071	< 0.071	< 0.071	< 0.071	< 0.071	< 0.071	ND
K3/HT01	4	< 0.055	< 0.055	< 0.055	< 0.055	< 0.110	< 0.110	< 0.110	< 0.110	< 0.110	< 0.110	ND
D9/HB01	2.5	< 5.400	< 5.400	< 5.400	< 5.400	< 1.000	< 1.000	< 1.000	< 1.000	< 1.000	< 1.000	ND
E7/HT01	2.5	< 0.380	< 0.380	< 0.380	< 0.380	< 0.760	< 0.760	< 0.760	< 0.760	< 0.760	< 0.760	ND
C11/HT01	4	< 0.110	< 0.110	< 0.110	< 0.110	0.36	< 0.210	< 0.210	< 0.210	< 0.210	< 0.210	0.36
D10/HB01	2.5	< 0.048	< 0.048	< 0.048	< 0.048	0.7	< 0.096	< 0.096	< 0.096	< 0.096	< 0.096	0.7
E11/HT01	4	0.22	< 0.220	< 0.220	< 0.220	0.48	< 0.440	< 0.440	< 0.440	< 0.440	< 0.440	0.7
I4/HB01	2.5	< 0.056	< 0.056	< 0.056	< 0.056	0.98	< 0.110	< 0.110	< 0.110	< 0.110	< 0.110	0.98
O5/HT01	4	< 0.270	< 0.270	< 0.270	< 0.270	1.3	< 0.540	< 0.540	< 0.540	< 0.540	< 0.540	1.3
S7/HT01	4	< 0.053	< 0.053	< 0.053	< 0.053	1.4	< 0.110	< 0.110	< 0.110	< 0.110	< 0.110	1.4
R12/HT01	3	< 0.740	< 0.740	< 0.740	< 0.740	1.5	< 1.500	< 1.500	< 1.500	< 1.500	< 1.500	1.5
O6/HB01	3	< 0.120	< 0.120	< 0.120	< 0.120	1.7	< 0.250	< 0.250	< 0.250	< 0.250	< 0.250	1.7
C5/HT01	4	0.22	0.28	0.26	0.25	< 0.400	0.42	0.42	< 0.400	< 0.400	< 0.400	1.85
L11/HB01	2.5	0.44	0.34	0.26	0.26	0.23	0.35	< 0.210	< 0.210	< 0.210	< 0.210	1.88
R1/HB01	2.5	0.35	0.44	0.49	0.43	0.66	0.58	0.6	0.49	< 0.170	0.45	4.49
N2/HB01	2.5	0.66	0.65	0.64	0.54	0.65	0.6	0.58	0.42	< 0.170	0.47	5.21
M1/HB01	2.5	0.82	1.7	0.91	0.82	0.53	0.4	0.37	< 0.190	< 0.190	< 0.190	5.55
G10/HT01	3	0.34	0.41	0.44	0.42	0.72	1.5	1.5	0.61	0.25	0.59	6.78
J5/HB01	2.5	19	7.7	3	2.4	0.97	2.7	2.7	0.6	< 0.470	< 0.470	39.07

Site	Depth-ft (>4.5-7)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
F6/HB01	5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	ND
D1/HT01	5	< 0.260	< 0.260	< 0.260	< 0.260	< 0.510	< 0.510	< 0.510	< 0.510	< 0.510	< 0.510	ND
D9/HT01	5	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	ND
R5/HT01	7	< 0.082	< 0.082	< 0.082	< 0.082	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	ND
C3/HT01	5	< 0.180	< 0.180	< 0.180	< 0.180	< 0.350	< 0.350	< 0.350	< 0.350	< 0.350	< 0.350	ND
I6/HB01	5	< 0.043	< 0.043	< 0.043	< 0.043	0.122	< 0.087	< 0.087	< 0.087	< 0.087	< 0.087	0.122
U2/HB01	5	< 0.150	0.15	< 0.150	< 0.150	< 0.310	< 0.310	< 0.310	< 0.310	< 0.310	< 0.310	0.15
J11/HT01	7	< 0.043	< 0.043	< 0.043	< 0.043	0.2	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	0.2
F5/HT01	5	< 0.044	< 0.044	< 0.044	< 0.044	0.23	< 0.088	< 0.088	< 0.088	< 0.088	< 0.088	0.23
O11/HB01	5	< 0.042	< 0.042	< 0.042	< 0.042	0.31	< 0.084	< 0.084	< 0.084	< 0.084	< 0.084	0.31
V7/HB01	5	< 0.042	< 0.042	< 0.042	< 0.042	0.41	< 0.084	< 0.084	< 0.084	< 0.084	< 0.084	0.41
P1/HB01	5	< 0.049	< 0.049	< 0.049	< 0.049	0.91	< 0.098	< 0.098	< 0.098	< 0.098	< 0.098	0.91
M9/HB01	5	< 0.051	< 0.051	< 0.051	< 0.051	0.92	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	0.92
J3/HB01	5	< 0.047	< 0.047	< 0.047	< 0.047	1	< 0.094	< 0.094	< 0.094	< 0.094	< 0.094	1
O7/HB01	5	< 0.170	< 0.170	< 0.170	< 0.170	1.5	< 0.340	< 0.340	< 0.340	< 0.340	< 0.340	1.5
A3/HT01	5	0.71	0.41	0.14	0.12	0.35	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	1.73
D12/HT01	7	< 0.740	< 0.740	< 0.740	< 0.740	2.2	< 1.500	< 1.500	< 1.500	< 1.500	< 1.500	2.2
R13/HT01	6	< 0.190	< 0.190	0.23	< 0.190	< 0.370	0.9	0.9	0.37	< 0.370	0.48	2.88
H11/HT01	5.5	0.42	0.89	0.94	0.66	< 0.680	0.74	0.74	< 0.680	< 0.680	< 0.680	4.39
J9/HB01	5	1.2	1.3	0.52	0.41	0.48	0.49	0.28	0.27	< 0.210	0.29	5.24
L1/HB01	5	< 0.049	< 0.049	< 0.049	< 0.049	7.8	< 0.098	< 0.098	< 0.098	< 0.098	< 0.098	7.8

HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>7)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
N6/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	ND
A13/HB01	7.5	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.082	< 0.082	< 0.082	< 0.082	< 0.082	ND
T3/HB01	7.5	< 0.200	< 0.200	< 0.200	< 0.200	< 0.400	< 0.400	< 0.400	< 0.400	< 0.400	< 0.400	ND
N3/HB01	7.5	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.088	< 0.088	< 0.088	< 0.088	< 0.088	ND
S9/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	0.19	< 0.084	< 0.084	< 0.084	< 0.084	< 0.084	0.19
K6/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	0.29	< 0.085	< 0.085	< 0.085	< 0.085	< 0.085	0.29
B11/HT01	8	< 0.100	< 0.100	< 0.100	< 0.100	0.31	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	0.31
P9/HB01	7.5	0.12	0.22	< 0.091	< 0.091	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	0.34
W5/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	0.38	< 0.086	< 0.086	< 0.086	< 0.086	< 0.086	0.38
R2/HB01	7.5	< 0.095	< 0.095	< 0.095	< 0.095	0.45	< 0.190	< 0.190	< 0.190	< 0.190	< 0.190	0.45
W12/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	0.45	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	0.45
A1/HT01	9	< 0.057	< 0.057	< 0.057	< 0.057	0.45	< 0.110	< 0.110	< 0.110	< 0.110	< 0.110	0.45
U1/HB01	7.5	< 0.041	< 0.041	< 0.041	< 0.041	1.5	< 0.083	< 0.083	< 0.083	< 0.083	< 0.083	1.5
O3/HB01	7.5	< 0.046	< 0.046	< 0.046	< 0.046	1.6	< 0.093	< 0.093	< 0.093	< 0.093	< 0.093	1.6
Q4/HB01	7.5	< 0.044	< 0.044	< 0.044	< 0.044	1.8	< 0.088	< 0.088	< 0.088	< 0.088	< 0.088	1.8
G5/HB01	7.5	< 0.049	< 0.049	< 0.049	< 0.049	1.8	< 0.098	< 0.098	< 0.098	< 0.098	< 0.098	1.8
P9/HB01	# 11	< 0.087	< 0.087	< 0.087	< 0.087	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	ND
N3/HB01	# 11	< 0.043	< 0.043	< 0.043	< 0.043	0.8	< 0.087	< 0.087	< 0.087	< 0.087	< 0.087	0.8
A3/HT01	# 11	0.93	0.53	0.2	0.16	0.17	0.3	0.3	< 0.160	< 0.160	< 0.160	2.59
R1/HB01	# 11	0.4	0.46	0.58	0.51	0.77	0.64	0.69	0.54	< 0.170	0.46	5.05
L1/HB01	# 11	< 0.049	< 0.049	< 0.049	< 0.049	6.2	< 0.099	< 0.099	< 0.099	< 0.099	< 0.099	6.2

Replicate samples

HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
LB19	0.5	< 0.294	< 0.385	< 0.165	< 0.092	< 0.202	< 0.716	< 0.606	< 0.385	< 0.349	< 0.624	ND
LS6	0.5	< 0.108	< 0.142	< 0.061	< 0.034	< 0.074	< 0.264	< 0.223	< 0.142	< 0.128	< 0.23	ND
LSD4	0	< 0.326	< 0.428	< 0.183	< 0.102	< 0.224	< 0.795	< 0.673	< 0.428	< 0.387	< 0.693	ND
LB22	1.5	< 0.206	< 0.271	< 0.116	< 0.065	< 0.142	< 0.503	< 0.426	< 0.271	< 0.245	< 0.439	ND
ES1	0	< 0.25	< 0.38	< 0.1	< 0.075	< 0.09	< 0.056	< 0.13	< 0.38	< 0.37	< 0.21	ND
LSD3	0	< 0.237	< 0.311	< 0.133	< 0.074	< 0.163	< 0.578	< 0.489	< 0.311	< 0.281	< 0.504	ND
LB20	1.5	< 1.204	< 1.58	< 0.677	< 0.376	< 0.827	< 2.934	< 2.482	< 1.58	< 1.429	< 2.558	ND
LB13	1.5	< 0.508	< 0.667	< 0.286	< 0.159	< 0.349	< 1.238	< 1.048	< 0.667	< 0.603	< 1.079	ND
LB23	0.5	< 0.335	< 0.44	< 0.188	< 0.105	< 0.23	< 0.817	< 0.691	< 0.44	< 0.398	< 0.712	ND
LB24	1.5	< 0.278	< 0.365	< 0.157	< 0.087	< 0.191	< 0.678	< 0.574	< 0.365	< 0.33	< 0.591	ND
LB16	0	< 0.25	< 0.328	< 0.141	< 0.078	< 0.172	< 0.609	< 0.516	< 0.328	< 0.297	< 0.531	ND
LB9	1.5	< 0.121	< 0.159	< 0.068	< 0.038	< 0.083	< 0.295	< 0.25	< 0.159	< 0.144	< 0.258	ND
LB1	1.5	< 0.214	< 0.281	< 0.12	< 0.067	< 0.147	< 0.522	< 0.441	< 0.281	< 0.254	< 0.455	ND
LS1	0.5	< 0.114	< 0.15	< 0.064	< 0.036	< 0.079	< 0.279	< 0.236	< 0.15	< 0.136	< 0.243	ND
LS11	0.5	< 0.109	< 0.143	< 0.061	< 0.034	< 0.075	< 0.265	< 0.224	< 0.143	< 0.129	< 0.231	ND
LB9	0	< 0.127	< 0.167	< 0.071	< 0.04	< 0.087	< 0.31	< 0.262	< 0.167	< 0.151	< 0.27	ND
LS5	0.5	< 0.116	< 0.152	< 0.065	< 0.036	< 0.08	< 0.283	< 0.239	< 0.152	< 0.138	< 0.246	ND
ES2	0	0.037	0.049	< 0.1	< 0.076	< 0.091	< 0.057	< 0.13	< 0.38	< 0.37	< 0.22	0.086
LS3	0.5	< 0.128	0.11	< 0.072	< 0.04	< 0.088	< 0.312	< 0.264	< 0.168	< 0.152	< 0.272	0.11
S1 S2	0	< 0.05	0.05	< 0.05	< 0.05	0.12	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.17
LB8	0	< 0.225	0.23	< 0.127	< 0.07	< 0.155	< 0.549	< 0.465	< 0.296	< 0.268	< 0.479	0.23
LW2S	0	0.084	0.044	< 0.058	< 0.032	0.027	0.05	0.05	< 0.135	< 0.122	< 0.218	0.255
LB18	1.5	< 0.446	< 0.586	< 0.251	0.27	< 0.307	< 1.088	< 0.921	< 0.586	< 0.53	< 0.948	0.27
LS2	0.5	0.16	0.13	< 0.063	< 0.035	< 0.077	< 0.273	< 0.231	< 0.147	< 0.133	< 0.238	0.29
LB18	1.5	< 0.894	< 1.173	< 0.503	0.36	< 0.615	< 2.179	< 1.844	< 1.173	< 1.061	< 1.899	0.36
LB6	0	0.17	0.11	0.093	0.067	< 0.078	0.1	0.1	< 0.149	< 0.135	< 0.242	0.64
LSD1	0	< 0.354	< 0.465	< 0.199	0.65	< 0.243	< 0.863	< 0.73	< 0.465	< 0.42	< 0.752	0.65
LB28	0	0.08	0.075	0.12	0.1	0.13	0.26	0.26	< 0.271	< 0.245	< 0.439	1.025
LW13S	0	0.54	0.23	0.18	0.1	< 0.105	0.11	0.11	< 0.2	< 0.18	0.072	1.342
LW9S	0	0.27	0.19	0.23	0.16	0.16	0.35	0.35	0.12	0.061	0.15	2.041
LW5S	1.5	0.26	0.2	0.54	0.27	0.26	0.35	0.35	0.11	0.051	0.22	2.611
LW5S	1.5	0.28	0.21	0.61	0.23	0.25	0.39	0.39	0.086	0.046	0.13	2.622
LB21	0.5	< 0.66	0.88	0.49	0.41	< 0.454	0.62	0.62	< 0.867	< 0.784	< 1.404	3.02
LB12	1.5	0.279	0.25	0.22	0.22	0.45	0.85	0.85	< 0.418	< 0.378	0.3	3.419
LB27	0	0.17	0.19	0.36	0.25	0.52	0.84	0.84	< 0.28	< 0.253	0.45	3.62
LB3	1.5	1.8	0.93	0.3	0.27	0.18	0.29	0.29	< 0.159	< 0.144	< 0.258	4.06
LS9	0	1.2	0.58	0.34	0.28	0.24	0.5	0.5	0.23	0.057	0.25	4.177
LB17	1.5	0.65	0.48	0.55	0.4	0.53	1.1	1.1	< 0.313	< 0.284	< 0.507	4.81
LW6S	1.5	0.69	0.49	0.62	0.45	0.46	0.85	0.85	< 0.333	< 0.302	0.54	4.95
LW5VS	0	0.124	0.162	0.87	0.77	0.56	0.95	0.95	0.34	0.079	0.47	5.275
LW7S	0	1.1	0.73	0.72	0.46	0.34	0.75	0.75	0.32	0.18	0.43	5.78
LW11S	0	< 1.118	2.1	2.7	1	< 0.769	< 2.725	< 2.306	< 1.467	< 1.328	< 2.376	5.8
LB26	1.5	0.98	0.7	0.81	0.58	0.56	1.1	1.1	< 0.433	< 0.392	0.56	6.39
LW8S	0	2.3	0.98	0.63	0.55	0.29	0.65	0.65	0.18	< 0.142	0.21	6.44
LB11	0	0.74	0.75	0.98	0.62	0.72	1.6	1.6	< 0.307	< 0.277	0.66	7.67
LS10	0	1.2	0.55	0.94	0.5	0.59	1.4	1.4	0.47	0.24	0.5	7.79
LB3	1.5	5.2	3.2	1.2	1	0.45	0.99	0.99	0.23	< 0.38	0.26	13.52
LW11VS	2	< 2.943	10	< 1.3	4.3	< 2.023	< 7.172	< 6.069	< 3.862	< 3.494	< 6.253	14.3
LW6S	1.5	2.4	1.6	2.2	1.7	1.8	3.2	3.2	1.6	< 0.281	2	19.7
LS7	0.5	3.7	3.5	2.8	3.1	1.9	3.9	3.9	1.2	0.49	1.1	25.59
LB25	0	7.2	5.5	3.4	2.8	1.8	4.1	4.1	1.5	0.64	1.4	32.44
LW11S	1.5	< 2.667	8.3	15	3.8	2.8	1.6	1.6		< 3.167	1.1	34.2
LB28	1.5	1.8	2	3.3	2.7	4.6	9.3	9.3	4.8	< 0.29	5.2	43

HIGH MOLECULAR WEIGHT POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL - CONTINUED
HISTORIC DATA

Site	Depth-ft (>2-4.5)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
LB4	3	< 0.52	< 0.683	< 0.293	< 0.163	< 0.358	< 1.268	< 1.073	< 0.683	< 0.618	< 1.106	ND
LB10	3	< 0.12	< 0.158	< 0.068	< 0.038	< 0.083	< 0.293	< 0.248	< 0.158	< 0.143	< 0.256	ND
LW2S	3	< 0.124	< 0.163	< 0.07	< 0.039	< 0.085	< 0.302	< 0.256	< 0.163	< 0.147	< 0.264	ND
LW1S	4.5	< 0.113	< 0.148	< 0.063	< 0.035	< 0.077	< 0.275	< 0.232	< 0.148	< 0.134	< 0.239	ND
LW10S	3	< 0.193	< 0.253	< 0.108	< 0.06	< 0.133	< 0.47	< 0.398	< 0.253	< 0.229	< 0.41	ND
LB2	4.5	0.22	0.19	< 0.068	0.06	< 0.083	< 0.293	< 0.248	< 0.158	< 0.143	< 0.256	0.47
LW12S	2.5	1.2	0.44	0.15	0.071	< 0.124	< 0.438	< 0.371	< 0.236	< 0.213	< 0.382	1.861
LW5VS	3	0.37	0.22	0.34	0.22	0.18	0.4	0.4	0.13	< 0.153	0.16	2.42
LB7	3	1.3	0.7	0.44	0.27	< 0.249	< 0.881	< 0.746	< 0.475	< 0.429	< 0.768	2.71
LW3S	3	1.5	0.75	0.34	0.27	0.17	0.27	0.27	< 0.661	< 0.598	< 1.071	3.57
LB5	3	0.45	0.35	0.42	0.31	0.33	0.7	0.7	0.29	< 0.293	0.31	3.86
LB14	3	0.67	0.49	0.93	0.59	0.9	1.8	1.8	< 0.375	< 0.339	0.9	8.08
LW11S	3	< 2.427	9.1	20	4.2	< 1.668	< 5.915	< 5.005		< 2.882	< 5.156	33.3

Site	Depth-ft (>4.5-7)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
LW1S	6	< 0.206	< 0.271	< 0.116	< 0.065	< 0.142	< 0.503	< 0.426	< 0.271	< 0.245	< 0.439	ND
LW7S	6	< 0.113	< 0.148	< 0.063	< 0.035	< 0.077	< 0.275	< 0.232	< 0.148	< 0.134	< 0.239	ND
LB2	6	< 0.168	< 0.22	< 0.094	< 0.052	< 0.115	< 0.408	< 0.346	< 0.22	< 0.199	< 0.356	ND
LW11S	6	< 0.143	0.99	1.1	0.44	< 0.099	< 0.35	< 0.296	< 0.188	< 0.17	< 0.305	2.53

Site	Depth-ft (>7)	Fluoranthene	Pyrene	Chrysene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	TOTAL HPAHs
LB9	10.5	< 0.598	< 0.785	< 0.336	< 0.187	< 0.411	< 1.458	< 1.234	< 0.785	< 0.71	< 1.271	ND
LW11S	9	1	1	1.3	0.41	< 0.351	< 1.243	< 1.052	< 0.669	< 0.606	< 1.084	3.71
LW11S	7.5	2.1	2.3	2.8	0.85	2.5	< 2.466	< 2.087	< 1.328	< 1.202	< 2.15	10.55

PHTHALATES DATA

PHTHALATES IN SOIL
HART CROWSER 1988 DATA

Site	Depth in ft (0-2)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
O9/HB01	0.7	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	ND
P6/HB01	0.5	< 0.230	< 0.230	< 0.230	< 0.230	< 0.230	< 0.230	ND
H7/HT01	1	< 0.091	< 0.091	< 0.091	< 0.091	< 0.091	< 0.091	ND
R4/HB01	0.5	< 2.300	< 2.300	< 2.300	< 2.300	< 2.300	< 2.300	ND
K11/HT01	2	< 0.074	< 0.074	< 0.074	< 0.074	< 0.074	< 0.074	ND
W3/HB01	0.2	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	ND
T11/HB01	1	< 0.790	< 0.790	< 0.790	< 0.790	< 0.790	< 0.790	ND
Q8/HB01	1	< 2.600	< 2.600	< 2.600	< 2.600	< 2.600	< 2.600	ND
V5/HB01	0.2	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	ND
P10/HB01	1	< 0.210	< 0.210	< 0.210	< 0.210	< 0.210	< 0.210	ND
P11/HT01	2	< 4.900	< 4.900	< 4.900	< 4.900	< 4.900	< 4.900	ND
I9/HB01	0.4	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	ND
J8/HB01	0.7	< 2.600	< 2.600	< 2.600	< 2.600	< 2.600	< 2.600	ND
Q3/HB01	0.5	< 0.038	< 0.038	< 0.130	< 0.038	< 0.038	< 0.038	ND
G6/HB01	0.1	< 0.072	< 0.072	< 0.072	< 0.072	< 0.072	< 0.072	ND
S5/HB01	0.1	< 0.077	< 0.077	< 0.077	< 0.077	< 0.077	< 0.077	ND
I11/HT01	2	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	ND
O4/HB01	1.5	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	ND
B9/HT01	2	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	ND
L3/HT01	2	< 0.037	< 0.037	0.038	< 0.037	< 0.037	< 0.037	0.038
L9/HB01	0.5	< 0.038	< 0.038	0.044	< 0.038	< 0.038	< 0.038	0.044
M10/HB01	0.6	< 0.039	< 0.039	0.052	< 0.039	< 0.039	< 0.039	0.052
M6/HB01	0.6	< 0.035	< 0.035	0.068	< 0.035	< 0.035	< 0.035	0.068
S2/HB01	1.2	< 0.068	< 0.068	0.07	< 0.068	< 0.068	< 0.068	0.07
N1/HB01	0.6	< 0.072	< 0.072	0.073	< 0.072	< 0.072	< 0.072	0.073
C12/HT01	2	< 0.075	< 0.075	0.077	< 0.075	< 0.075	< 0.075	0.077
G4/HB01	0.3	< 0.037	< 0.037	0.079	< 0.037	< 0.037	< 0.037	0.079
V9/HB01	0.6	< 0.083	< 0.083	0.086	< 0.083	< 0.083	< 0.083	0.086
E6/HT01	2	< 0.033	< 0.077	0.087	< 0.033	< 0.077	< 0.077	0.087
J6/HB01	0.5	< 0.040	< 0.040	0.087	< 0.040	< 0.040	< 0.040	0.087
Q2/HB01	2	< 0.084	< 0.084	0.09	< 0.084	< 0.084	< 0.084	0.09
J4/HT01	2	< 0.089	< 0.089	0.093	< 0.089	< 0.089	< 0.089	0.093
U3/HB01	0	< 0.073	< 0.073	0.12	< 0.073	< 0.073	< 0.073	0.12
M3/HT01	2	< 0.038	< 0.038	0.073	0.047	< 0.038	< 0.038	0.12
T5/HB01	0.4	< 0.083	< 0.083	0.12	< 0.083	< 0.083	< 0.083	0.12
K5/HB01	0.5	0.054	< 0.036	0.073	< 0.036	< 0.036	< 0.036	0.127
R6/HB01	0.2	< 0.080	< 0.080	0.13	< 0.080	< 0.080	< 0.080	0.13
E9/HB01	1.1	< 0.077	< 0.077	0.14	< 0.077	< 0.077	< 0.077	0.14
R7/HB01	0.6	< 0.091	< 0.091	0.15	< 0.091	< 0.091	< 0.091	0.15
U7/HT01	1	< 0.045	< 0.045	0.16	< 0.045	< 0.045	< 0.045	0.16
P2/HB01	1.9	< 0.080	< 0.080	0.21	< 0.080	< 0.080	< 0.080	0.21
V1/HB01	0.3	< 0.180	< 0.180	0.27	< 0.180	< 0.180	< 0.180	0.27
P7/HB01	0.7	< 0.200	< 0.200	0.29	< 0.200	< 0.200	< 0.200	0.29
M8/HB01	0.7	0.14	< 0.100	0.17	< 0.100	< 0.100	< 0.100	0.31
F1/HT01	2	0.14	< 0.073	0.2	< 0.073	< 0.073	< 0.073	0.34
L7/HB01	0.6	< 0.190	< 0.190	0.34	< 0.190	< 0.190	< 0.190	0.34
B13/HB01	0.2	< 0.039	< 0.039	0.64	< 0.039	< 0.039	< 0.039	0.64
D11/HT01	1.5	< 0.037	0.83	0.16	< 0.037	< 0.037	< 0.037	0.99
B1/HB01	0.2	< 0.076	< 0.076	1.2	< 0.076	< 0.076	< 0.076	1.2
N8/HB01	0.6	2.2	< 0.220	0.42	0.35	< 0.220	< 0.220	2.97

PHTHALATES IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth in ft (>2-4.5)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
G10/HT01	3	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	ND
Q9/HB01	2.5	< 5.400	< 5.400	< 5.400	< 5.400	< 5.400	< 5.400	ND
C5/HT01	4	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	ND
L10/HB01	2.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	ND
K3/HT01	4	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	ND
W7/HB01	2.5	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	ND
V3/HB01	2.5	< 0.043	< 0.043	0.064	< 0.043	< 0.043	< 0.043	0.064
S7/HT01	4	< 0.053	< 0.053	0.068	< 0.053	< 0.053	< 0.053	0.068
I4/HB01	2.5	< 0.056	< 0.056	0.069	< 0.056	< 0.056	< 0.056	0.069
O10/HB01	2.5	0.09	< 0.048	< 0.048	< 0.048	< 0.048	< 0.048	0.09
L11/HB01	2.5	< 0.100	< 0.100	0.11	< 0.100	< 0.100	< 0.100	0.11
R1/HB01*	2.5	< 0.083	< 0.083	0.21	< 0.083	< 0.083	< 0.083	0.21
M1/HB01	2.5	< 0.093	< 0.093	0.23	< 0.093	< 0.093	< 0.093	0.23
C11/HT01	4	< 0.110	< 0.110	0.24	< 0.110	< 0.110	< 0.110	0.24
B3/HB01	2.5	< 0.180	< 0.180	0.3	< 0.180	< 0.180	< 0.180	0.3
Q6/HB01	3	< 0.120	< 0.120	0.37	< 0.120	< 0.120	< 0.120	0.37
E11/HT01	4	< 0.220	< 0.220	0.41	< 0.220	< 0.220	< 0.220	0.41
J5/HB01	2.5	< 0.230	< 0.230	0.44	< 0.230	< 0.230	< 0.230	0.44
Q5/HT01	4	< 0.270	< 0.270	0.81	< 0.270	< 0.270	< 0.270	0.81
A11/HT01	4	< 0.040	< 0.040	0.82	< 0.040	< 0.040	< 0.040	0.82
N2/HB01	2.5	< 0.083	< 0.083	0.39	0.57	< 0.083	< 0.083	0.96
E7/HT01	2.5	< 0.380	< 0.380	1.1	< 0.380	< 0.380	< 0.380	1.1
R12/HT01	3	< 0.740	< 0.740	1.9	< 0.740	< 0.740	< 0.740	1.9

* Values indicate the average of replicate samples

Site	Depth in ft (>4.5-7)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
R13/HT01	6	< 0.190	< 0.190	< 0.190	< 0.190	< 0.190	< 0.190	ND
D12/HT01	7	< 0.740	< 0.740	< 0.740	< 0.740	< 0.740	< 0.740	ND
J11/HT01	7	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	ND
J9/HB01	5	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100	ND
C3/HT01	5	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	< 0.180	ND
D1/HT01	5	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	< 0.260	ND
Q7/HB01	5	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	< 0.170	ND
V7/HB01	5	< 0.042	< 0.042	0.048	< 0.042	< 0.042	< 0.042	0.048
I6/HB01	5	< 0.043	< 0.043	0.048	< 0.043	< 0.043	< 0.043	0.048
M9/HB01	5	< 0.051	< 0.051	0.059	< 0.051	< 0.051	< 0.051	0.059
D9/HT01	5	< 0.041	< 0.041	0.063	< 0.041	< 0.041	< 0.041	0.063
Q11/HB01	5	< 0.042	< 0.042	0.095	< 0.042	< 0.042	< 0.042	0.095
F5/HT01	5	< 0.044	< 0.044	0.1	< 0.044	< 0.044	< 0.044	0.1
R5/HT01	7	< 0.082	< 0.082	0.11	< 0.082	< 0.082	< 0.082	0.11
F6/HB01	5	< 0.040	< 0.040	0.11	< 0.040	< 0.040	< 0.040	0.11
L1/HB01*	5	< 0.049	< 0.049	0.135	< 0.049	< 0.049	< 0.049	0.135
J3/HB01	5	< 0.047	< 0.047	0.16	< 0.047	< 0.047	< 0.047	0.16
A3/HT01*	5	< 0.086	< 0.086	0.18	< 0.086	< 0.086	< 0.086	0.18
U2/HB01	5	< 0.150	< 0.150	0.21	< 0.150	< 0.150	< 0.150	0.21
P1/HB01	5	< 0.049	< 0.049	0.35	< 0.049	< 0.049	< 0.049	0.35
H11/HT01	5.5	< 0.340	< 0.340	0.75	< 0.340	< 0.340	< 0.340	0.75

* Values indicate the average of replicate samples

PHTHALATES IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth in ft (>7)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
S9/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	ND
W5/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	ND
U1/HB01	7.5	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	ND
R2/HB01	7.5	< 0.095	< 0.095	< 0.390	< 0.095	< 0.095	< 0.095	ND
N3/HB01*	7.5	< 0.043	< 0.043	0.049	< 0.043	< 0.043	< 0.043	0.049
O3/HB01	7.5	< 0.046	< 0.046	0.05	< 0.046	< 0.046	< 0.046	0.05
A1/HT01	9	< 0.057	< 0.057	0.084	< 0.057	< 0.057	< 0.057	0.084
A13/HB01	7.5	< 0.041	< 0.041	0.089	< 0.041	< 0.041	< 0.041	0.089
N6/HB01	7.5	< 0.043	< 0.043	0.1	< 0.043	< 0.043	< 0.043	0.1
P9/HB01*	7.5	< 0.091	< 0.091	0.11	< 0.091	< 0.091	< 0.091	0.11
K6/HB01	7.5	< 0.043	< 0.043	0.11	< 0.043	< 0.043	< 0.043	0.11
Q4/HB01	7.5	< 0.044	< 0.044	0.14	< 0.044	< 0.044	< 0.044	0.14
G5/HB01	7.5	< 0.049	< 0.049	0.15	< 0.049	< 0.049	< 0.049	0.15
W12/HB01	7.5	< 0.042	< 0.042	0.15	< 0.042	< 0.042	< 0.042	0.15
B11/HT01	8	< 0.100	< 0.100	0.3	< 0.100	< 0.100	< 0.100	0.3
T3/HB01	7.5	< 0.200	< 0.200	0.52	< 0.200	< 0.200	< 0.200	0.52

* Values indicate the average of replicate samples

PHTHALATES IN SOIL
HISTORIC DATA

Site	Depth in ft (0-2)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
LB19	0.5	< 0.752	< 0.789	< 0.642	< 0.183	< 0.569	< 0.275	ND
LB25	0	< 0.541	< 0.568	< 0.462	< 0.132	< 0.409	< 0.198	ND
LS2	0.5	< 0.287	< 0.301	< 0.245	< 0.07	< 0.217	< 0.105	ND
LB8	0	< 0.577	< 0.606	< 0.493	< 0.141	< 0.437	< 0.211	ND
ES1	0	< 0.15	< 0.11	< 0.087	< 0.33	< 0.028	< 0.079	ND
LW9S	0	< 0.281	< 0.295	< 0.24	< 0.068	< 0.212	< 0.103	ND
LW11VS	2	< 7.54	< 7.908	< 6.437	< 0.67	< 5.701	< 2.759	ND
LW5VS	0	< 0.317	< 0.332	< 0.27	< 0.077	< 0.239	< 0.116	ND
LW13S	0	< 0.39	< 0.41	< 0.333	< 0.095	< 0.295	< 0.143	ND
LB20	1.5	< 3.084	< 3.235	< 2.633	< 0.752	< 2.332	< 1.128	ND
LB13	1.5	< 1.302	< 1.365	< 1.111	< 0.317	< 0.984	< 0.476	ND
LB12	1.5	< 0.816	< 0.856	< 0.697	< 0.199	< 0.617	< 0.299	ND
LSD3	0	< 0.607	< 0.637	< 0.519	< 0.148	< 0.459	< 0.222	ND
LB1	1.5	< 0.548	< 0.575	< 0.468	< 0.134	< 0.415	< 0.201	ND
ES2	0	< 0.15	< 0.11	< 0.087	< 0.33	< 0.028	< 0.08	ND
LB28	0	< 0.529	< 0.555	< 0.452	< 0.129	< 0.4	< 0.194	ND
LB28	1.5	< 0.626	< 0.656	< 0.534	< 0.153	< 0.473	< 0.229	ND
LS3	0.5	< 0.328	< 0.344	< 0.28	< 0.08	< 0.248	< 0.12	ND
LB23	0.5	< 0.859	< 0.901	< 0.733	< 0.209	< 0.649	< 0.314	ND
LB21	0.5	< 1.692	< 1.775	< 1.445	< 0.413	< 1.28	< 0.619	ND
LB24	1.5	< 0.713	< 0.748	< 0.609	< 0.174	< 0.539	< 0.261	ND
LS6	0.5	< 0.277	< 0.291	< 0.236	< 0.068	< 0.209	< 0.101	ND
LB26	1.5	< 0.845	< 0.887	< 0.722	< 0.206	< 0.639	< 0.309	ND
LB27	0	< 0.547	< 0.573	< 0.467	< 0.133	< 0.413	< 0.2	ND
LB9	1.5	< 0.311	< 0.326	< 0.265	< 0.076	< 0.235	< 0.114	ND
LS1	0.5	< 0.293	< 0.307	< 0.25	< 0.071	< 0.221	< 0.107	ND
LB11	0	< 0.599	< 0.628	< 0.511	< 0.146	< 0.453	< 0.219	ND
LB16	0	< 0.641	< 0.372	< 0.547	< 0.156	< 0.484	< 0.234	ND
LB17	1.5	< 0.612	< 0.642	0.08	< 0.149	< 0.463	< 0.224	0.08
LW5S	1.5	< 0.345	< 0.361	0.11	< 0.084	< 0.261	< 0.126	0.11
LS7	0.5	< 0.334	< 0.35	0.15	< 0.081	< 0.252	< 0.122	0.15
LB9	0	< 0.325	< 0.341	0.18	< 0.079	< 0.246	< 0.119	0.18
LB22	1.5	< 0.529	< 0.555	0.2	< 0.129	< 0.4	< 0.194	0.2
LW2S	0	< 0.263	< 0.276	0.22	< 0.064	< 0.199	< 0.096	0.22
LW7S	0	0.082	< 0.304	0.18	< 0.071	< 0.219	< 0.106	0.262
S1 S2	0	< 0.05	< 0.05	0.12	0.15	< 0.05	< 0.05	0.27
LS11	0.5	0.33	< 0.293	< 0.238	< 0.068	< 0.211	< 0.102	0.33
LW6S	1.5	< 0.651	< 0.683	0.37	< 0.159	< 0.492	< 0.238	0.37
LW5S	1.5	< 0.319	< 0.335	0.39	< 0.078	< 0.241	< 0.117	0.39
LB3	1.5	< 0.311	< 0.326	0.31	0.11	< 0.235	< 0.114	0.42
LB3	1.5	< 0.82	< 0.86	0.41	0.18	< 0.62	< 0.3	0.59
LW6S	1.5	< 0.607	< 0.637	0.6	< 0.148	< 0.459	< 0.222	0.6
LB18	1.5	< 2.291	0.67	< 1.955	< 0.559	< 1.732	< 0.838	0.67
LSD4	0	< 0.836	< 0.877	0.71	< 0.204	< 0.632	< 0.306	0.71
LB18	1.5	< 1.144	0.88	< 0.976	< 0.279	< 0.865	< 0.418	0.88
LW11S	0	< 2.865	< 3.004	< 2.445	< 0.699	< 2.166	0.89	0.89
LW8S	0	0.21	0.52	0.3	< 0.075	< 0.232	< 0.112	1.03
LS5	0.5	< 0.297	1.6	0.51	< 0.072	< 0.225	< 0.109	2.11
LB6	0	< 0.292	0.49	2.7	0.047	< 0.221	< 0.107	3.237
LS10	0	0.083	< 0.307	3.7	< 0.071	< 0.221	< 0.107	3.783
LW11S	1.5	< 6.833	< 7.167	6.3	< 1.667	< 5.167	< 2.5	6.3
LS9	0	0.084	< 0.281	14	< 0.065	< 0.203	< 0.098	14.084
LSD1	0	< 0.907	< 0.951	9	11	< 0.686	< 0.332	20

PHTHALATES IN SOIL
HISTORIC DATA - CONTINUED

Site	Depth in ft (>2-4.5)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
LB10	3	< 0.308	< 0.323	< 0.263	< 0.075	< 0.233	< 0.113	ND
LW12S	2.5	< 0.461	< 0.483	< 0.393	< 0.112	< 0.348	< 0.169	ND
LW5VS	3	< 0.331	< 0.347	< 0.282	< 0.081	< 0.25	< 0.121	ND
LB5	3	< 0.633	< 0.664	< 0.541	< 0.154	< 0.479	< 0.232	ND
LB14	3	< 0.732	< 0.768	< 0.625	< 0.179	< 0.554	< 0.268	ND
LB4	3	< 1.333	< 1.398	< 1.138	< 0.325	< 1.008	< 0.488	ND
LW11S	3	< 6.218	< 6.521	< 5.308	< 1.517	< 4.701	< 2.275	ND
LW10S	3	< 0.494	< 0.518	< 0.422	< 0.12	< 0.373	< 0.181	ND
LW1S	4.5	< 0.289	< 0.303	< 0.246	< 0.07	< 0.218	< 0.106	ND
LW2S	3	< 0.318	< 0.333	0.17	< 0.078	< 0.24	< 0.116	0.17
LB7	3	< 0.927	< 0.972	0.43	< 0.226	< 0.701	< 0.339	0.43
LW3S	3	< 1.291	< 1.354	0.49	< 0.315	< 0.976	< 0.472	0.49
LB2	4.5	< 0.308	15	0.19	< 0.075	< 0.233	< 0.113	15.19

Site	Depth in ft (>4.5-7)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
LW1S	6	< 0.529	< 0.555	< 0.452	< 0.129	< 0.4	< 0.194	ND
LW7S	6	< 0.289	< 0.303	< 0.246	< 0.07	< 0.218	< 0.106	ND
LW11S	6	< 0.368	< 0.386	0.43	< 0.09	< 0.278	< 0.135	0.43
LB2	6	< 0.429	2.3	1.3	< 0.105	< 0.325	< 0.157	3.6

Site	Depth in ft (>7)	Di-n-butyl phthalate	Butyl-benzyl-phthalate	Bis(2-ethylhexyl) phthalate	Di-n-octyl phthalate	Dimethyl phthalate	Diethyl phthalate	TOTAL PHTHALATES
LW11S	7.5	< 2.593	< 2.719	< 2.213	< 0.632	< 1.96	< 0.949	ND
LB9	10.5	< 1.533	< 1.607	< 1.308	< 0.374	< 1.159	< 0.561	ND
LW11S	9	< 1.307	< 1.371	< 1.116	0.67	< 0.988	< 0.478	0.67

PHENOL DATA

PHENOLIC COMPOUNDS IN SOIL
HART CROWSER 1988 DATA

Site	Depth in ft (0-2)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
D9/HB01	0.7	< 1.600	< 1.600	< 1.600	< 0.160	< 0.160	< 0.160	< 0.160	< 0.310	< 0.160	< 0.310	< 0.310	< 0.310	< 0.310	ND
U3/HB01	0	< 0.730	< 0.730	< 0.730	< 0.073	< 0.073	< 0.073	< 0.073	< 0.140	< 0.073	< 0.140	< 0.140	< 0.140	< 0.140	ND
M8/HB01	0.7	< 1.000	< 1.000	< 1.000	< 0.100	< 0.100	< 0.100	< 0.100	< 0.200	< 0.100	< 0.200	< 0.200	< 0.200	< 0.200	ND
G6/HB01	0.1	< 0.720	< 0.720	< 0.720	< 0.072	< 0.072	< 0.072	< 0.072	< 0.140	< 0.072	< 0.140	< 0.140	< 0.140	< 0.140	ND
J8/HB01	0.7	< 6.000	< 6.000	< 6.000	< 2.600	< 2.600	< 2.600	< 2.600	< 5.200	< 2.600	< 5.200	< 5.200	< 5.200	< 5.200	ND
B1/HB01	0.2	< 0.760	< 0.760	< 0.760	< 0.076	< 0.076	< 0.076	< 0.076	< 0.150	< 0.076	< 0.150	< 0.150	< 0.150	< 0.150	ND
P7/HB01	0.7	< 2.000	< 2.000	< 2.000	< 0.200	< 0.200	< 0.200	< 0.200	< 0.410	< 0.200	< 0.410	< 0.410	< 0.410	< 0.410	ND
R6/HB01	0.2	< 0.800	< 0.800	< 0.800	< 0.080	< 0.080	< 0.080	< 0.080	< 0.160	< 0.080	< 0.160	< 0.160	< 0.160	< 0.160	ND
T11/HB01	1	< 7.900	< 7.900	< 7.900	< 0.790	< 0.790	< 0.790	< 0.790	< 1.600	< 0.790	< 1.600	< 1.600	< 1.600	< 1.600	ND
V1/HB01	0.3	< 1.800	< 1.800	< 1.800	< 0.180	< 0.180	< 0.180	< 0.180	< 0.370	< 0.180	< 0.370	< 0.370	< 0.370	< 0.370	ND
U7/HT01	1	< 0.450	< 0.450	< 0.450	< 0.045	< 0.045	< 0.045	< 0.045	< 0.090	< 0.045	< 0.090	< 0.090	< 0.090	< 0.090	ND
I9/HB01	0.4	< 2.000	< 2.000	< 2.000	< 0.200	< 0.200	< 0.200	< 0.200	< 0.400	< 0.200	< 0.400	< 0.400	< 0.400	< 0.400	ND
P10/HB01	1	< 2.100	< 2.100	< 2.100	< 0.210	< 0.210	< 0.210	< 0.210	< 0.420	< 0.210	< 0.420	< 0.420	< 0.420	< 0.420	ND
O3/HB01	0.5	< 0.380	< 0.380	< 0.380	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.038	< 0.076	< 0.076	< 0.076	< 0.076	ND
H7/HT01	1	< 0.910	< 0.910	< 0.910	< 0.091	< 0.091	< 0.091	< 0.091	< 0.180	< 0.091	< 0.180	< 0.180	< 0.180	< 0.180	ND
L9/HB01	0.5	< 0.380	< 0.380	< 0.380	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.038	< 0.076	< 0.076	< 0.076	< 0.076	ND
B9/HT01	2	< 2.000	< 2.000	< 2.000	< 0.200	< 0.200	< 0.200	< 0.200	< 0.410	< 0.200	< 0.410	< 0.410	< 0.410	< 0.410	ND
R4/HB01	0.5	< 3.000	< 3.000	< 3.000	< 2.300	< 2.300	< 2.300	< 2.300	< 4.600	< 2.300	< 4.600	< 4.600	< 4.600	< 4.600	ND
O8/HB01	1	< 6.000	< 6.000	< 6.000	< 2.600	< 2.600	< 2.600	< 2.600	< 5.100	< 2.600	< 5.100	< 5.100	< 5.100	< 5.100	ND
L7/HB01	0.6	< 1.900	< 1.900	< 1.900	< 0.190	< 0.190	< 0.190	< 0.190	< 0.370	< 0.190	< 0.370	< 0.370	< 0.370	< 0.370	ND
E9/HB01	1.1	< 0.770	< 0.770	< 0.770	< 0.077	< 0.077	< 0.077	< 0.077	< 0.150	< 0.077	< 0.150	< 0.150	< 0.150	< 0.150	ND
N8/HB01	0.6	< 2.200	< 2.200	< 2.200	< 0.220	< 0.220	< 0.220	< 0.220	< 0.430	< 0.220	< 0.430	< 0.430	< 0.430	< 0.430	ND
S2/HB01	1.2	< 0.680	< 0.680	< 0.680	< 0.068	< 0.068	< 0.068	< 0.068	< 0.140	< 0.068	< 0.140	< 0.140	< 0.140	< 0.140	ND
N1/HB01	0.6	< 0.720	< 0.720	< 0.720	< 0.072	< 0.072	< 0.072	< 0.072	< 0.140	< 0.072	< 0.140	< 0.140	< 0.140	< 0.140	ND
O4/HB01	1.5	< 0.800	< 0.800	< 0.800	< 0.080	< 0.080	< 0.080	< 0.080	< 0.160	< 0.080	< 0.160	< 0.160	< 0.160	< 0.160	ND
R7/HB01	0.6	< 0.910	< 0.910	< 0.910	< 0.091	< 0.091	< 0.091	< 0.091	< 0.180	< 0.091	< 0.180	< 0.180	< 0.180	< 0.180	ND
D11/HT01	1.5	< 0.370	< 0.370	< 0.370	< 0.037	< 0.037	< 0.037	< 0.037	< 0.074	< 0.037	< 0.074	< 0.074	< 0.074	< 0.074	ND
B13/HB01	0.2	< 0.390	< 0.390	< 0.390	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.039	< 0.077	< 0.077	< 0.077	< 0.077	ND
P2/HB01	1.9	< 0.800	< 0.800	< 0.800	< 0.080	< 0.080	< 0.080	< 0.080	< 0.160	< 0.080	< 0.160	< 0.160	< 0.160	< 0.160	ND
V5/HB01	0.2	< 1.600	< 1.600	< 1.600	< 0.160	< 0.160	< 0.160	< 0.160	< 0.310	< 0.160	< 0.310	< 0.310	< 0.310	< 0.310	ND
J4/HT01	2	< 0.890	< 0.890	< 0.890	< 0.089	< 0.089	< 0.089	< 0.089	< 0.180	< 0.089	< 0.180	< 0.180	< 0.180	< 0.180	ND
T5/HB01	0.4	< 0.830	< 0.830	< 0.830	< 0.083	< 0.083	< 0.083	< 0.083	< 0.170	< 0.083	< 0.170	< 0.170	< 0.170	< 0.170	ND
I11/HT01	2	< 1.800	< 1.800	< 1.800	< 0.180	< 0.180	< 0.180	< 0.180	< 0.360	< 0.180	< 0.360	< 0.360	< 0.360	< 0.360	ND
P6/HB01	0.5	< 2.300	< 2.300	< 2.300	< 0.230	< 0.230	< 0.230	< 0.230	< 0.470	< 0.230	< 0.470	< 0.470	< 0.470	< 0.470	ND
F1/HT01	2	< 0.730	< 0.730	< 0.730	< 0.073	< 0.073	< 0.073	< 0.073	< 0.150	< 0.073	< 0.150	< 0.150	< 0.150	< 0.150	ND
M10/HB01	0.6	< 0.390	< 0.390	< 0.390	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.039	< 0.077	< 0.077	< 0.077	< 0.077	ND
M3/HT01	2	< 0.380	< 0.380	< 0.380	< 0.038	< 0.038	< 0.038	< 0.038	< 0.075	< 0.038	< 0.075	< 0.075	< 0.075	< 0.075	ND
S5/HB01	0.1	< 0.770	< 0.770	< 0.770	< 0.077	< 0.077	< 0.077	< 0.077	< 0.150	< 0.077	< 0.150	< 0.150	< 0.150	< 0.150	ND
L3/HT01	2	< 0.370	< 0.370	< 0.370	< 0.037	< 0.037	< 0.037	< 0.037	< 0.073	< 0.037	< 0.073	< 0.073	< 0.073	< 0.073	ND
G4/HB01	0.3	< 0.370	< 0.370	< 0.370	< 0.037	< 0.037	< 0.037	< 0.037	< 0.073	< 0.037	< 0.073	< 0.073	< 0.073	< 0.073	ND
K11/HT01	2	< 0.740	< 0.740	< 0.740	< 0.074	< 0.074	< 0.074	< 0.074	< 0.150	< 0.074	< 0.150	< 0.150	< 0.150	< 0.150	ND
V9/HB01	0.6	< 0.830	< 0.830	< 0.830	< 0.083	< 0.083	< 0.083	< 0.083	< 0.170	< 0.083	< 0.170	< 0.170	< 0.170	< 0.170	ND
C12/HT01	2	< 0.750	< 0.750	< 0.750	< 0.075	< 0.075	< 0.075	< 0.075	< 0.150	< 0.075	< 0.150	< 0.150	< 0.150	< 0.150	ND
W3/HB01	0.2	< 1.600	< 1.600	< 1.600	< 0.160	< 0.160	< 0.160	< 0.160	< 0.330	< 0.160	< 0.330	< 0.330	< 0.330	< 0.330	ND
M6/HB01	0.6	< 0.350	< 0.350	< 0.350	< 0.035	< 0.035	< 0.035	< 0.035	< 0.070	< 0.035	< 0.070	< 0.070	< 0.070	< 0.070	ND
Q2/HB01	2	< 0.840	< 0.840	< 0.840	< 0.084	< 0.084	< 0.084	< 0.084	< 0.170	< 0.084	< 0.170	< 0.170	< 0.170	< 0.170	ND
P11/HT01	2	< 9.000	< 9.000	< 9.000	< 4.900	< 4.900	< 4.900	< 4.900	< 9.900	< 4.900	< 9.900	< 9.900	< 9.900	< 9.900	ND
K5/HB01	0.5	< 0.360	< 0.360	< 0.360	0.19	< 0.036	< 0.036	< 0.036	< 0.073	< 0.036	< 0.073	< 0.073	< 0.073	< 0.073	0.19
J6/HB01	0.5	< 0.400	< 0.400	< 0.400	0.4	< 0.040	0.1	0.16	< 0.080	0.17	< 0.080	< 0.080	< 0.080	< 0.080	0.83
E6/HT01	2	< 0.770	< 0.770	< 0.770	0.77	< 0.077	0.19	0.41	< 0.150	0.19	< 0.150	< 0.150	< 0.150	< 0.150	1.56

PHENOLIC COMPOUNDS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth in ft (>2-4.5)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
V3/HB01	2.5	< 0.430	< 0.430	< 0.430	< 0.430	< 0.430	< 0.430	< 0.430	< 0.860	< 0.430	< 0.860	< 0.860	< 0.860	< 0.860	ND
I4/HB01	2.5	< 0.560	< 0.560	< 0.560	< 0.056	< 0.056	< 0.056	< 0.056	< 0.110	< 0.056	< 0.110	< 0.110	< 0.110	< 0.110	ND
R1/HB01	2.5	< 0.830	< 0.830	< 0.830	< 0.083	< 0.083	< 0.083	< 0.083	< 0.170	< 0.083	< 0.170	< 0.170	< 0.170	< 0.170	ND
Q6/HB01	3	< 1.200	< 1.200	< 1.200	< 0.120	< 0.120	< 0.120	< 0.120	< 0.250	< 0.120	< 0.250	< 0.250	< 0.250	< 0.250	ND
M1/HB01	2.5	< 0.930	< 0.930	< 0.930	< 0.093	< 0.093	< 0.093	< 0.093	< 0.190	< 0.093	< 0.190	< 0.190	< 0.190	< 0.190	ND
E7/HT01	2.5	< 3.800	< 3.800	< 3.800	< 0.380	< 0.380	< 0.380	< 0.380	< 0.760	< 0.380	< 0.760	< 0.760	< 0.760	< 0.760	ND
C5/HT01	4	< 2.000	< 2.000	< 2.000	< 0.200	< 0.200	< 0.200	< 0.200	< 0.400	< 0.200	< 0.400	< 0.400	< 0.400	< 0.400	ND
R12/HT01	3	< 7.400	< 7.400	< 7.400	< 0.740	< 0.740	< 0.740	< 0.740	< 1.500	< 0.740	< 1.500	< 1.500	< 1.500	< 1.500	ND
B3/HB01	2.5	< 1.800	< 1.800	< 1.800	< 0.180	< 0.180	< 0.180	< 0.180	< 0.370	< 0.180	< 0.370	< 0.370	< 0.370	< 0.370	ND
S7/HT01	4	< 0.530	< 0.530	< 0.530	< 0.053	< 0.053	< 0.053	< 0.053	< 0.110	< 0.053	< 0.110	< 0.110	< 0.110	< 0.110	ND
Q9/HB01	2.5	< 4.000	< 4.000	< 4.000	< 5.400	< 5.400	< 5.400	< 5.400	< 1.000	< 5.400	< 1.000	< 1.000	< 1.000	< 1.000	ND
C11/HT01	4	< 1.100	< 1.100	< 1.100	< 0.110	< 0.110	< 0.110	< 0.110	< 0.210	< 0.110	< 0.210	< 0.210	< 0.210	< 0.210	ND
D10/HB01	2.5	< 0.480	< 0.480	< 0.480	< 0.048	< 0.048	< 0.048	< 0.048	< 0.096	< 0.048	< 0.096	< 0.096	< 0.096	< 0.096	ND
K3/HT01	4	< 0.550	< 0.550	< 0.550	< 0.055	< 0.055	< 0.055	< 0.055	< 0.110	< 0.055	< 0.110	< 0.110	< 0.110	< 0.110	ND
J5/HB01	2.5	< 2.300	< 2.300	< 2.300	< 0.230	< 0.230	< 0.230	< 0.230	< 0.470	< 0.230	< 0.470	< 0.470	< 0.470	< 0.470	ND
E11/HT01	4	< 2.200	< 2.200	< 2.200	< 0.220	< 0.220	< 0.220	< 0.220	< 0.440	< 0.220	< 0.440	< 0.440	< 0.440	< 0.440	ND
W7/HB01	2.5	< 0.350	< 0.350	< 0.350	< 0.035	< 0.035	< 0.035	< 0.035	< 0.071	< 0.035	< 0.071	< 0.071	< 0.071	< 0.071	ND
A11/HT01	4	< 0.400	< 0.400	< 0.400	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	ND
L11/HB01	2.5	< 1.000	< 1.000	< 1.000	< 0.100	< 0.100	< 0.100	< 0.100	< 0.210	< 0.100	< 0.210	< 0.210	< 0.210	< 0.210	ND
N2/HB01	2.5	< 0.830	< 0.830	< 0.830	< 0.083	< 0.083	< 0.083	< 0.083	< 0.170	< 0.083	< 0.170	< 0.170	< 0.170	< 0.170	ND
L10/HB01	2.5	< 0.400	< 0.400	< 0.400	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	ND
Q5/HT01	4	< 2.700	< 2.700	< 2.700	< 0.270	< 0.270	< 0.270	< 0.270	< 0.540	< 0.270	< 0.540	< 0.540	< 0.540	< 0.540	ND
G10/HT01	3	< 0.380	< 0.380	< 0.380	< 0.190	< 0.038	< 0.038	0.048	< 0.077	< 0.038	< 0.077	< 0.077	< 0.077	< 0.077	0.048

PHENOLIC COMPOUNDS IN SOIL
HART CROWSER 1988 DATA - CONTINUED

Site	Depth in ft (>4.5-7)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
U2/HB01	5	< 1.500	< 1.500	< 1.500	< 0.150	< 0.150	< 0.150	< 0.150	< 0.310	< 0.150	< 0.310	< 0.310	< 0.310	< 0.310	ND
H11/HT01	5.5	< 3.400	< 3.400	< 3.400	< 0.340	< 0.340	< 0.340	< 0.340	< 0.680	< 0.340	< 0.680	< 0.680	< 0.680	< 0.680	ND
Q7/HB01	5	< 1.700	< 1.700	< 1.700	< 0.170	< 0.170	< 0.170	< 0.170	< 0.340	< 0.170	< 0.340	< 0.340	< 0.340	< 0.340	ND
F5/HT01	5	< 0.440	< 0.440	< 0.440	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.044	< 0.088	< 0.088	< 0.088	< 0.088	ND
V7/HB01	5	< 0.420	< 0.420	< 0.420	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.042	< 0.084	< 0.084	< 0.084	< 0.084	ND
R13/HT01	6	< 1.900	< 1.900	< 1.900	< 0.190	< 0.190	< 0.190	< 0.190	< 0.370	< 0.190	< 0.370	< 0.370	< 0.370	< 0.370	ND
I6/HB01	5	< 0.430	< 0.430	< 0.430	< 0.043	< 0.043	< 0.043	< 0.043	< 0.087	< 0.043	< 0.087	< 0.087	< 0.087	< 0.087	ND
F6/HB01	5	< 0.400	< 0.400	< 0.400	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.040	< 0.080	< 0.080	< 0.080	< 0.080	ND
M9/HB01	5	< 0.510	< 0.510	< 0.510	< 0.051	< 0.051	< 0.051	< 0.051	< 0.100	< 0.051	< 0.100	< 0.100	< 0.100	< 0.100	ND
R5/HT01	7	< 0.820	< 0.820	< 0.820	< 0.082	< 0.082	< 0.082	< 0.082	< 0.160	< 0.082	< 0.160	< 0.160	< 0.160	< 0.160	ND
Q11/HB01	5	< 0.420	< 0.420	< 0.420	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.042	< 0.084	< 0.084	< 0.084	< 0.084	ND
J9/HB01	5	< 1.000	< 1.000	< 1.000	< 0.100	< 0.100	< 0.100	< 0.100	< 0.210	< 0.100	< 0.210	< 0.210	< 0.210	< 0.210	ND
J3/HB01	5	< 0.470	< 0.470	< 0.470	< 0.047	< 0.047	< 0.047	< 0.047	< 0.094	< 0.047	< 0.094	< 0.094	< 0.094	< 0.094	ND
D1/HT01	5	< 2.600	< 2.600	< 2.600	< 0.260	< 0.260	< 0.260	< 0.260	< 0.510	< 0.260	< 0.510	< 0.510	< 0.510	< 0.510	ND
D9/HT01	5	< 0.410	< 0.410	< 0.410	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	< 0.041	< 0.083	< 0.083	< 0.083	< 0.083	ND
P1/HB01	5	< 0.490	< 0.490	< 0.490	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.049	< 0.098	< 0.098	< 0.098	< 0.098	ND
D12/HT01	7	< 7.400	< 7.400	< 7.400	< 0.740	< 0.740	< 0.740	< 0.740	< 1.500	< 0.740	< 1.500	< 1.500	< 1.500	< 1.500	ND
C3/HT01	5	< 1.800	< 1.800	< 1.800	< 0.180	< 0.180	< 0.180	< 0.180	< 0.350	< 0.180	< 0.350	< 0.350	< 0.350	< 0.350	ND
L1/HB01	5	< 0.490	< 0.490	< 0.490	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.049	< 0.098	< 0.098	< 0.098	< 0.098	ND
J11/HT01	7	< 0.430	< 0.430	< 0.430	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.043	< 0.086	< 0.086	< 0.086	< 0.086	ND
A3/HT01*	5	< 0.860	< 0.860	< 0.860	0.24	< 0.086	< 0.086	0.12	< 0.170	< 0.086	< 0.170	< 0.170	< 0.170	< 0.170	0.36

* Replicate sample

Site	Depth in ft (>7')	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
O3/HB01	7.5	< 0.460	< 0.460	< 0.460	< 0.046	< 0.046	< 0.046	< 0.046	< 0.093	< 0.046	< 0.093	< 0.093	< 0.093	< 0.093	ND
Q4/HB01	7.5	< 0.440	< 0.440	< 0.440	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.044	< 0.088	< 0.088	< 0.088	< 0.088	ND
U1/HB01	7.5	< 0.410	< 0.410	< 0.410	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	< 0.041	< 0.083	< 0.083	< 0.083	< 0.083	ND
K6/HB01	7.5	< 0.430	< 0.430	< 0.430	< 0.043	< 0.043	< 0.043	< 0.043	< 0.085	< 0.043	< 0.085	< 0.085	< 0.085	< 0.085	ND
A13/HB01	7.5	< 0.410	< 0.410	< 0.410	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.041	< 0.082	< 0.082	< 0.082	< 0.082	ND
R2/HB01	7.5	< 0.950	< 0.950	< 0.950	< 0.095	< 0.095	< 0.095	< 0.095	< 0.190	< 0.095	< 0.190	< 0.190	< 0.190	< 0.190	ND
W5/HB01	7.5	< 0.430	< 0.430	< 0.430	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.043	< 0.086	< 0.086	< 0.086	< 0.086	ND
B11/HT01	8	< 1.000	< 1.000	< 1.000	< 0.100	< 0.100	< 0.100	< 0.100	< 0.200	< 0.100	< 0.200	< 0.200	< 0.200	< 0.200	ND
S9/HB01	7.5	< 0.420	< 0.420	< 0.420	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.042	< 0.084	< 0.084	< 0.084	< 0.084	ND
A1/HT01	9	< 0.570	< 0.570	< 0.570	< 0.057	< 0.057	< 0.057	< 0.057	< 0.110	< 0.057	< 0.110	< 0.110	< 0.110	< 0.110	ND
N6/HB01	7.5	< 0.430	< 0.430	< 0.430	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.043	< 0.086	< 0.086	< 0.086	< 0.086	ND
N3/HB01	7.5	< 0.440	< 0.440	< 0.440	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.044	< 0.088	< 0.088	< 0.088	< 0.088	ND
T3/HB01	7.5	< 2.000	< 2.000	< 2.000	< 0.200	< 0.200	< 0.200	< 0.200	< 0.400	< 0.200	< 0.400	< 0.400	< 0.400	< 0.400	ND
W12/HB01	7.5	< 0.420	< 0.420	< 0.420	< 0.042	< 0.042	< 0.042	< 0.042	< 0.083	< 0.042	< 0.083	< 0.083	< 0.083	< 0.083	ND
G5/HB01	7.5	< 0.490	< 0.490	< 0.490	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.049	< 0.098	< 0.098	< 0.098	< 0.098	ND
P9/HB01	7.5	< 0.910	< 0.910	< 0.910	< 0.091	< 0.091	< 0.091	< 0.091	< 0.180	< 0.091	< 0.180	< 0.180	< 0.180	< 0.180	ND

PHENOLIC COMPOUNDS IN SOIL
HISTORIC DATA

Site	Depth in ft (0-2)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
LB19	0.5	< 0.606	< 0.367	< 0.202	< 0.789	< 0.459	< 0.404	< 0.642	< 0.587	< 0.844	< 0.33	< 0.257	< 0.367	< 0.55	ND
LS7	0.5	< 0.269	< 0.163	< 0.09	< 0.35	< 0.204	< 0.179	< 0.285	< 0.261	< 0.375	< 0.147	< 0.114	< 0.163	< 0.244	ND
LB16	0	< 0.516	< 0.313	< 0.172	< 0.372	< 0.391	< 0.344	< 0.547	< 0.5	< 0.719	< 0.281	< 0.219	< 0.313	< 0.469	ND
LB23	0.5	< 0.691	< 0.419	< 0.23	< 0.901	< 0.524	< 0.461	< 0.733	< 0.67	< 0.963	< 0.377	< 0.293	< 0.419	< 0.628	ND
ES1	0	< 0.38	< 0.41	< 0.13	< 0.087	< 0.023	< 0.24	< 0.23	< 0.045	< 0.13	< 0.06	< 0.083	< 0.032	< 0.071	ND
LS5	0.5	< 0.239	< 0.145	< 0.08	< 0.312	< 0.181	< 0.159	< 0.254	< 0.232	< 0.333	< 0.13	< 0.101	< 0.145	< 0.217	ND
S1 S2	0	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	ND
LS2	0.5	< 0.231	< 0.14	< 0.077	< 0.301	< 0.175	< 0.154	< 0.245	< 0.224	< 0.322	< 0.126	< 0.098	< 0.14	< 0.21	ND
LW13S	0	< 0.314	< 0.19	< 0.105	< 0.41	< 0.238	< 0.21	< 0.333	< 0.305	< 0.438	< 0.171	< 0.133	< 0.19	< 0.286	ND
LS1	0.5	< 0.236	< 0.143	< 0.079	< 0.307	< 0.179	< 0.157	< 0.25	< 0.229	< 0.329	< 0.129	< 0.1	< 0.143	< 0.214	ND
LW2S	0	< 0.212	< 0.128	< 0.071	< 0.276	< 0.16	< 0.141	< 0.224	< 0.205	< 0.295	< 0.115	< 0.09	< 0.128	< 0.192	ND
LB21	0.5	< 1.362	< 0.826	< 0.454	< 1.775	< 1.032	< 0.908	< 1.445	< 1.321	< 1.889	< 0.743	< 0.578	< 0.826	< 1.238	ND
LSD3	0	< 0.489	< 0.296	< 0.163	< 0.637	< 0.37	< 0.326	< 0.519	< 0.474	< 0.681	< 0.267	< 0.207	< 0.296	< 0.444	ND
LB1	1.5	< 0.441	< 0.268	< 0.147	< 0.575	< 0.334	< 0.294	< 0.468	< 0.428	< 0.615	< 0.241	< 0.187	< 0.268	< 0.401	ND
ES2	0	< 0.38	< 0.42	< 0.13	< 0.087	< 0.023	< 0.25	< 0.24	< 0.046	< 0.13	< 0.061	< 0.084	< 0.032	< 0.072	ND
LB12	1.5	< 0.657	< 0.398	< 0.219	< 0.856	< 0.498	< 0.438	< 0.697	< 0.637	< 0.915	< 0.358	< 0.279	< 0.398	< 0.597	ND
LSD4	0	< 0.673	< 0.408	< 0.224	< 0.877	< 0.51	< 0.449	< 0.714	< 0.652	< 0.938	< 0.367	< 0.285	< 0.408	< 0.612	ND
LB25	0	< 0.436	< 0.264	< 0.145	< 0.568	< 0.33	< 0.29	< 0.462	< 0.422	< 0.607	< 0.238	< 0.185	< 0.264	< 0.396	ND
LB6	0	< 0.235	< 0.142	< 0.078	< 0.306	< 0.178	< 0.157	< 0.249	< 0.228	< 0.327	< 0.128	< 0.1	< 0.142	< 0.214	ND
LB20	1.5	< 2.482	< 1.504	< 0.827	< 3.235	< 1.881	< 1.655	< 2.633	< 2.407	< 3.46	< 1.354	< 1.053	< 1.504	< 2.257	ND
LW7S	0	< 0.233	< 0.141	< 0.078	< 0.304	< 0.177	< 0.155	< 0.247	< 0.226	< 0.325	< 0.127	< 0.099	< 0.141	< 0.212	ND
LW6S	1.5	< 0.524	< 0.317	< 0.175	< 0.683	< 0.397	< 0.349	< 0.556	< 0.508	< 0.73	< 0.286	< 0.222	< 0.317	< 0.476	ND
LB9	0	< 0.262	< 0.159	< 0.087	< 0.341	< 0.198	< 0.175	< 0.278	< 0.254	< 0.365	< 0.143	< 0.111	< 0.159	< 0.238	ND
LW5S	1.5	< 0.257	< 0.156	< 0.086	< 0.335	< 0.195	< 0.171	< 0.272	< 0.249	< 0.358	< 0.14	< 0.109	< 0.156	< 0.233	ND
LS3	0.5	< 0.264	< 0.16	< 0.088	< 0.344	< 0.2	< 0.176	< 0.28	< 0.256	< 0.368	< 0.144	< 0.112	< 0.16	< 0.24	ND
LB18	1.5	< 1.844	< 1.117	< 0.615	< 2.402	< 1.397	< 1.229	< 1.955	< 1.788	< 2.57	< 1.006	< 0.782	< 1.117	< 1.676	ND
LS6	0.5	< 0.223	< 0.135	< 0.074	< 0.291	< 0.169	< 0.149	< 0.236	< 0.216	< 0.311	< 0.122	< 0.095	< 0.135	< 0.203	ND
LB18	1.5	< 0.921	< 0.558	< 0.307	< 1.199	< 0.697	< 0.614	< 0.976	< 0.893	< 1.283	< 0.502	< 0.391	< 0.558	< 0.837	ND
LB8	0	< 0.465	< 0.282	< 0.155	< 0.606	< 0.352	< 0.31	< 0.493	< 0.451	< 0.648	< 0.254	< 0.197	< 0.282	< 0.423	ND
LB22	1.5	< 0.426	< 0.258	< 0.142	< 0.555	< 0.323	< 0.284	< 0.452	< 0.413	< 0.594	< 0.232	< 0.181	< 0.258	< 0.387	ND
LW5VS	0	< 0.255	< 0.154	< 0.085	< 0.332	< 0.193	< 0.17	< 0.27	< 0.247	< 0.355	< 0.139	< 0.108	< 0.154	< 0.232	ND
LB17	1.5	< 0.493	< 0.299	< 0.164	< 0.642	< 0.373	< 0.328	< 0.522	< 0.478	< 0.687	< 0.269	< 0.209	< 0.299	< 0.448	ND
LS9	0	< 0.216	< 0.131	< 0.072	< 0.281	< 0.163	< 0.144	< 0.229	< 0.209	< 0.301	< 0.118	< 0.092	< 0.131	< 0.196	ND
LW11VS	2	< 6.069	< 3.678	< 2.023	< 7.908	< 4.598	< 4.046	< 6.437	< 5.885	< 8.46	< 3.31	< 2.575	< 3.678	< 5.517	ND
LB9	1.5	< 0.25	< 0.152	< 0.083	< 0.326	< 0.189	< 0.167	< 0.265	< 0.242	< 0.348	< 0.136	< 0.106	< 0.152	< 0.227	ND
LW5S	1.5	< 0.277	< 0.168	< 0.092	< 0.361	< 0.21	< 0.185	< 0.294	< 0.269	< 0.387	< 0.151	< 0.118	< 0.168	< 0.252	ND
LW11S	0	< 2.306	< 1.397	< 0.769	< 3.004	< 1.747	< 1.537	< 2.445	< 2.236	< 3.214	< 1.258	< 0.978	< 1.397	< 2.096	ND
LW11S	1.5	< 5.5	< 3.333	< 1.833	< 7.167	< 4.167	< 3.667	< 5.833	< 5.333	< 7.667	< 3	< 2.333	< 3.333	< 5	ND
LS11	0.5	< 0.224	< 0.136	< 0.075	< 0.293	< 0.17	< 0.15	< 0.238	< 0.218	< 0.313	< 0.122	< 0.095	< 0.136	< 0.204	ND
LB28	1.5	< 0.504	< 0.305	< 0.168	< 0.656	< 0.382	< 0.336	< 0.534	< 0.489	< 0.702	< 0.275	< 0.214	< 0.305	< 0.458	ND
LW9S	0	< 0.226	< 0.137	< 0.075	< 0.295	< 0.171	< 0.151	< 0.24	< 0.219	< 0.315	< 0.123	< 0.096	< 0.137	< 0.205	ND
LB26	1.5	< 0.68	< 0.412	< 0.227	< 0.887	< 0.515	< 0.454	< 0.722	< 0.66	< 0.948	< 0.371	< 0.289	< 0.412	< 0.619	ND
LB11	0	< 0.482	< 0.292	< 0.161	< 0.628	< 0.365	< 0.321	< 0.511	< 0.467	< 0.672	< 0.263	< 0.204	< 0.292	< 0.438	ND
LB24	1.5	< 0.574	< 0.348	< 0.191	< 0.748	< 0.435	< 0.383	< 0.609	< 0.557	< 0.8	< 0.313	< 0.243	< 0.348	< 0.522	ND
LB28	0	< 0.426	< 0.258	< 0.142	< 0.555	< 0.323	< 0.284	< 0.452	< 0.413	< 0.594	< 0.232	< 0.181	< 0.258	< 0.387	ND
LB13	1.5	< 1.048	< 0.635	< 0.349	< 1.365	< 0.794	< 0.698	< 1.111	< 1.016	< 1.46	< 0.571	< 0.444	< 0.635	< 0.952	ND
LS10	0	< 0.236	< 0.143	< 0.079	< 0.307	< 0.179	< 0.157	< 0.25	< 0.229	< 0.329	< 0.129	< 0.1	< 0.143	< 0.214	ND
LB27	0	< 0.4[illegible]	< 0.267	< 0.147	< 0.573	< 0.333	< 0.293	< 0.467	< 0.427	< 0.613	< 0.24	< 0.187	< 0.267	< 0.4	ND
LSD1	0	< 0.73	< 0.442	< 0.243	< 0.951	< 0.553	< 0.487	< 0.774	< 0.708	< 1.018	< 0.398	< 0.31	< 0.442	< 0.664	ND
LW6S	1.5	< 0.489	< 0.296	< 0.163	< 0.637	< 0.37	< 0.326	< 0.519	< 0.474	< 0.681	< 0.267	< 0.207	< 0.296	< 0.444	ND
LW8S	0	< 0.247	< 0.15	< 0.082	0.079	< 0.187	< 0.165	< 0.262	< 0.24	< 0.345	< 0.135	< 0.105	< 0.15	< 0.225	0.079
LB3	1.5	< 0.66	< 0.4	< 0.22	0.077	< 0.5	< 0.44	0.3	< 0.64	< 0.92	< 0.36	< 0.28	< 0.4	< 0.6	0.377
LB3	1.5	< 0.25	< 0.152	< 0.083	0.27	< 0.189	< 0.167	0.29	< 0.242	< 0.348	< 0.136	< 0.106	< 0.152	< 0.227	0.56

PHENOLIC COMPOUNDS IN SOIL
HISTORIC DATA - CONTINUED

Site	Depth in ft (>2-4.5)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
LB7	3	< 0.746	< 0.452	< 0.249	< 0.972	< 0.565	< 0.497	< 0.791	< 0.723	< 1.04	< 0.407	< 0.316	< 0.452	< 0.678	ND
LW2S	3	< 0.256	< 0.155	< 0.085	< 0.333	< 0.194	< 0.171	< 0.271	< 0.248	< 0.357	< 0.14	< 0.109	< 0.155	< 0.233	ND
LW5VS	3	< 0.266	< 0.161	< 0.089	< 0.347	< 0.202	< 0.177	< 0.282	< 0.258	< 0.371	< 0.145	< 0.113	< 0.161	< 0.242	ND
LW3S	3	< 1.039	< 0.63	< 0.346	< 1.354	< 0.787	< 0.693	< 1.102	< 1.008	< 1.449	< 0.567	< 0.441	< 0.63	< 0.945	ND
LB14	3	< 0.589	< 0.357	< 0.196	< 0.768	< 0.446	< 0.393	< 0.625	< 0.571	< 0.821	< 0.321	< 0.25	< 0.357	< 0.536	ND
LW11S	3	< 5.005	< 3.033	< 1.668	< 6.521	< 3.791	< 3.336	< 5.308	< 4.853	< 6.976	< 2.73	< 2.123	< 3.033	< 4.55	ND
LB10	3	< 0.248	< 0.15	< 0.083	< 0.323	< 0.188	< 0.165	< 0.263	< 0.241	< 0.346	< 0.135	< 0.105	< 0.15	< 0.226	ND
LW10S	3	< 0.398	< 0.241	< 0.133	< 0.518	< 0.301	< 0.265	< 0.422	< 0.386	< 0.554	< 0.217	< 0.169	< 0.241	< 0.361	ND
LB5	3	< 0.51	< 0.309	< 0.17	< 0.664	< 0.386	< 0.34	< 0.541	< 0.494	< 0.71	< 0.278	< 0.216	< 0.309	< 0.463	ND
LW12S	2.5	< 0.371	< 0.225	< 0.124	< 0.483	< 0.281	< 0.247	< 0.393	< 0.36	< 0.517	< 0.202	< 0.157	< 0.225	< 0.337	ND
LB4	3	< 1.073	< 0.65	< 0.358	< 1.398	< 0.813	< 0.715	< 1.138	< 1.041	< 1.496	< 0.585	< 0.455	< 0.65	< 0.976	ND
LW1S	4.5	< 0.232	< 0.141	< 0.077	< 0.303	< 0.176	< 0.155	< 0.246	< 0.225	< 0.324	< 0.127	< 0.099	< 0.141	< 0.211	ND
LB2	4.5	< 0.248	< 0.15	< 0.083	0.23	< 0.188	< 0.165	0.21	< 0.241	< 0.246	< 0.135	< 0.105	< 0.15	< 0.226	0.44

Site	Depth in ft (>4.5-7)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
LW1S	6	< 0.426	< 0.258	< 0.142	< 0.555	< 0.323	< 0.284	< 0.452	< 0.413	< 0.594	< 0.232	< 0.181	< 0.258	< 0.387	ND
LW7S	6	< 0.232	< 0.141	< 0.077	< 0.303	< 0.176	< 0.155	< 0.246	< 0.255	< 0.324	< 0.127	< 0.099	< 0.141	< 0.211	ND
LB2	6	< 0.346	< 0.209	< 0.115	< 0.45	< 0.262	< 0.23	< 0.366	< 0.335	< 0.482	< 0.188	< 0.147	< 0.209	< 0.314	ND
LW11S	6	< 0.296	< 0.179	< 0.099	< 0.386	< 0.224	< 0.197	< 0.314	< 0.287	< 0.413	< 0.161	< 0.126	< 0.179	< 0.269	ND

Site	Depth in ft (>7)	2,4-Dinitro-phenol	4-Nitro-phenol	4,6-Dinitro-2-methyl-phenol	Phenol	2-Chloro-phenol	2-Methyl-phenol	4-Methyl-phenol	2-Nitro-phenol	2,4-Di-methyl-phenol	2,4-Di-chloro-phenol	4-Chloro-3-methyl-phenol	2,4,6-Tri-chloro-phenol	2,4,5-Tri-chloro-phenol	TOTAL PHENOLS
LW11S	7.5	< 2.087	< 1.265	< 0.696	< 2.719	< 1.581	< 1.391	< 2.213	< 2.024	< 2.909	< 1.138	< 0.885	< 1.265	< 1.897	ND
LW11S	9	< 1.052	< 0.637	< 0.351	< 1.371	< 0.797	< 0.701	< 1.116	< 1.02	< 1.466	< 0.574	< 0.446	< 0.637	< 0.956	ND
LB9	10.5	< 1.234	< 0.748	< 0.411	< 1.607	< 0.935	< 0.822	< 1.308	< 1.196	< 1.72	< 0.673	< 0.523	< 0.748	< 1.121	ND

PCB DATA

PCBs IN SOIL
HISTORIC DATA

Site	Depth-ft (0-2')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
LB6	0	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LS2	0.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LB28	0	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LB27	0	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LW5S	1.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LB11	0	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LW11VS	2	< 1.28	< 1.28	< 1.28	< 1.28	< 1.28	< 2.56	< 2.56	ND
LB18	1.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LS10	0	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	ND
LB18	1.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
S1	0	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	ND
LW6S	1.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LB21	0.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LW6S	1.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LB12	1.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.64	< 0.64	ND
LW7S	0	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LB26	1.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LW15S	1.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LW11S	1.5	< 1.28	< 1.28	< 1.28	< 1.28	< 1.28	< 2.56	< 2.56	ND
ES1	0	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.005	0.035	0.035
S1 S2	0	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.066	0.066
ES2	0	< 0.005	< 0.002	< 0.002	< 0.002	< 0.002	< 0.005	0.082	0.082
LW8S	0	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	0.093	< 0.16	0.093
LS9	0	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	0.12	< 0.16	0.12
TB-1B4	0.5							1.8	1.8
LSD1	0	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	3.1	< 0.32	3.1
LS7	0.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	4.8	< 0.32	4.8

Site	Depth-ft (>2-4.5')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
LW11S	3	< 1.28	< 1.28	< 1.28	< 1.28	< 1.28	< 2.56	< 2.56	ND
LB4	3	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LB10	3	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND
LW3S	3	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	0.11	< 0.08	0.11
LB2	4.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	0.5	< 0.32	0.5
LB7	3	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.64	24	24

Site	Depth-ft (>4.5-7')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
LW7S	6	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.16	< 0.16	ND
LW1S	6	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND

Site	Depth-ft (>7')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
LB9	7.5	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.32	< 0.32	ND

PCBs IN SOIL
HART CROWSER 1988 DATA

Site	Depth-ft (0-2')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
O9/HB01	0.7	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.078	< 0.078	ND
U3/HB01	0	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	< 0.073	< 0.073	ND
M8/HB01	0.7	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.101	< 0.101	ND
G6/HB01	0.1	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	< 0.072	< 0.072	ND
M6/HB01	0.6	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.070	< 0.070	ND
R7/HB01	0.6	< 0.045	< 0.045	< 0.045	< 0.045	< 0.045	< 0.090	< 0.090	ND
W3/HB01	0.2	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.082	ND
S5/HB01	0.1	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	ND
V5/HB01	0.2	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.078	< 0.078	ND
B13/HB01	0.2	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	ND
R6/HB01	0.2	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
V1/HB01	0.3	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	< 0.074	< 0.074	ND
T5/HB01	0.4	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	< 0.083	ND
I9/HB01	0.4	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.079	< 0.079	ND
L9/HB01	0.5	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	ND
B1/HB01	0.2	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	ND
L3/HT01	2	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	< 0.073	< 0.073	ND
P7/HB01	0.7	< 0.051	< 0.051	< 0.051	< 0.051	< 0.051	< 0.102	< 0.102	ND
Q2/HB01	2	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.084	ND
T11/HB01	1	< 0.160	< 0.160	< 0.160	< 0.160	< 0.160	< 0.320	< 0.320	ND
E6/HT01	2	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	ND
U7/HT01	1	< 0.045	< 0.045	< 0.045	< 0.045	< 0.045	< 0.090	< 0.090	ND
M10/HB01	0.6	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	ND
P10/HB01	1	< 0.045	< 0.045	< 0.045	< 0.045	< 0.045	< 0.091	< 0.091	ND
M3/HT01	2	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	ND
H7/HT01	1	< 0.046	< 0.046	< 0.046	< 0.046	< 0.046	< 0.091	< 0.091	ND
Q3/HB01	0.5	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	ND
J4/HT01	2	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 0.089	< 0.089	ND
R4/HB01	0.5	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.076	< 0.076	ND
C12/HT01	2	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	< 0.075	< 0.075	ND
P11/HT01	2	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.082	ND
S2/HB01	1.2	< 0.034	< 0.034	< 0.034	< 0.034	< 0.034	< 0.068	< 0.068	ND
P2/HB01	1.9	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
O4/HB01	1.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.081	< 0.081	ND
L7/HB01	0.6	< 0.047	< 0.047	< 0.047	< 0.047	< 0.047	< 0.094	< 0.094	ND
K5/HB01	0.5	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	< 0.073	< 0.073	ND
I11/HT01	2	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	< 0.072	< 0.072	ND
K11/HT01	2	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	< 0.074	< 0.074	ND
G4/HB01	0.3	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	0.079	< 0.073	0.079
Q8/HB01	1	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	0.095	< 0.085	0.095
V9/HB01	0.6	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	0.095	0.095
N1/HB01	0.6	< 0.036	< 0.036	< 0.036	< 0.036	< 0.036	0.1	< 0.072	0.1
J8/HB01	0.7	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	0.12	< 0.089	0.12
B9/HT01	2	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	0.15	< 0.082	0.15
P6/HB01	0.5	< 0.047	< 0.047	< 0.047	< 0.047	< 0.047	0.19	< 0.093	0.19
E9/HB01	1.1	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	0.24	< 0.077	0.24
D11/HT01	1.5	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	0.33	0.084	0.414
N8/HB01	0.6	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	0.21	0.4	0.61
F1/HT01	2	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	0.81	0.91	1.72
J6/HB01	0.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	2.4	2.3	4.7

PCBs IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>2-4.5)	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
V3/HB01	2.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
I4/HB01	2.5	< 0.056	< 0.056	< 0.056	< 0.056	< 0.056	< 0.110	< 0.110	ND
R1/HB01	2.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.083	< 0.083	ND
Q6/HB01	3	< 0.063	< 0.063	< 0.063	< 0.063	< 0.063	< 0.130	< 0.130	ND
M1/HB01	2.5	< 0.046	< 0.046	< 0.046	< 0.046	< 0.046	< 0.093	< 0.093	ND
G10/HT01	3	< 0.039	< 0.039	< 0.039	< 0.039	< 0.039	< 0.077	< 0.077	ND
E7/HT01	2.5	< 0.077	< 0.077	< 0.077	< 0.077	< 0.077	< 0.150	< 0.150	ND
R12/HT01	3	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.300	< 0.300	ND
B3/HB01	2.5	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	< 0.073	< 0.073	ND
S7/HT01	4	< 0.053	< 0.053	< 0.053	< 0.053	< 0.053	< 0.110	< 0.110	ND
Q9/HB01	2.5	< 0.045	< 0.045	< 0.045	< 0.045	< 0.045	< 0.091	< 0.091	ND
C11/HT01	4	< 0.053	< 0.053	< 0.053	< 0.053	< 0.053	< 0.110	< 0.110	ND
D10/HB01	2.5	< 0.048	< 0.048	< 0.048	< 0.048	< 0.048	< 0.096	< 0.096	ND
K3/HT01	4	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.110	< 0.110	ND
L10/HB01	2.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
E11/HT01	4	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.088	ND
W7/HB01	2.5	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.071	< 0.071	ND
A11/HT01	4	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
L11/HB01	2.5	< 0.052	< 0.052	< 0.052	< 0.052	< 0.052	< 0.100	< 0.100	ND
N2/HB01	2.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.083	< 0.083	ND
C5/HT01	4	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
Q5/HT01	4	< 0.055	< 0.055	< 0.055	< 0.055	< 0.055	< 0.110	< 0.110	ND
J5/HB01	2.5	< 0.047	< 0.047	< 0.047	< 0.047	< 0.047	0.15	< 0.094	0.15

Site	Depth-ft (>4.5-7')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
P1/HB01	5	< 0.049	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.098	ND
Q7/HB01	5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
J3/HB01	5	< 0.047	< 0.047	< 0.047	< 0.047	< 0.047	< 0.094	< 0.094	ND
V7/HB01	5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.084	ND
L1/HB01	5	< 0.049	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.098	ND
I6/HB01	5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.087	< 0.087	ND
D9/HT01	5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.083	< 0.083	ND
M9/HB01	5	< 0.051	< 0.051	< 0.051	< 0.051	< 0.051	< 0.100	< 0.100	ND
C3/HT01	5	< 0.035	< 0.035	< 0.035	< 0.035	< 0.035	< 0.070	< 0.070	ND
Q11/HB01	5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.084	ND
J9/HB01	5	< 0.052	< 0.052	< 0.052	< 0.052	< 0.052	< 0.100	< 0.100	ND
D12/HT01	7	< 0.150	< 0.150	< 0.150	< 0.150	< 0.150	< 0.290	< 0.290	ND
F5/HT01	5	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.088	ND
A3/HT01	5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
R13/HT01	6	< 0.037	< 0.037	< 0.037	< 0.037	< 0.037	< 0.075	< 0.075	ND
D1/HT01	5	< 0.051	< 0.051	< 0.051	< 0.051	< 0.051	< 0.100	< 0.100	ND
F6/HB01	5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.080	< 0.080	ND
J11/HT01	7	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
R5/HT01	7	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.082	ND
H11/HT01	5.5	< 0.068	< 0.068	< 0.068	< 0.068	< 0.068	1	0.22	1.22
U2/HB01	5	< 0.038	< 0.038	< 0.038	< 0.038	< 0.038	1.2	0.23	1.43

PCBs IN SOIL - CONTINUED
HART CROWSER 1988 DATA

Site	Depth-ft (>7')	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	TOTAL PCBs
W12/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.083	< 0.083	ND
U1/HB01	7.5	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.083	< 0.083	ND
N3/HB01	7.5	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.088	ND
A13/HB01	7.5	< 0.041	< 0.041	< 0.041	< 0.041	< 0.041	< 0.082	< 0.082	ND
P9/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.085	< 0.085	ND
W5/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
T3/HB01	7.5	< 0.040	< 0.040	< 0.040	< 0.040	< 0.040	< 0.079	< 0.079	ND
S9/HB01	7.5	< 0.042	< 0.042	< 0.042	< 0.042	< 0.042	< 0.084	< 0.084	ND
G5/HB01	7.5	< 0.049	< 0.049	< 0.049	< 0.049	< 0.049	< 0.098	< 0.098	ND
N6/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.086	< 0.086	ND
O3/HB01	7.5	< 0.046	< 0.046	< 0.046	< 0.046	< 0.046	< 0.093	< 0.093	ND
Q4/HB01	7.5	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 0.088	< 0.088	ND
K6/HB01	7.5	< 0.043	< 0.043	< 0.043	< 0.043	< 0.043	< 0.085	< 0.085	ND
R2/HB01	7.5	< 0.048	< 0.048	< 0.048	< 0.048	< 0.048	< 0.095	< 0.095	ND
B11/HT01	8	< 0.051	< 0.051	< 0.051	< 0.051	< 0.051	< 0.100	< 0.100	ND
A1/HT01	9	< 0.058	< 0.058	< 0.058	< 0.058	< 0.058	< 0.120	< 0.120	ND

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J-1639-09

SOIL QUALITY DATA AND QA/QC DOCUMENTATION
PRL SAMPLES, JANUARY 1989

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CLIENT: Hart Crowser Inc.
1910 Fairview Ave. E.
Seattle, WA 98102-3699
ATTN: Matt Dalton

LABORATORY NO. 14233

DATE: Mar. 28, 1989

JOB #1639-10

REPORT ON: SOIL

SAMPLE
IDENTIFICATION: Submitted 1/25/89 and identified as shown:

1) PRL-TP-2 (S-1) 1/19 10:15
2) PRL-TP-4 (S-1) 1/19 1:10
3) PRL-TP-6 (S-2) 1/19 3:00
4) PRL-TP-8 (S-3) 1/19 9:30

Samples were passed through a No. 10 sieve, with percent retained and description of retained matter shown below. Only material passing the sieve was analyzed.

Sample No.	% Retained	Major Description	Minor Description
1	4.	rock	----
2	20.	rock	----
3	6.	rock	----
4	<2.	---	----

	parts per million (mg/kg), dry basis			
	1	2	3	4
Total Recoverable Petroleum Hydrocarbon Oil & Grease	200.	150.	140.	33.

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	1	2	3	4
Total Solids, %	84.1	85.2	83.3	94.2
	parts per million (mg/kg), dry basis			
Total Arsenic	4.5	1.1	4.1	4.5
Total Cadmium	<0.5	<0.5	<0.5	<0.5
Total Chromium	49.	3.	46.	45.
Total Copper	31.	32.	31.	30.
Total Lead	<10.	<10.	<10.	<10.
Total Nickel	48.	3.	47.	44.
Total Zinc	55.	12.	58.	55.

Method Blanks

Blank Name	Sample No.	Analyte	Result	Units	SDL	MDL
B0131TRPH.S01	1-4	TRPH	<20.	mg/kg DB	20.	20.
B0130ICP.S01	1-4	Copper	5.	mg/kg DB	1.	1.
B0130ICP.S01	1-4	Nickel	<2.	mg/kg DB	2.	2.
B0130ICP.S01	1-4	Cadmium	<0.5	mg/kg DB	0.5	0.5
B0130ICP.S01	1-4	Lead	<10.	mg/kg DB	10.	10.
B0130ICP.S01	1-4	Chromium	<1.	mg/kg DB	1.	1.
B0130ICP.S01	1-4	Zinc	2.	mg/kg DB	1.	1.
B0131HY.S02	1-4	Arsenic	<0.5	mg/kg DB	0.5	0.5

SDL = Sample Detection Limit
MDL = Method Detection Limit
DB = Dry Basis

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Sample No. 4 was analyzed in accordance with Test Methods for Evaluating Solid Waste (SW-846) U.S.E.P.A. 1986 Method 8270 (semi-volatile extractables).

parts per billion (ug/kg), dry basis

	4	Lab Blank
Phenol	<35.	<33.
Aniline	<180.	<170.
bis(2-Chloroethyl)Ether	<35.	<33.
2-Chlorophenol	<35.	<33.
1,3-Dichlorobenzene	<35.	<33.
1,4-Dichlorobenzene	<35.	<33.
Benzyl Alcohol	<35.	<33.
1,2-Dichlorobenzene	<35.	<33.
2-Methylphenol	<35.	<33.
bis(2-Chloroisopropyl)Ether	<35.	<33.
4-Methylphenol	<35.	<33.
N-Nitroso-Di-n-Propylamine	<35.	<33.
Hexachloroethane	<71.	<67.
Nitrobenzene	<35.	<33.
Isophorone	<35.	<33.
2-Nitrophenol	<71.	<67.
2,4-Dimethylphenol	<35.	<33.
Benzoic Acid	<880.	<830.
bis(2-Chloroethoxy)Methane	<35.	<33.
2,4-Dichlorophenol	<71.	<67.
1,2,4-Trichlorobenzene	<35.	<33.
Naphthalene	**130.**	<67.
4-Chloroaniline	<35.	<33.
Hexachlorobutadiene	<35.	<33.
4-Chloro-3-Methylphenol	<71.	<67.
2-Methylnaphthalene	**67.**	<33.

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parts per billion (ug/kg), dry basis

	4	Lab Blank
Hexachlorocyclopentadiene	<71.	<67.
2,4,6-Trichlorophenol	<71.	<67.
2,4,5-Trichlorophenol	<71.	<67.
2-Chloronaphthalene	<35.	<33.
2-Nitroaniline	<71.	<67.
Dimethyl Phthalate	<35.	<33.
Acenaphthylene	<35.	<33.
3-Nitroaniline	<180.	<170.
Acenaphthene	<35.	<33.
2,4-Dinitrophenol	<350.	<330.
4-Nitrophenol	<350.	<330.
Dibenzofuran	<35.	<33.
2,4-Dinitrotoluene	<71.	<67.
2,6-Dinitrotoluene	<71.	<67.
Diethyl Phthalate	<35.	<33.
4-Chlorophenyl-Phenylether	<35.	<33.
Fluorene	<35.	<33.
4-Nitroaniline	<71.	<67.
4,6-Dinitro-2-Methylphenol	<350.	<330.
N-Nitrosodiphenylamine	<35.	<33.
1,2-Diphenylhydrazine	<71.	<67.
4-Bromophenyl-Phenylether	<71.	<67.
Hexachlorobenzene	<71.	<67.
Pentachlorophenol	<350.	<330.
Phenanthrene	110.	<33.
Anthracene	<35.	<33.
Di-n-Butyl Phthalate	<35.	<33.
Fluoranthene	140.	<33.
Pyrene	210.	<33.
Benzidine	<880.	<830.
Butylbenzylphthalate	<35.	<33.
3,3'Dichlorobenzidine	<350.	<330.

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parts per billion (ug/kg), dry basis

	4	Lab Blank
Benzo(a)Anthracene	330.	<33.
bis(2-Ethylhexyl)Phthalate	<35.	<33.
Chrysene	390.	<33.
Di-n-Octyl Phthalate	<35.	<33.
Benzo(b)Fluoranthene	670.	<67.
Benzo(k)Fluoranthene	350.	<67.
Benzo(a)Pyrene	520.	<67.
Indeno(1,2,3-cd)Pyrene	420.	<67.
Dibenzo(a,h)Anthracene	81.	<67.
Benzo(g,h,i)Perylene	400.	<67.

Key

< = less than

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J. M. Owens

J. M. Owens

JMO:veg

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LABORATORY NO. 14233

APPENDIX A

Matrix Spike/Matrix Spike Duplicate Report

		mg/kg, dry basis				mg/kg				
									QC LIMITS	
Sample	Analyte	Spike Level	Sample Result	MS Result	% Rec	MSD Result	% Rec	RPD	RPD	REC
4	TRPH	640.	33.	620.	92.	660.	97.	7.	13	82-114
1	Copper	100.	31.	120.	90.	120.	91.	1.	5	67-123
1	Nickel	100.	48.	140.	93.	140.	95.	2.	6	68-130
1	Cadmium	5.	<0.5	4.4	89.	4.4	87.	2.	7	59-124
1	Lead	100.	<10.	91.	91.	91.	91.	0.	6	60-131
1	Chromium	100.	49.	140.	91.	140.	87.	4.	8	65-126
1	Zinc	100.	55.	150.	94.	150.	93.	1.	5	68-126
1	Arsenic	25.	4.5	29.	96.	30.	100.	4	8	69-118

MS = Matrix Spike
MSD = Matrix Spike Duplicate

Rec = Recovery
RPD = Relative Percent Difference

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APPENDIX B

Surrogate Recovery Quality Control Report

Attached are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

Comment Key

D. Persistently poor surrogate and spike recoveries signal a laboratory problem and the need for re-extraction and re-analysis. However, occasional outliers are regarded as anomolies and, in this case, re-analysis was not deemed necessary because other indicators were in control.

JOB No. 14233 DATE: 02/09/89

Sample No. 14233-MB Matrix: Soil Analysis: MS-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Fluorophenol	51		30 - 99
d5-Phenol	57		27 - 105
2-Bromophenol	52		30 - 107
d5-Nitrobenzene	58		45 - 100
2-Fluorobiphenyl	57		54 - 103
d10-Azobenzene	61		34 - 123
2.4.6-Tribromophenol	60		10 - 158
d14-p-Terphenyl	68		29 - 130

Sample No. 14233-4 Matrix: Soil Analysis: MS-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Fluorophenol	50		30 - 99
d5-Phenol	57		27 - 105
2-Bromophenol	53		30 - 107
d5-Nitrobenzene	56		45 - 100
2-Fluorobiphenyl	62		54 - 103
d10-Azobenzene	66		34 - 123
2.4.6-Tribromophenol	66		10 - 158
d14-p-Terphenyl	63		29 - 130

Sample No. 14233-4MS Matrix: Soil Analysis: MS-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Fluorophenol	48		30 - 99
d5-Phenol	48		27 - 105
2-Bromophenol	50		30 - 107
d5-Nitrobenzene	54		45 - 100
2-Fluorobiphenyl	51	D	54 - 103
d10-Azobenzene	53		34 - 123
2.4.6-Tribromophenol	52		10 - 158
d14-p-Terphenyl	50		29 - 130

Sample No. 14233-4MSD Matrix: Soil Analysis: MS-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Fluorophenol	53		30 - 99
d5-Phenol	53		27 - 105
2-Bromophenol	55		30 - 107
d5-Nitrobenzene	58		45 - 100
2-Fluorobiphenyl	59		54 - 103
d10-Azobenzene	63		34 - 123
2.4.6-Tribromophenol	59		10 - 158
d14-p-Terphenyl	58		29 - 130

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APPENDIX C

Matrix Spike/Duplicate Spike Quality Control

Attached are the results of additional QC compounds utilized in the analysis of organic compounds. Compounds of interest are spiked into two additional sample aliquots prior to extraction and/or analysis to monitor for matrix effects, sample processing errors, and to calculate percent recoveries of compounds of interest and relative error in the analysis. The control limits represent the 95% confidence interval established in the laboratory through repetitive analysis of samples.

Job No. 14233   Group No.   DATE: 02/16/89

Sample No. 4   Matrix: Soil   Analysis: MS-ABN

Spiking Analyte	Percent Recovery MS	Percent Recovery MSD	Comment MS	Comment MSD	%RPD	Recovery Control Limits	%RPD Control Limit
Phenol	45	51			11	39-95	13
2-Chlorophenol	44	51			14	30-108	15
1.4-Dichlorobenzene	50	57			13	38-103	10
N-Nitroso-di-n-Propylamine	49	56			13	33-133	16
1.2.4-Trichlorobenzene	53	58			10	43-110	9
4-Chloro-3-Methylphenol	53	59			11	47-113	11
Acenaphthene	54	61			12	45-116	8
4-Nitrophenol	52	53			1	22-134	13
2.4-Dinitrotoluene	47	56			18	32-141	9
Pentachlorophenol	48	46			5	10-137	26
Pyrene	48	58			18	23-115	11

APPENDIX H
SELECTED GROUNDWATER QUALITY DATA

CONTENTS

Hart Crowser
J-1639-09

RESULTS OF JUNE 1986 GROUNDWATER ANALYSES (OFF-SITE RENTON WELLS BY CH2M HILL)

CH2MHILL WATER QUALITY SAMPLING RESULTS
OFF-SITE RENTON WELLS
SAMPLED JUNE 1986

ANALYTE	WELL NUMBER	MW-1	MW-4	MW-5	MW-7
INORGANICS (Dissolved) (mg/l)					
Antimony		5 U	5 U	5 U	5 U
Arsenic		5 U	5 U	5 U	5 U
Beryllium		1 U	1 U	1 U	1 U
Cadmium		1 U	1 U	0.002	0.002
Chromium		0.001	0.001	0.003	0.002
Copper		0.003	0.003	0.004	0.004
Lead		10 U	10 U	10 U	10 U
Mercury		1 U	1 U	1 U	1 U
Nickel		0.004	0.004	0.009	0.006
Selenium		5 U	5 U	5 U	5 U
Silver		0.002	0.002	0.003	0.005
Thallium		5 U	5 U	5 U	5 U
Zinc		0.015	0.023	0.024	0.075
Total Cyanide		5 U	5 U	5 U	5 U
Total Phenol		5 U	5 U	5 U	5 U
VOLATILE ORGANIC COMPOUNDS (ug/L)					
Chloromethane		1 U	1 U	1 U	1 U
Bromomethane		1 U	1 U	1 U	1 U
Vinyl Chloride		1 U	1 U	1 U	1 U
Chloroethane		1 U	1 U	1 U	1 U
Methylene Chloride		26	29	64	2
Acrolein		5 U	5 U	5 U	5 U
Acetone		7	9	7	TR
Acrylonitrile		5 U	5 U	5 U	5 U
Carbon Disulfide		1 U	1 U	1 U	1 U
1,1-Dichloroethene		1 U	1 U	1 U	1 U
1,1-Dichloroethane		1 U	1 U	1 U	1 U
Trans-1,2-dichloropropene		1 U	1 U	1 U	1 U
Chloroform		1 U	1 U	1 U	1 U
2-Butanone		1 U	1 U	1 U	1 U
1,2-Dichloroethane		1 U	1 U	1 U	1 U
1,1,1-Trichloroethane		1 U	1 U	1 U	1 U
Vinyl Acetate		1 U	1 U	1 U	1 U
Bromodichloromethane		1 U	1 U	1 U	1 U
Carbon Tetrachloride		1 U	1 U	1 U	1 U
1,2-Dichloropropane		1 U	1 U	1 U	1 U
Trichloroethylene		1 U	1 U	1 U	1 U
Benzene		1 U	1 U	1 U	1 U
Chlorodibromomethane		1 U	1 U	1 U	1 U
1,1,2-Trichloroethane		1 U	1 U	1 U	1 U
2-Chloroethylvinylether		1 U	1 U	1 U	1 U
Bromoform		1 U	1 U	1 U	1 U
4-Methyl-2-pentanone		1 U	1 U	1 U	1 U
2-Hexanone		1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane		1 U	1 U	1 U	1 U
Tetrachloroethylene		1 U	1 U	1 U	1 U
Toluene		1 U	1 U	1 U	1 U
Chlorobenzene		1 U	1 U	1 U	1 U
Trans-1,3-dichloropropene		1 U	1 U	1 U	1 U
Ethylbenzene		1 U	1 U	1 U	1 U
Cis-1,3-dichloropropene		1 U	1 U	1 U	1 U
Styrene		1 U	1 U	1 U	1 U
Xylenes (0)		1 U	1 U	1 U	1 U

CH2MHILL WATER QUALITY SAMPLING RESULTS
OFF-SITE RENTON WELLS
SAMPLED JUNE 1986

ANALYTE	WELL NUMBER	MW-1	MW-4	MW-5	MW-7
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug/L)					
N-Nitrosodiphenylamine		1 U	1 U	1 U	1 U
Bis(2-chloroisopropyl)Ether		1 U	1 U	1 U	1 U
2-Chlorophenol		1 U	1 U	1 U	1 U
Phenol		1 U	1 U	1 U	1 U
1,3-Dichlorobenzene		1 U	1 U	1 U	1 U
1,4-Dichlorobenzene		1 U	1 U	1 U	1 U
1,2-Dichlorobenzene		1 U	1 U	1 U	1 U
Bis(2-chloroethyl)Ether		1 U	1 U	1 U	1 U
Hexachloroethane		1 U	1 U	1 U	1 U
N-nitroso-di-n-propylamine		1 U	1 U	1 U	1 U
Nitrobenzene		1 U	1 U	1 U	1 U
Isophorone		1 U	1 U	1 U	1 U
2-Nitrophenol		1 U	1 U	1 U	1 U
2,4-Dichlorophenol		1 U	1 U	1 U	1 U
Bis(2-chloroethoxy)Methane		1 U	1 U	1 U	1 U
2,4-Dichlorophenol		1 U	1 U	1 U	1 U
1,2,4-Trichlorobenzene		1 U	1 U	1 U	1 U
Naphthalene		1 U	1 U	1 U	1 U
Hexachlorocyclopentadiene		1 U	1 U	1 U	1 U
4-Chloro-3-Methyphenol		1 U	1 U	1 U	1 U
Hexachlorobutadiene		1 U	1 U	1 U	1 U
2,4,6-Trichlorophenol		1 U	1 U	1 U	1 U
2-Chloronaphthalene		1 U	1 U	1 U	1 U
Acenaphthylene		1 U	1 U	1 U	1 U
Di-Methyl phthalate		1 U	1 U	1 U	1 U
2,6-Dinitrotoluene		1 U	1 U	1 U	1 U
Acenaphthene		1 U	1 U	1 U	1 U
2,4-Dinitrophenol		1 U	1 U	1 U	1 U
2,4-Dinitrotoluene		1 U	1 U	1 U	1 U
4-Nitrophenol		1 U	1 U	1 U	1 U
Fluorene		1 U	1 U	1 U	1 U
4-Chlorophenyl Phenyl Ether		1 U	1 U	1 U	1 U
Di-Ethyl phthalate		1 U	1 U	1 U	1 U
4,6-Dinitro-o-cresol		1 U	1 U	1 U	1 U
1,2 Diphenylhydrazine		1 U	1 U	1 U	1 U
4-Bromophenyl-phenylether		1 U	1 U	1 U	1 U
Hexachlorobenzene		1 U	1 U	1 U	1 U
Pentachlorophenol		1 U	1 U	1 U	1 U
Anthracene		1 U	1 U	1 U	1 U
Di-n-Butyl phthalate		1 U	1 U	1 U	1 U
Fluoranthene		1 U	1 U	1 U	1 U
Benzidine		1 U	1 U	1 U	1 U
Butylbenzyl phthalate		1 U	1 U	1 U	1 U
Benzo(a)Anthracene		1 U	1 U	1 U	1 U
Chrysene		1 U	1 U	1 U	1 U
3,3'-Dichlorobenzidine		1 U	1 U	1 U	1 U
Bis(2-ethylhexyl)Phthalate		1 U	1 U	1 U	1 U
N-Nitrosodiphenylamine		1 U	1 U	1 U	1 U
Di-n-Octyl phthalate		1 U	1 U	1 U	1 U
Benzo(b)Fluoranthene		1 U	1 U	1 U	1 U
Benzo(k)Fluoranthene		1 U	1 U	1 U	1 U
Benzo(a)Pyrene		1 U	1 U	1 U	1 U
Indeno(123-cd)Pyrene		1 U	1 U	1 U	1 U
Dibenzo(a,h)Anthracene		1 U	1 U	1 U	1 U
Benzo(ghi)Perylene		1 U	1 U	1 U	1 U
Aniline		1 U	1 U	1 U	1 U
Benzoic Acid		1 U	1 U	1 U	1 U
Benzyl Alcohol		1 U	1 U	1 U	1 U
4-Chloroaniline		1 U	1 U	1 U	1 U
Dibenzofuran		1 U	1 U	1 U	1 U
2-Methylnaphthalene		1 U	1 U	1 U	1 U
2-Methylphenol		1 U	1 U	1 U	1 U
4-Methylphenol		1 U	1 U	1 U	1 U
2-Nitroaniline		1 U	1 U	1 U	1 U
3-Nitroaniline		1 U	1 U	1 U	1 U
4-Nitroaniline		1 U	1 U	1 U	1 U
2,4,5-Trichlorophenol		1 U	1 U	1 U	1 U

CH2MHILL WATER QUALITY SAMPLING RESULTS
OFF-SITE RENTON WELLS
SAMPLED JUNE 1986

ANALYTE	WELL NUMBER	MW-1	MW-4	MW-5	MW-7
PESTICIDES/PLB (ug/l)					
alpha-BHC		0.02 U	0.02 U	0.02 U	0.02 U
beta-BHC		0.02 U	0.02 U	0.02 U	0.02 U
delta-BHC		0.02 U	0.02 U	0.02 U	0.02 U
gamma-BHC (lindane)		0.02 U	0.02 U	0.02 U	0.02 U
heptachlor		0.02 U	0.02 U	0.02 U	0.02 U
aldrin		0.02 U	0.02 U	0.02 U	0.02 U
heptachlor epoxide		0.02 U	0.02 U	0.02 U	0.02 U
dieldrin		0.02 U	0.02 U	0.02 U	0.02 U
4,4´-DDE		0.02 U	0.02 U	0.02 U	0.02 U
4,4´-DDD		0.04 U	0.04 U	0.04 U	0.04 U
endosulfan sulfate		0.04 U	0.04 U	0.04 U	0.04 U
4,4´-DDT		0.04 U	0.04 U	0.04 U	0.04 U
chlordane		0.04 U	0.04 U	0.04 U	0.04 U
alpha endusulfan		0.04 U	0.04 U	0.04 U	0.04 U
beta endosulfan		0.04 U	0.04 U	0.04 U	0.04 U
endrin		0.04 U	0.04 U	0.04 U	0.04 U
endrin aldehyde		0.04 U	0.04 U	0.04 U	0.04 U
toxaphene		5 U	5 U	5 U	5 U
PCB 1016		1 U	1 U	1 U	1 U
PCB 1221		1 U	1 U	1 U	1 U
PCB 1232		1 U	1 U	1 U	1 U
PCB 1242		1 U	1 U	1 U	1 U
PCB 1248		1 U	1 U	1 U	1 U
PCB 1254		1 U	1 U	1 U	1 U
PCB 1260		1 U	1 U	1 U	1 U
Methoxychlor		0.1 U	0.1 U	0.1 U	0.1 U
Endrin Ketone		0.04 U	0.04 U	0.04 U	0.04 U

NOTES:

1. AR indicates a result expressed on the as-received basis.
2. DB indicates a result expressed on a dry basis.
3. NA indicates parameter or analyte not measured.
4. U indicates analyte not detected. Value expressed is the detection limit.
5. J indicates analyte was detected below the established limit of detection.
6. B indicates the analyte was detected in the method blank associated with the sample.
7. D indicates analysis performed on a diluted sample.
8. X indicates value reported has been blank corrected.
9. T1 denotes a pair of co-eluting compounds. The value reported for each is the sum of the two flagged compounds.
10. P indicates the sample was hand-picked to remove coarse material, but that sieving was not necessary.

Hart Crowser
J-1639-09

RESULTS OF JULY 1986 GROUNDWATER ANALYSES (BY LANDAU ASSOCIATES)

ANDAU ASSOCIATES GROUNDWATER ANALYSES
ULY/AUGUST 1986 SAMPLING

ANALYTE	STATION NUMBER LAB SAMPLE NO.	LW-2D	LW-3D	LW-5D	LW-6D	LW-7D	LW-8D	MW-3D	MW-4S
INORGANICS (mg/l)									
Total Suspended Solids		300	320	140	370	260	92	450	40
Total Phenol		0.005 U	0.027	0.016	--	0.005 U	0.005 U	--	0.005 U
Total Cyanide		0.005 U	0.005 U	0.005 U	0.005 U	0.0054	0.005 U	0.0054	0.005 U
Total Arsenic		0.08	0.02	0.06	0.09	0.05	0.03	--	--
Total Cadmium		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--
Total Chromium		0.014	0.01	0.005 U	0.005 U	0.01	0.006	--	--
Total Nickel		0.015	0.012	0.005	0.006	0.008	0.005 U	--	--
Total Lead		0.05	0.01	0.04	0.05	0.02	0.01 U	--	--
Total Zinc		0.028	0.026	0.017	0.014	0.023	0.27	--	--
Total Mercury		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--
Total Copper		0.018	0.013	0.005	0.005	0.012	--	--	--
Total Alumium		36	17	28	50	31	--	--	--
Total Iron		36	18	28	49	32	--	--	--
Total Hardness		--	--	--	--	--	--	--	--
Total Selenium		--	--	--	0.024	--	--	--	--
Total Barium		--	--	--	0.02	--	--	--	--
Hexavalent Chromium		--	--	--	0.005 U	--	--	--	--
Silver		--	--	--	0.002 U	--	--	--	--

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

WELL NUMBER ANALYTE	LW-1S	LW-2S	LW-2D	LW-3S	LW-3S	LW-3D	MW-4S	LW5-VS
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	3 U	3 U	1.6 U	3 U	3 U	1.6 U		3 U
Bromomethane	4 U	4 U	2.1 U	4 U	4 U	2.1 U		4 U
Vinyl Chloride	4 U	4 U	1.9 U	4 U	4 U	1.9 U		4 U
Chloroethane	4 U	4 U	2.2 U	14	4 U	2.2 U		4 U
Methylene Chloride	3 U	3 U	1.7 U	3 U	2 J	1.7 U		3 U
Acetone	13	18 B	5.8 U	36	12 U	5.8 U		2 B
Carbon Disulfide	2 U	2 U	1 U	2 U	2 U	1 U		2 U
1,1-Dichloroethene	5 U	5 U	2.3 U	5 U	5 U	2.3 U		5 U
1,1-Dichloroethane	2 U	2 U	1 U	300	250	1 U		2 U
Trans-1,2-dichloropropene	3 U	3 U	1.4 U	2 T	1 T	1.4 U		3 U
Chloroform	3 U	3 U	1.3 U	3 U	3 U	1.3 U		3 U
1,2-Dichloroethane	2 U	2 U	1.2 U	13	2 U	1.2 U		2 U
2-Butanone	6 U	6 U	3.2 U	6 U	6 U	3.2 U		6 U
1,1,1-Trichloroethane	2 U	2 U	0.8 U	2 J	1 T	0.8 U		2 U
Carbon Tetrachloride	2 U	2 U	0.9 U	2 U	2 U	0.9 U		2 U
Vinyl Acetate	6 U	6 U	2.9 U	6 U	6 U	2.9 U		6 U
Bromodichloromethane	1 U	1 U	0.7 U	1 U	1 U	0.7 U		1 U
1,2-Dichloropropane	2 U	2 U	0.8 U	2 J	1 T	0.8 U		2 U
Trans-1,3-dichloropropene	2 U	2 U	0.9 U	2 U	2 U	0.9 U		2 U
Trichloroethylene	1 U	1 U	0.7 U	1 U	1 U	0.7 U		1 U
Dibromochloromethane	2 U	2 U	0.8 U	2 U	2 U	0.8 U		2 U
1,1,2-Trichloroethane	2 U	2 U	0.8 U	2 U	2 U	0.8 U		2 U
Benzene	3	2 U	0.9 U	20	16	1		2 U
Cis-1,3-dichloropropene	2 U	2 U	0.9 U	2 U	2 U	0.9 U		2 U
2-Chloroethylvinylether	3 U	3 U	1.3 U	3 U	3 U	1.3 U		3 U
Bromoform	2 U	2 U	1 U	2 U	2 U	1 U		2 U
4-Methyl-2-pentanone	4 U	4 U	1.8 U	4 U	4 U	1.8 U		4 U
2-Hexanone	2 U	2 U	1 U	13	5	1 U		2 U
Tetrachloroethylene	1 U	1 U	0.6 U	1 T	1 T	0.6 U		1 U
1,1,2,2-Tetrachloroethane	2 U	2 U	1.1 U	2 U	2 U	1.1 U		2 U
Toluene	2 U	2 U	0.8 U	0.62 K	490	1 T		2 U
Chlorobenzene	1 U	1 U	0.7 U	8	9	0.7 U		1 U
Ethylbenzene	2 U	2 U	1.1 U	380 K	310	5 T		2 U
Sturene	3 U	3 U	1.4 U	3 U	3 U	1.4 U		3 U
Xylenes (Total)	2 U	2 U	1.2 U	520 K	800	4 T		2 U
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug/l)								
Phenol	4 U	4 U	2.2 U	4 U	4 U	2.2 U	2.2 U	4 U
Bis(2-chloroisopropyl)Ether	5 U	5 U	2.4 U	5 U	5 U	2.4 U	2.4 U	5 U
2-Chlorophenol	3 U	3 U	1.3 U	3 U	3 U	1.3 U	1.3 U	3 U
1,3-Dichlorobenzene	3 U	3 U	1.5 U	1 T	1 T	1.5 U	1.5 U	3 U
1,4-Dichlorobenzene	3 U	3 U	1.7 U	4	3 J	1.7 U	1.7 U	3 U
Benzyl Alcohol	4 U	4 U	2 U	4 U	4 U	2 U	2 U	4 U
1,2-Dichlorobenzene	4 U	4 U	1.9 U	14	12	1.9 U	1.9 U	4 U
2-Methylphenol	2 U	2 U	1.1 U	32	9	1.1 U	1.1 U	2 U
Bis(2-chloroethyl)Ether	3 U	3 U	1.3 U	3 U	3 U	1.3 U	1.3 U	3 U
4-Methylphenol	4 U	4 U	1.8 U	33	10	1.8 U	1.8 U	4 U
N-nitroso-di-n-propylamine	5 U	5 U	2.4 U	5 U	5 U	2.4 U	2.4 U	5 U
Hexachloroethane	5 U	5 U	2.6 U	5 U	5 U	2.6 U	2.6 U	5 U
Nitrobenzene	4 U	4 U	1.9 U	4 U	4 U	1.9 U	1.9 U	4 U
Isophorone	2 U	2 U	1.2 U	2 U	2 U	1.2 U	1.2 U	2 U
2-Nitrophenol	3 U	3 U	1.6 U	3 U	3 U	1.6 U	1.6 U	3 U
2,4-Dichlorophenol	5 U	5 U	2.3 U	24	180	25	2.3 U	5 U
Benzoic Acid	3 U	3 U	1.7 U	3 U	3 U	1.7 U	1.7 U	3 U
Bis(2-chloroethoxy)Methane	4 U	4 U	1.8 U	4 U	4 U	1.8 U	1.8 U	4 U
2,4-Dichlorophenol	2 U	2 U	0.9 U	2 U	2 U	0.9 U	0.9 U	2 U
1,2,4-Trichlorobenzene	4 U	4 U	2.1 U	4 U	4 U	2.1 U	2.1 U	4 U
Naphthalene	3 U	3 U	1.5 U	180	140	1.5 U	1.5 U	3 U
4-Chloroaniline	2 U	2 U	0.9 U	2 U	2 U	0.9 U	0.9 U	2 U
Hexachlorocyclopentadiene	4 U	4 U	2.2 U	4 U	4 U	2.2 U	2.2 U	4 U
4-Chloro-3-Methyphenol	1 U	1 U	0.7 U	1 U	1 U	0.7 U	0.7 U	1 U
2-Methylnaphthalene	5 U	5 U	2.6 U	32	19	2.6 U	2.6 U	5 U
Hexachlorobutadiene	5 U	5 U	2.7 U	5 U	5 U	2.7 U	2.7 U	5 U
2,4,6-Trichlorophenol	2 U	2 U	1 U	2 U	2 U	1 U	1 U	2 U
2,4,5-Trichlorophenol	3 U	3 U	1.5 U	3 U	3 U	1.5 U	1.5 U	3 U

LANDAU ASSOCIATES GROUNDWATER ANALYSES
JULY/AUGUST 1986 SAMPLING

ANALYTE	STATION NUMBER / LAB SAMPLE NO.	LW-8S	LW-9S	DW-2D	MW-1I	DM-3D	LW-4S
INORGANICS (mg/l)							
Total Phenol		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	--
Cyanide		0.005 U	0.005 U	0.005 U	0.005 U	--	--
Total Suspended Solids		1100	1200	930	290	--	--
Dissolved Arsenic		0.02	0.13	0.07	0.12	0.11	0.024
Dissolved Barium		--	0.02	--	--	--	--
Dissolved Zinc		0.012	0.016	0.016	0.016	0.014	0.01
Dissolved Chromium		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Dissolved Lead		0.01 U	0.01 U	0.01 U	0.01 U	0.01	0.014
Dissolved Copper		--	0.002	--	0.001 U	--	--
Dissolved Cadmium		0.001 U	0.001	0.001 U	0.001 U	0.002	0.001 U
Dissolved Nickel		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Dissolved Mercury		0.001 U	0.001 U	--	--	--	--
Dissolved Alumium		--	56	--	--	--	--
Dissolved Iron		--	55	--	--	--	--
Dissolved Silver		--	0.001	--	--	--	--
Dissolved Selenium		--	0.2 U	--	--	--	--
Hexavalent Chromium		--	0.005 U	--	--	--	--

* See Total Metals Summary

LANDAU ASSOCIATES GROUNDWATER ANALYSES
JULY/AUGUST 1986 SAMPLING

ANALYTE	STATION NUMBER / LAB SAMPLE NO.	LW-12D	LW-10S	LW-11S	LW-12S	LW-14S	LW-13S	LW-1S	LW-6S
INORGANICS (mg/l)									
Total Phenol		*	0.005 U	0.008	0.009	0.005 U	0.005 U	0.005 U	0.005 U
Cyanide		*	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Total Suspended Solids		*	340	240	60	200	63	340	1100
Dissolved Arsenic		0.02	0.04	0.16	0.03	0.2 U	0.08 U	0.02 U	0.03 U
Dissolved Barium		0.07	--	--	0.02	--	--	--	0.01
Dissolved Zinc		0.037	0.052	0.017	0.016	0.021	0.017	0.01	0.011
Dissolved Chromium		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Dissolved Lead		0.03	0.01 U	0.01	0.01 U	0.01 U	0.01 U	0.01	0.011
Dissolved Copper		0.001 U	--	0.001 U	0.002	--	0.001 U	0.001 U	0.001 U
Dissolved Cadmium		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Dissolved Nickel		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005	0.005
Dissolved Mercury		0.001 U	0.001 U	0.001 U	0.001 U	--	--	0.001 U	0.001 U
Dissolved Alumium		13	--	63	16	--	--	1.1	13
Dissolved Iron		13	--	61	16	--	--	1.1	13
Dissolved Silver		0.001 U	--	--	0.01 U	--	--	0.01	0.01
Dissolved Selenium		0.02 U	--	--	0.2 U	--	--	--	0.024
Hexavalent Chromium		0.005 U	--	--	0.005 U	--	--	0.005 U	0.005 U

* See Total Metals Summary

LANDAU ASSOCIATES GROUNDWATER ANALYSES
JULY/AUGUST 1986 SAMPLING

ANALYTE / STATION NUMBER / LAB SAMPLE NO.	LW-2S	LW-3S	LW-5S	LW-15S	LW-7S	LW-11D	MW-3D	MW-4S
INORGANICS (mg/l)								
Total Phenol	0.005 U	0.068	0.005 U	0.005 U	0.005 U	*	--	*
Cyanide	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	*	*	*
Total Suspended Solids	440	520	170	170	55	*	--	*
Dissolved Arsenic	0.07	0.09	0.06	0.03	0.02 U	--	0.09	0.03
Dissolved Barium	--	--	--	--	--	--	0.09	0.09
Dissolved Zinc	0.047	0.053	0.054	0.039	0.038	--	0.061	0.037
Dissolved Chromium	0.005	0.005 U	0.005 U	0.005 U	0.005 U	--	0.005 U	0.008
Dissolved Lead	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	--	0.03	0.04
Dissolved Copper	0.001 U	0.001 U		--	--	--	0.001	0.003
Dissolved Cadmium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	--	--	--
Dissolved Nickel	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	--	--	--
Dissolved Mercury	0.001 U	--	--	--	--	0.003	--	--
Dissolved Alumium	34	--	--	--	--	--	--	--
Dissolved Iron	34	--	--	--	--	--	--	--
Dissolved Silver	--	--	--	--	--	--	--	--
Dissolved Selenium	--	--	--	--	--	--	--	--
Hexavalent Chromium	--	--	--	--	--	--	--	--

* See Total Metals Summary

LANDAU ASSOCIATES GROUNDWATER ANALYSES
JULY/AUGUST 1986 SAMPLING

ANALYTE	STATION NUMBER LAB SAMPLE NO.	LW-12D	LW-9D	LW-9DR	LW-13D	LW-10D
INORGANICS (mg/l)						
Total Suspended Solids		75	360	450	340	620
Total Phenol		0.023	0.005 U	0.005 U	0.05	0.005 U
Total Cyanide		0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Total Arsenic		--	0.2 U	0.2 U	0.2 U	0.1
Total Cadmium		--	0.0014	0.001 U	0.001	0.001 U
Total Chromium		--	0.022	0.02	0.019	0.031
Total Nickel		--	0.016	0.017	0.012	0.022
Total Lead		--	0.01	0.01 U	0.01 U	0.01 U
Total Zinc		--	0.045	42 U	0.039	0.06
Total Mercury		--	0.001 U	0.001 U	--	0.001 U
Total Copper		--	0.035	0.025	--	--
Total Alumium		--	--	--	--	--
Total Iron		--	--	--	--	--
Total Hardness		--	220	250	200	--
Total Selenium		--	0.2 U	0.2 U	--	--
Total Barium		--	0.06	0.06	--	--
Hexavalent Chromium		--	--	--		
Silver		--	--	--		

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-1S	LW-2S	LW-2D	LW-3S	LW-3S	LW-3D	MW-4S	LW5-VS
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug/l)								
2-Chloronaphthalene	2 U	2 U	0.9 U	2 U	2 U	0.9 U	0.9 U	2 U
2-Nitroaniline	1 U	1 U	0.6 U	1 U	1 U	0.6 U	0.6 U	1 U
Di-Methyl phthalate	3 U	3 U	1.6 U	3 U	3 U	1.6 U	1.6 U	3 U
Acenaphthylene	1 U	1 U	0.4 U	1 U	1 U	0.4 U	0.4 U	1 U
3-Nitroaniline	7 U	7 U	3.3 U	7 U	7 U	3.3 U	3.3 U	7 U
Acenaphthene	8 U	8 U	3.8 U	24	22	3.8 U	3.8 U	8 U
2,4-Dinitrophenol	3 U	3 U	1.7 U	3 U	3 U	1.7 U	1.7 U	3 U
4-Nitrophenol	2 U	2 U	1 U	2 U	2 U	1 U	1 U	2 U
Dibenzofuran	4 U	4 U	1.8 U	4 J	4	1.8 U	1.8 U	4 U
2,4-Dinitrotoluene	2 U	2 U	1.1 U	2 U	2 U	1.1 U	1.1 U	2 U
2,6-Dinitrotoluene	3 U	3 U	1.3 U	3 U	3 U	1.3 U	1.3 U	3 U
Di-Ethyl phthalate	2 U	2 U	0.8 U	2 U	2 U	8 U	8 U	2 U
4-Chlorophenyl Phenyl Ether	6 U	6 U	3.2 U	6 U	6 U	3.2 U	3.2 U	6 U
Fluorene	3 U	3 U	1.5 U	7	7	1.5 U	1.5 U	3 U
4-Nitroaniline	7 U	7 U	3.6 U	7 U	7 U	3.6 U	3.6 U	7 U
4,6-Dinitro-2-methylphenol	1 U	1 U	0.6 U	1 U	1 U	0.6 U	0.6 U	1 U
N-Nitrosodiphenylamine	3 U	3 U	1.6 U	3 U	3 U	1.6 U	1.6 U	3 U
4-Bromophenyl-phenylether	3 U	3 U	1.6 U	3 U	3 U	1.6 U	1.6 U	3 U
Hexachlorobenzene	4 U	4 U	2.2 U	4 U	4 U	2.2 U	2.2 U	4 U
Pentachlorophenol	1 U	1 U	0.6 U	1 U	1 U	0.6 U	0.6 U	1 U
Phenanthrene	4 U	4 U	2.2 U	2 J	2 J	2.2 U	2.2 U	4 U
Anthracene	3 U	3 U	1.7 U	3 U	3 U	1.7 U	1.7 U	3 U
Di-n-Butyl phthalate	4 U	4 U	2.1 U	4 U	4 U	1 T	2.1 U	4 U
Fluoranthene	2 U	2 U	0.8 U	2 U	2 U	0.8 U	0.8 U	2 U
Pyrene	2 U	2 U	1.2 U	2 U	2 U	1.1 U	1.1 U	2 U
Butylbenzylphthalate	4 U	4 U	2.2 U	4 U	4 U	2.2 U	2.2 U	4 U
3,3'-Dichlorobenzidine	2 U	2 U	1 U	2 U	2 U	1 U	1 U	2 U
Benzo(a)Anthracene	1 U	1 U	0.3 U	1 U	1 U	0.3 U	0.3 U	1 U
Bis(2-ethylhexyl)Phthalate	4 U	4 U	1.8 U	4 U	3 J	1.8 U	1.8 U	4 U
Chrysene	1 U	1 U	0.5 U	1 U	1 U	0.5 U	0.5 U	1 U
Di-n-Octyl phthalate	1 U	1 U	0.5 U	1 U	1 U	0.5 U	0.5 U	1 U
Benzo(b)Fluoranthene	4 U	4 U	2 U	4 U	4 U	2 U	2 U	4 U
Benzo(k)Fluoranthene	3 U	3 U	1.7 U	3 U	3 U	1.7 U	1.7 U	3 U
Benzo(a)Pyrene	1 U	1 U	0.6 U	1 U	1 U	0.6 U	0.6 U	1 U
Indeno(123-cd)Pyrene	2 U	2 U	1.1 U	2 U	2 U	1.1 U	1.1 U	2 U
Dibenzo(a,h)Anthracene	2 U	2 U	1 U	2 U	2 U	1 U	1 U	2 U
Benzo(ghi)Perylene	3 U	3 U	1.7 U	3 U	3 U	1.7 U	1.7 U	3 U

PESTIDIDE/PCBS (ug/l)

ANALYTE / WELL NUMBER	LW-1S	LW-2S	LW-2D	LW-3S	LW-3S	LW-3D	MW-4S	LW5-VS
Alpha-BHC	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Beta-BHC	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Delta-BHC	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Gamma-BHC(Lindane)	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Heptachlor	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aldrin	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Heptachlor Expoxide	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Endosulfan 1	0.5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Dieldrin	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
4,4-DDE	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
Endrin	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
Enndosulfan II	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
4,4-DDD	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
Endosulfan Sulfate	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
4,4-DDT	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
Methoxuchlor	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Endrin Ketone	1 U	0.1 U	0.1 U	0.1 U	NA	0.1 U	NA	0.1 U
Chlordane	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Toxaphene	10 U	1 U	1 U	1 U	NA	1 U	NA	1 U
Aroclor-1016	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aroclor-1221	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aroclor-1232	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aroclor-1242	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aroclor-1248	5 U	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U
Aroclor-12[illegible]	5 U	0.5 U	1 U	0.5 U	NA	1 U	NA	[illegible]
Aroclor-12[illegible]	10 U	1 U	1 U	1 U	NA	1 U	NA	[illegible]

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-5S	LW5-D	LW-6S	LW-6D	LW-7S	LW-7D	LW-8S	LW-8D 6/26/86
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	3 U	1.6 U	3 U	1.6 U	3 U	3 U	3 U	3 U
Bromomethane	4 U	2.1 U	4 U	2.1 U	4 U	4 U	4 U	4 U
Vinyl Chloride	4 U	1.9 U	4 U	80	4 U	4 U	4 U	17
Chloroethane	4 U	2.2 U	4 U	2.2 U	4 U	4 U	4 U	4 U
Methylene Chloride	3 U	1.7 U	3 U	1.7 U	3 U	3 U	3 U	3 U
Acetone	5 J	5.8 U	5 TB	5.8 U	12 U	12 U	23	11
Carbon Disulfide	2 U	1 U	2 U	1 U	2 U	2 U	2 U	2 U
1,1-Dichloroethene	5 U	2.3 U	5 U	2.3 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	2 U	1 U	2 U	1 U	2 U	2 U	2 U	2 T
Trans-1,2-dichloropropene	3 U	1.4 U	3 U	1.4 U	3 U	3 U	3 U	1 T
Chloroform	3 U	1.3 U	3 U	1.3 U	3 U	3 U	3 U	3 U
1,2-Dichloroethane	2 U	1.2 U	2 U	1.2 U	2 U	2 U	2 U	2 U
2-Butanone	6 U	3.2 U	6 U	3.2 U	6 U	6 U	6 U	6 U
1,1,1-Trichloroethane	2 U	0.8 U	2 U	0.8 U	2 U	2 U	2 U	2 U
Carbon Tetrachloride	2 U	0.9 U	2 U	0.9 U	2 U	2 U	2 U	2 U
Vinyl Acetate	6 U	2.9 U	6 U	2.9 U	6 U	6 U	6 U	6 U
Bromodichloromethane	1 U	0.7 U	1 U	0.7 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	2 U	0.8 U	2 U	0.8 U	2 U	2 U	2 U	2 U
Trans-1,3-dichloropropene	2 U	0.9 U	2 U	0.9 U	2 U	2 U	2 U	2 U
Trichloroethylene	1 U	0.7 U	1 U	0.7 U	1 U	1 U	1 U	1 U
Dibromochloromethane	2 U	0.8 U	2 U	0.8 U	2 U	2 U	2 U	2 U
1,1,2-Trichloroethane	2 U	0.8 U	2 U	0.8 U	2 U	2 U	2 U	2 U
Benzene	2 U	0.9 U	2 U	0.9 U	2 U	2 U	2 U	9
Cis-1,3-dichloropropene	2 U	0.9 U	2 U	0.9 U	2 U	2 U	2 U	2 U
2-Chloroethylvinylether	3 U	1.3 U	3 U	1.3 U	3 U	3 U	3 U	3 U
Bromoform	2 U	1 U	2 U	1 U	2 U	2 U	2 U	2 U
4-Methyl-2-pentanone	4 U	1.8 U	4 U	1.8 U	4 U	4 U	4 U	4 U
2-Hexanone	2 U	1 U	2 U	1 U	2 U	2 U	2 U	2 U
Tetrachloroethylene	1 U	0.6 U	1 U	0.6 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	2 U	1.1 U	2 U	1.1 U	2 U	2 U	2 U	2 U
Toluene	2 U	0.8 U	2 U	0.8 U	2 U	2 U	2 U	2 U
Chlorobenzene	1 U	0.7 U	1 U	0.7 U	1 U	1 U	1 U	1 U
Ethylbenzene	2 U	1.1 U	2 U	1.1 U	2 U	2 U	2 U	2 U
Sturene	3 U	1.4 U	3 U	1.4 U	3 U	3 U	3 U	3 U
Xylenes (Total)	2 U	1.2 U	2 U	1.2 U	2 U	2 U	2 U	2 U
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
Phenol	4 U	1 T	4 U	NA	4 U	2.2 U	4 U	2.2 U
Bis(2-chloroisopropyl)Ether	5 U	2.4 U	5 U	NA	5 U	2.4 U	5 U	2.4 U
2-Chlorophenol	3 U	1.3 U	3 U	NA	3 U	1.3 U	3 U	1.3 U
1,3-Dichlorobenzene	3 U	1.5 U	3 U	NA	3 U	1.5 U	3 U	1.5 U
1,4-Dichlorobenzene	3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
Benzyl Alcohol	4 U	2 U	4 U	NA	4 U	2 U	4 U	2 U
1,2-Dichlorobenzene	4 U	1.9 U	4 U	NA	4 U	1.9 U	4 U	1.9 U
2-Methylphenol	2 U	1.1 U	2 U	NA	2 U	1.1 U	2 U	1.1 U
Bis(2-chloroethyl)Ether	3 U	1.3 U	3 U	NA	3 U	1.3 U	3 U	1.3 U
4-Methylphenol	4 U	1.8 U	4 U	NA	4 U	1.8 U	4 U	1.8 U
N-nitroso-di-n-propylamine	5 U	2.4 U	5 U	NA	5 U	2.4 U	5 U	2.4 U
Hexachloroethane	5 U	2.6 U	5 U	NA	5 U	2.6 U	5 U	2.6 U
Nitrobenzene	4 U	1.9 U	4 U	NA	4 U	1.9 U	4 U	1.9 U
Isophorone	2 U	1.2 U	2 U	NA	2 U	1.2 U	2 U	1.2 U
2-Nitrophenol	3 U	1.6 U	3 U	NA	3 U	1.6 U	3 U	1.6 U
2,4-Dichlorophenol	5 U	2.3 U	5 U	NA	5 U	2.3 U	5 U	2.3 U
Benzoic Acid	3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
Bis(2-chloroethoxy)Methane	4 U	1.8 U	4 U	NA	4 U	1.8 U	4 U	1.8 U
2,4-Dichlorophenol	2 U	0.9 U	2 U	NA	2 U	0.9 U	2 U	0.9 U
1,2,4-Trichlorobenzene	4 U	2.1 U	4 U	NA	4 U	2.1 U	4 U	2.1 U
Naphthalene	3 U	1.5 U	3 U	NA	3 U	1.5 U	3 U	1.5 U
4-Chloroaniline	2 U	0.9 U	2 U	NA	2 U	0.9 U	2 U	0.9 U
Hexachlorocyclopentadiene	4 U	2.2 U	4 U	NA	4 U	2.2 U	4 U	2.2 U
4-Chloro-3-Methyphenol	1 U	0.7 U	1 U	NA	1 U	0.7 U	1 U	0.7 U
2-Methylnaphthalene	5 U	2.6 U	5 U	NA	5 U	2.6 U	5 U	2.6 U
Hexachlorobutadiene	5 U	2.7 U	5 U	NA	5 U	2.7 U	5 U	2.7 U
2,4,6-Trichlorophenol	2 U	1 U	2 U	NA	2 U	1 U	2 U	1 U
2,4,5-Trichlorophenol	3 U	1.5 U	3 U	NA	3 U	1.5 U	3 U	1.5 U

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE	WELL NUMBER	LW-5S	LW5-D	LW-6S	LW-6D	LW-7S	LW-7D	LW-8S	LW-8D 6/26/86
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug									
2-Chloronaphthalene		2 U	0.9 U	2 U	NA	2 U	0.9 U	2 U	0.9 U
2-Nitroaniline		1 U	0.6 U	1 U	NA	1 U	0.6 U	1 U	0.6 U
Di-Methyl phthalate		3 U	1.6 U	3 U	NA	3 U	1.6 U	3 U	1.6 U
Acenaphthylene		1 U	0.4 U	1 U	NA	1 U	0.4 U	1 U	0.4 U
3-Nitroaniline		7 U	3.3 U	7 U	NA	7 U	3.3 U	7 U	3.3 U
Acenaphthene		8 U	3.8 U	8 U	NA	8 U	3.8 U	8 U	3.8 U
2,4-Dinitrophenol		3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
4-Nitrophenol		2 U	1 U	2 U	NA	2 U	1 U	2 U	1 U
Dibenzofuran		4 U	1.8 U	4 U	NA	4 U	1.8 U	4 U	1.8 U
2,4-Dinitrotoluene		2 U	1.1 U	2 U	NA	2 U	1.1 U	2 U	1.1 U
2,6-Dinitrotoluene		3 U	1.3 U	3 U	NA	3 U	1.3 U	3 U	1.3 U
Di-Ethyl phthalate		2 U	8 U	2 U	NA	2 U	8 U	2 U	8 U
4-Chlorophenyl Phenyl Ether		6 U	3.2 U	6 U	NA	6 U	3.2 U	6 U	3.2 U
Fluorene		3 U	1.5 U	3 U	NA	3 U	1.5 U	3 U	1.5 U
4-Nitroaniline		7 U	3.6 U	7 U	NA	7 U	3.6 U	7 U	3.6 U
4,6-Dinitro-2-methylphenol		1 U	0.6 U	1 U	NA	1 U	0.6 U	1 U	0.6 U
N-Nitrosodiphenylamine		3 U	1.6 U	3 U	NA	3 U	1.6 U	3 U	1.6 U
4-Bromophenyl-phenylether		3 U	1.6 U	3 U	NA	3 U	1.6 U	3 U	1.6 U
Hexachlorobenzene		4 U	2.2 U	4 U	NA	4 U	2.2 U	4 U	2.2 U
Pentachlorophenol		1 U	0.6 U	1 U	NA	1 U	0.6 U	1 U	0.6 U
Phenanthrene		4 U	2.2 U	4 U	NA	4 U	2.2 U	4 U	2.2 U
Anthracene		3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
Di-n-Butyl phthalate		1 T	1 T	4 U	NA	4 U	0.5 U	4 U	1 T
Fluoranthene		2 U	0.8 U	2 U	NA	2 U	0.8 U	2 U	0.8 U
Pyrene		2 U	1.1 U	2 U	NA	2 U	1.1 U	2 U	1.1 U
Butylbenzylphthalate		4 U	2.2 U	4 U	NA	4 U	2.2 U	4 U	2.2 U
3,3'-Dichlorobenzidine		2 U	1 U	2 U	NA	2 U	1 U	2 U	1 U
Benzo(a)Anthracene		1 U	0.3 U	1 U	NA	1 U	0.3 U	1 U	0.3 U
Bis(2-ethylhexyl)Phthalate		4 U	1.8 U	4 U	NA	4 U	1.8 U	3 J	1.8 U
Chrysene		1 U	0.5 U	1 U	NA	1 U	0.5 U	1 U	0.5 U
Di-n-Octyl phthalate		1 U	0.5 U	1 U	NA	1 U	0.5 U	1 U	0.5 U
Benzo(b)Fluoranthene		4 U	2 U	4 U	NA	4 U	2 U	4 U	2 U
Benzo(k)Fluoranthene		3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
Benzo(a)Pyrene		1 U	0.6 U	1 U	NA	1 U	0.6 U	1 U	0.6 U
Indeno(123-cd)Pyrene		2 U	1.1 U	2 U	NA	2 U	1.1 U	2 U	1.1 U
Dibenzo(a,h)Anthracene		2 U	1 U	2 U	NA	2 U	1 U	2 U	1 U
Benzo(ghi)Perylene		3 U	1.7 U	3 U	NA	3 U	1.7 U	3 U	1.7 U
PESTIDIDE/PCBS (ug/l)									
Alpha-BHC		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Beta-BHC		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Delta-BHC		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Gamma-BHC(Lindane)		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Heptachlor		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Aldrin		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Heptachlor Expoxide		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Endosulfan 1		0.5 U	0.5 U	0.5 U	NA	0.5 U	0.5 U	NA	NA
Dieldrin		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
4,4-DDE		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
Endrin		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
Enndosulfan II		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
4,4-DDD		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
Endosulfan Sulfate		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
4,4-DDT		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
Methoxuchlor		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Endrin Ketone		0.1 U	0.1 U	1 U	NA	0.1 U	0.1 U	NA	NA
Chlordane		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Toxaphene		1 U	1 U	10 U	NA	1 U	1 U	NA	NA
Aroclor-1016		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Aroclor-1221		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Aroclor-1232		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Aroclor-1242		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Aroclor-1248		0.5 U	0.5 U	5 U	NA	0.5 U	0.5 U	NA	NA
Aroclor-1254		0.5 U	1 U	5 U	NA	0.5 U	1 U	NA	NA
Aroclor-1260		1 U	1 U	10 U	NA	1 U	1 U	NA	NA

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-8D 8/18/86	LW-9S	LW-9D 7/22/86	LW-9D 7/22/86	LW-10S	LW-10D	LW-11S 8/8/86	LW-11S NA
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	3 U	3 U	3 U	3 U	3 U	3 U	320 U	NA
Bromomethane	4 U	4 U	4 U	4 U	4 U	4 U	420 U	NA
Vinyl Chloride	9	8	69	62	34	13	370 U	NA
Chloroethane	4 U	4 U	4 U	4 U	4 U	4 U	440 U	NA
Methylene Chloride	3 U	3 U	3 U	3 U	3 U	3 U	330 B	NA
Acetone	12 U	19	12 U	12 U	12 U	12 U	440 B	NA
Carbon Disulfide	2 U	2 U	2 U	2 U	2 U	2 U	200 U	NA
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	450 U	NA
1,1-Dichloroethane	2 J	2 U	2 U	2 U	2 U	2 U	200 U	NA
Trans-1,2-dichloropropene	1 J	3 U	3 U	3 U	1 T	3 U	270 U	NA
Chloroform	3 U	3 U	3 U	3 U	3 U	3 U	250 U	NA
1,2-Dichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	230 U	NA
2-Butanone	6 U	6 U	6 U	6 U	6 U	6 U	630 U	NA
1,1,1-Trichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	160 U	NA
Carbon Tetrachloride	2 U	2 U	2 U	2 U	2 U	2 U	170 U	NA
Vinyl Acetate	6 U	6 U	6 U	6 U	6 U	6 U	580 U	NA
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	130 U	NA
1,2-Dichloropropane	2 U	2 U	2 U	2 U	2 U	2 U	160 U	NA
Trans-1,3-dichloropropene	2 U	2 U	2 U	2 U	2 U	2 U	170 U	NA
Trichloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	140 U	NA
Dibromochloromethane	2 U	2 U	2 U	2 U	2 U	2 U	160 U	NA
1,1,2-Trichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	160 U	NA
Benzene	1 T	2 U	2 U	2 U	2 U	2 U	170 U	NA
Cis-1,3-dichloropropene	2 U	2 U	2 U	2 U	2 U	2 U	170 U	NA
2-Chloroethylvinylether	3 U	3 U	3 U	3 U	3 U	3 U	260 U	NA
Bromoform	2 U	2 U	2 U	2 U	2 U	2 U	190 U	NA
4-Methyl-2-pentanone	4 U	4 U	4 U	4 U	4 U	4 U	360 U	NA
2-Hexanone	2 U	2 U	2 U	2 U	2 U	2 U	190 U	NA
Tetrachloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	120 U	NA
1,1,2,2-Tetrachloroethane	2 U	2 U	2 U	2 U	2 U	2 U	210 U	NA
Toluene	2 U	2 U	2 U	2 U	2 U	2 U	150 U	NA
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	130 U	NA
Ethylbenzene	2 U	2 U	2 U	2 U	2 U	2 U	210 U	NA
Sturene	3 U	3 U	3 U	3 U	3 U	3 U	240 U	NA
Xylenes (Total)	2 U	2 U	2 U	2 U	2 U	2 U	270 U	NA
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
Phenol	NA	4 U	9 U	9 U	1 T	4 U	4 U	4 U
Bis(2-chloroisopropyl)Ether	NA	5 U	10 U	10 U	5 U	5 U	5 U	5 U
2-Chlorophenol	NA	3 U	5 U	5 U	3 U	3 U	3 U	3 U
1,3-Dichlorobenzene	NA	3 U	6 U	6 U	3 U	3 U	3 U	3 U
1,4-Dichlorobenzene	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
Benzyl Alcohol	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
1,2-Dichlorobenzene	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
2-Methylphenol	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Bis(2-chloroethyl)Ether	NA	3 U	5 U	5 U	3 U	3 U	3 U	3 U
4-Methylphenol	NA	4 U	7 U	7 U	4 U	4 U	4 U	4 U
N-nitroso-di-n-propylamine	NA	5 U	10 U	10 U	5 U	5 U	5 U	5 U
Hexachloroethane	NA	5 U	10 U	10 U	5 U	5 U	5 U	5 U
Nitrobenzene	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
Isophorone	NA	2 U	5 U	5 U	2 U	2 U	2 U	2 U
2-Nitrophenol	NA	3 U	6 U	6 U	3 U	3 U	3 U	3 U
2,4-Dichlorophenol	NA	5 U	9 U	9 U	5 U	5 U	5 U	5 U
Benzoic Acid	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
Bis(2-chloroethoxy)Methane	NA	4 U	7 U	7 U	4 U	4 U	4 U	4 U
2,4-Dichlorophenol	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
1,2,4-Trichlorobenzene	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
Naphthalene	NA	3 U	6 U	6 U	3 U	3 U	36	24
4-Chloroaniline	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Hexachlorocyclopentadiene	NA	4 U	9 U	9 U	4 U	4 U	4 U	4 U
4-Chloro-3-Methyphenol	NA	1 U	3 U	3 U	1 U	1 U	1 U	1 U
2-Methylnaphthalene	NA	5 U	10 U	10 U	5 U	5 U	39	15
Hexachlorobutadiene	NA	5 U	11 U	11 U	5 U	5 U	5 U	5 U
2,4,6-Trichlorophenol	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
2,4,5-Trichlorophenol	NA	3 U	8 U	8 U	3 U	3 U	3 U	3 U

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

WELL NUMBER	LW-8D	LW-9S	LW-9D	LW-9D	LW-10S	LW-10D	LW-11S	LW-11S
ANALYTE	8/18/86		7/22/86	7/22/86			8/8/86	NA
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
2-Chloronaphthalene	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
2-Nitroaniline	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
Di-Methyl phthalate	NA	3 U	6 U	6 U	3 U	3 U	3 U	3 U
Acenaphthylene	NA	1 U	2 U	2 U	1 U	1 U	1 U	1
3-Nitroaniline	NA	7 U	13 U	13 U	7 U	7 U	7 U	7 U
Acenaphthene	NA	8 U	15 U	15 U	8 U	8 U	8 U	1 T
2,4-Dinitrophenol	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
4-Nitrophenol	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Dibenzofuran	NA	4 U	7 U	7 U	4 U	4 U	4 U	1 T
2,4-Dinitrotoluene	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
2,6-Dinitrotoluene	NA	3 U	5 U	5 U	3 U	3 U	3 U	3 U
Di-Ethyl phthalate	NA	2 U	3 U	3 U	2 U	2 U	2 U	2 U
4-Chlorophenyl Phenyl Ether	NA	6 U	13 U	13 U	6 U	6 U	6 U	6 U
Fluorene	NA	3 U	6 U	6 U	1 T	3 U	3	2 J
4-Nitroaniline	NA	7 U	14 U	14 U	7 U	7 U	7 U	7 U
4,6-Dinitro-2-methylphenol	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
N-Nitrosodiphenylamine	NA	3 U	6 U	6 U	3 U	3 U	3 U	3 U
4-Bromophenyl-phenylether	NA	3 U	6 U	6 U	3 U	3 U	3 U	3 U
Hexachlorobenzene	NA	4 U	9 U	9 U	4 U	4 U	4 U	4 U
Pentachlorophenol	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
Phenanthrene	NA	4 U	9 U	9 U	4 U	4 U	3 J	1 T
Anthracene	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
Di-n-Butyl phthalate	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
Fluoranthene	NA	2 U	3 U	3 U	2 U	2 U	2 U	2 U
Pyrene	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Butylbenzylphthalate	NA	4 U	9 U	9 U	4 U	4 U	4 U	4 U
3,3'-Dichlorobenzidine	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Benzo(a)Anthracene	NA	1 U	1 U	1 U	1 U	1 U	1 J	1 U
Bis(2-ethylhexyl)Phthalate	NA	4 U	7 U	7 U	4 U	4 U	4 U	4 U
Chrysene	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
Di-n-Octyl phthalate	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
Benzo(b)Fluoranthene	NA	4 U	8 U	8 U	4 U	4 U	4 U	4 U
Benzo(k)Fluoranthene	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
Benzo(a)Pyrene	NA	1 U	2 U	2 U	1 U	1 U	1 U	1 U
Indeno(123-cd)Pyrene	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Dibenzo(a,h)Anthracene	NA	2 U	4 U	4 U	2 U	2 U	2 U	2 U
Benzo(ghi)Perylene	NA	3 U	7 U	7 U	3 U	3 U	3 U	3 U
PESTIDIDE/PCBS (ug/l)								
Alpha-BHC	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Beta-BHC	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Delta-BHC	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Gamma-BHC(Lindane)	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Heptachlor	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Aldrin	NA	0.5 U	0.5 U	0.5 U	NA	NA	NA	NA
Heptachlor Expoxide	NA	1 U	0.5 U	0.5 U	NA	NA	NA	NA
Endosulfan 1	NA	1 U	0.5 U	0.5 U	NA	NA	NA	NA
Dieldrin	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
4,4-DDE	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
Endrin	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
Enndosulfan II	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
4,4-DDD	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
Endosulfan Sulfate	NA	5 U	0.1 U	0.1 U	NA	NA	NA	NA
4,4-DDT	NA	1 U	0.1 U	0.1 U	NA	NA	NA	NA
Methoxuchlor	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Endrin Ketone	NA	10 U	0.1 U	0.1 U	NA	NA	NA	NA
Chlordane	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Toxaphene	NA	5 U	1 U	1 U	NA	NA	NA	NA
Aroclor-1016	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Aroclor-1221	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Aroclor-1232	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Aroclor-1242	NA	5 U	0.5 U	0.5 U	NA	NA	NA	NA
Aroclor-1248	NA	10 U	0.5 U	0.5 U	NA	NA	NA	NA
Aroclor-1254	NA		0.5 U	0.5 U	NA	NA	NA	NA
[illegible]	NA		1 U	1 U	NA	NA	NA	NA

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-11D	LW-12S	LW-12D 6/27/86	LW-12D NA	LW-12S	LW-13S	LW-13D	LW-14S
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Bromomethane	4 U	4 U	4 U	NA	4 U	4 U	4 U	4 U
Vinyl Chloride	4 U	4 U	4 U	NA	4 U	1 T	4 U	4 U
Chloroethane	4 U	4 U	4 U	NA	4 U	4 U	4 U	4 U
Methylene Chloride	3 U	3 T	3 U	NA	3 U	3 U	3 U	3 U
Acetone	12 J	19 J	13 T	NA	12 U	1 TB	12 U	10 J
Carbon Disulfide	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
1,1-Dichloroethene	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U
1,1-Dichloroethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Trans-1,2-dichloropropene	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Chloroform	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
1,2-Dichloroethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
2-Butanone	6 U	6 U	6 U	NA	6 U	6 U	6 U	6 U
1,1,1-Trichloroethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Carbon Tetrachloride	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Vinyl Acetate	6 U	6 U	6 U	NA	6 U	6 U	6 U	6 U
Bromodichloromethane	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,2-Dichloropropane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Trans-1,3-dichloropropene	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Trichloroethylene	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Dibromochloromethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
1,1,2-Trichloroethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Benzene	2 U	26	2 U	NA	18	2 U	2 U	2 U
Cis-1,3-dichloropropene	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
2-Chloroethylvinylether	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Bromoform	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
4-Methyl-2-pentanone	4 U	4 U	4 U	NA	4 U	4 U	4 U	4 U
2-Hexanone	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Tetrachloroethylene	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Toluene	2 U	2 U	2 U	NA	2 J	2 U	2 U	2 U
Chlorobenzene	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Ethylbenzene	2 U	2 U	2 U	NA	2 U	2 U	2 U	2 U
Sturene	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Xylenes (Total)	2 U	14	2 U	NA	19	2 U	2 U	2 U
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
Phenol	4 U	3 J	2.2 U	4 U	4 U	4 U	4 U	4 U
Bis(2-chloroisopropyl)Ether	5 U	5 U	2.4 U	5 U	5 U	5 U	5 U	5 U
2-Chlorophenol	3 U	3 U	1.3 U	3 U	3 U	3 U	3 U	3 U
1,3-Dichlorobenzene	3 U	3 U	1.5 U	3 U	3 U	3 U	3 U	3 U
1,4-Dichlorobenzene	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U
Benzyl Alcohol	4 U	4 U	2 U	4 U	4 U	4 U	4 U	4 U
1,2-Dichlorobenzene	4 U	4 U	1.9 U	4 U	4 U	4 U	4 U	4 U
2-Methylphenol	2 U	2 U	1.1 U	2 U	2 U	2 U	2 U	2 U
Bis(2-chloroethyl)Ether	3 U	3 U	1.3 U	3 U	3 U	3 U	3 U	3 U
4-Methylphenol	4 U	4 U	1.8 U	4 U	4 U	4 U	4 U	4 U
N-nitroso-di-n-propylamine	5 U	5 U	2.4 U	5 U	5 U	5 U	5 U	5 U
Hexachloroethane	5 U	5 U	2.6 U	5 U	5 U	5 U	5 U	5 U
Nitrobenzene	4 U	4 U	1.9 U	4 U	4 U	4 U	4 U	4 U
Isophorone	2 U	2 U	1.2 U	2 U	2 U	2 U	2 U	2 U
2-Nitrophenol	3 U	3 U	1.6 U	3 U	3 U	3 U	3 U	3 U
2,4-Dichlorophenol	5 U	5 U	29	24	24	2 U	2 U	2 U
Benzoic Acid	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U
Bis(2-chloroethoxy)Methane	4 U	4 U	1.8 U	4 U	4 U	4 U	4 U	4 U
2,4-Dichlorophenol	2 U	2 U	0.9 U	2 U	2 U	2 U	2 U	2 U
1,2,4-Trichlorobenzene	4 U	4 U	2.1 U	4 U	4 U	4 U	4 U	4 U
Naphthalene	3 U	97	4	3 U	48	3 U	3 U	3 U
4-Chloroaniline	2 U	2 U	0.9 U	2 U	2 U	2 U	2 U	2 U
Hexachlorocyclopentadiene	4 U	4 U	2.2 U	4 U	4 U	4 U	4 U	4 U
4-Chloro-3-Methyphenol	1 U	1 U	0.7 U	1 U	1 U	1 U	1 U	1 U
2-Methylnaphthalene	5 U	100	10	5 U	58	5 U	5 U	5 U
Hexachlorobutadiene	5 U	5 U	2.7 U	5 U	5 U	5 U	5 U	5 U
2,4,6-Trichlorophenol	2 U	2 U	1 U	2 U	2 U	2 U	[illegible]	[illegible]
2,4,5-Trichlorophenol	3 U	3 U	1.6 U	3 U	3 U	3 U	[illegible]	[illegible]

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-11D	LW-12S	LW-12D 6/27/86	LW-12D NA	LW-12S	LW-13S	LW-13D	LW-14S
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
2-Chloronaphthalene	2 U	2 U	0.9 U	2 U	2 U	2 U	2 U	2 U
2-Nitroaniline	1 U	1 U	0.6 U	1 U	1 U	1 U	1 U	1 U
Di-Methyl phthalate	3 U	3 U	1.6 U	3 U	3 U	3 U	3 U	3 U
Acenaphthylene	1 U	3	0.4 U	1 U	2	1 U	1 U	1 U
3-Nitroaniline	7 U	7 U	3.3 U	7 U	7 U	7 U	7 U	7 U
Acenaphthene	8 U	5 J	1 T	8 U	4 J	8 U	8 U	8 U
2,4-Dinitrophenol	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U
4-Nitrophenol	2 U	2 U	1 U	2 U	2 U	2 U	2 U	2 U
Dibenzofuran	4 U	5	1.8 U	4 U	3 J	4 U	4 U	4 U
2,4-Dinitrotoluene	2 U	2 U	1.1 U	2 U	2 U	2 U	2 U	2 U
2,6-Dinitrotoluene	3 U	3 U	1.3 U	3 U	3 U	3 U	3 U	3 U
Di-Ethyl phthalate	2 U	2 U	8 U	2 U	2 U	1 T	3 U	3 U
4-Chlorophenyl Phenyl Ether	6 U	6 U	3.2 U	6 U	6 U	6 U	6 U	6 U
Fluorene	3 U	15	2 T	3 U	9	3 U	3 U	3 U
4-Nitroaniline	7 U	7 U	3.6 U	7 U	7 U	7 U	7 U	7 U
4,6-Dinitro-2-methylphenol	1 U	1 U	0.6 U	1 U	1 U	1 U	1 U	1 U
N-Nitrosodiphenylamine	3 U	3 U	1.6 U	3 U	3 U	3 U	3 U	3 U
4-Bromophenyl-phenylether	3 U	3 U	1.6 U	3 U	3 U	3 U	3 U	3 U
Hexachlorobenzene	4 U	4 U	2.2 U	4 U	4 U	4 U	4 U	4 U
Pentachlorophenol	1 U	1 U	0.6 U	1 U	1 T	1 U	1 U	1 U
Phenanthrene	4 U	11	4	4 U	5	4 U	4 U	4 U
Anthracene	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U
Di-n-Butyl phthalate	4 U	4 U	2.1 U	4 U	4 U	7	8 U	1 T
Fluoranthene	2 U	2 U	0.8 U	2 U	2 U	2 U	2 U	2 U
Pyrene	2 U	2 U	1.1 U	2 U	2 U	2 U	2 U	2 U
Butylbenzylphthalate	4 U	4 U	2.2 U	4 U	4 U	4 U	4 U	4 U
3,3'-Dichlorobenzidine	2 U	2 U	1 U	2 U	2 U	2 U	2 U	2 U
Benzo(a)Anthracene	1 U	1 J	0.3 U	1 U	1 U	1 U	1 U	1 U
Bis(2-ethylhexyl)Phthalate	4 U	4 U	1.8 U	4 U	4 U	4 U	4 U	3 J
Chrysene	1 U	1 U	0.5 U	1 U	1 U	1 U	1 U	1 U
Di-n-Octyl phthalate	1 U	1 U	0.5 U	1 U	1 U	1 U	1 U	1 U
Benzo(b)Fluoranthene	4 U	4 U	2 U	4 U	4 U	4 U	4 U	4 U
Benzo(k)Fluoranthene	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U
Benzo(a)Pyrene	1 U	1 U	0.6 U	1 U	1 U	1 U	1 U	1 U
Indeno(123-cd)Pyrene	2 U	2 U	1.1 U	2 U	2 U	2 U	2 U	2 U
Dibenzo(a,h)Anthracene	2 U	2 U	1 U	2 U	2 U	2 U	2 U	2 U
Benzo(ghi)Perylene	3 U	3 U	1.7 U	3 U	3 U	3 U	3 U	3 U

PESTIDIDE/PCBS (ug/l)

ANALYTE	LW-11D	LW-12S	LW-12D 6/27/86	LW-12D NA	LW-12S	LW-13S	LW-13D	LW-14S
Alpha-BHC	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Beta-BHC	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Delta-BHC	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Gamma-BHC(Lindane)	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Heptachlor	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Aldrin	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Heptachlor Expoxide	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Endosulfan 1	NA	0.5 U	NA	NA	NA	NA	NA	0.5 U
Dieldrin	NA	0.1 U	NA	NA	NA	NA	NA	1 U
4,4-DDE	NA	0.1 U	NA	NA	NA	NA	NA	1 U
Endrin	NA	0.1 U	NA	NA	NA	NA	NA	1 U
Enndosulfan II	NA	0.1 U	NA	NA	NA	NA	NA	1 U
4,4-DDD	NA	0.1 U	NA	NA	NA	NA	NA	1 U
Endosulfan Sulfate	NA	0.1 U	NA	NA	NA	NA	NA	1 U
4,4-DDT	NA	0.1 U	NA	NA	NA	NA	NA	1 U
Methoxuchlor	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Endrin Ketone	NA	0.1 U	NA	NA	NA	NA	NA	1 U
Chlordane	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Toxaphene	NA	1 U	NA	NA	NA	NA	NA	10 U
Aroclor-1016	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Aroclor-1221	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Aroclor-1232	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Aroclor-1242	NA	0.5 U	NA	NA	NA	NA	NA	5 U
Aroclor-1248	NA	0.5 U	NA	NA	NA	NA	NA	[illegible]
[illegible]	NA	[illegible]	NA	NA	NA	NA	NA	[illegible]
[illegible]	NA	1 U	NA	NA	NA	NA	NA	[illegible]

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

WELL NUMBER / ANALYTE	LW-15S	MW-1I	MW-2D	MW-3I	DM-2D	DM-3D	METHOD BLANK	TRIP BLANK
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Bromomethane	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Vinyl Chloride	4 U	1 T	4 U	4 U	4 U	4	4 U	4 U
Chloroethane	4 U	33	4 U	4 U	4 U	4 U	4 U	4 U
Methylene Chloride	3 U	13	8	3 U	7	7	3 U	16
Acetone	7 J	15	10 J	12 U	17	19	18	6 T
Carbon Disulfide	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1-Dichloroethene	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-Dichloroethane	2 U	1 T	2 U	2 U	2 U	2 U	2 U	2 U
Trans-1,2-dichloropropene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Chloroform	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,2-Dichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-Butanone	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
1,1,1-Trichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Carbon Tetrachloride	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Vinyl Acetate	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trans-1,3-dichloropropene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Trichloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1,2-Trichloroethane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Benzene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Cis-1,3-dichloropropene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-Chloroethylvinylether	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Bromoform	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
4-Methyl-2-pentanone	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2-Hexanone	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Tetrachloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2,2-Tetrachloroethane	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Toluene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Sturene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Xylenes (Total)	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
Phenol	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Bis(2-chloroisopropyl)Ether	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA
2-Chlorophenol	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
1,3-Dichlorobenzene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
1,4-Dichlorobenzene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Benzyl Alcohol	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
1,2-Dichlorobenzene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
2-Methylphenol	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Bis(2-chloroethyl)Ether	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Methylphenol	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
N-nitroso-di-n-propylamine	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA
Hexachloroethane	5 U	5 U	5 U	NA	5 U	5 U	4 U	NA
Nitrobenzene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Isophorone	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
2-Nitrophenol	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
2,4-Dichlorophenol	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Benzoic Acid	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Bis(2-chloroethoxy)Methane	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
2,4-Dichlorophenol	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
1,2,4-Trichlorobenzene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Naphthalene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Chloroaniline	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Hexachlorocyclopentadiene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
4-Chloro-3-Methyphenol	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
2-Methylnaphthalene	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA
Hexachlorobutadiene	5 U	5 U	5 U	NA	5 U	5 U	5 U	NA
2,4,6-Trichlorophenol	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
[illegible]	3 U	3 U	[illegible]	NA	3 U	3 U	3 U	NA

LANDAU ASSOCIATES SAMPLING RESULTS
JUNE/JULY/AUGUST 1986 SAMPLING

ANALYTE / WELL NUMBER	LW-15S	MW-1I	MW-2D	MW-3I	DM-2D	DM-3D	METHOD BLANK	TRIP BLANK
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug								
2-Chloronaphthalene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
2-Nitroaniline	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
Di-Methyl phthalate	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Acenaphthylene	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
3-Nitroaniline	7 U	7 U	7 U	NA	7 U	7 U	7 U	NA
Acenaphthene	8 U	8 U	8 U	NA	8 U	8 U	8 U	NA
2,4-Dinitrophenol	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Nitrophenol	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Dibenzofuran	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
2,4-Dinitrotoluene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
2,6-Dinitrotoluene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Di-Ethyl phthalate	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Chlorophenyl Phenyl Ether	6 U	6 U	6 U	NA	6 U	6 U	6 U	NA
Fluorene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Nitroaniline	7 U	7 U	7 U	NA	7 U	7 U	7 U	NA
4,6-Dinitro-2-methylphenol	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
N-Nitrosodiphenylamine	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
4-Bromophenyl-phenylether	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Hexachlorobenzene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Pentachlorophenol	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
Phenanthrene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Anthracene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Di-n-Butyl phthalate	1 T	4 U	2 T	NA	2 T	7	2 T	NA
Fluoranthene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Pyrene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Butylbenzylphthalate	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
3,3'-Dichlorobenzidine	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Benzo(a)Anthracene	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
Bis(2-ethylhexyl)Phthalate	2 T	4 U	4 U	NA	4 U	3 J	4 U	NA
Chrysene	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
Di-n-Octyl phthalate	1 U	1 U	1 U	NA	1 U	1 J	1 U	NA
Benzo(b)Fluoranthene	4 U	4 U	4 U	NA	4 U	4 U	4 U	NA
Benzo(k)Fluoranthene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA
Benzo(a)Pyrene	1 U	1 U	1 U	NA	1 U	1 U	1 U	NA
Indeno(123-cd)Pyrene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Dibenzo(a,h)Anthracene	2 U	2 U	2 U	NA	2 U	2 U	2 U	NA
Benzo(ghi)Perylene	3 U	3 U	3 U	NA	3 U	3 U	3 U	NA

PESTIDIDE/PCBS (ug/l)

Analyte	LW-15S	MW-1I	MW-2D	MW-3I	DM-2D	DM-3D	METHOD BLANK	TRIP BLANK
Alpha-BHC	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Beta-BHC	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Delta-BHC	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Gamma-BHC(Lindane)	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Heptachlor	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Aldrin	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Heptachlor Expoxide	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Endosulfan I	0.5 U	0.5 U	0.5 U	NA	0.5 U	NA	0.5 U	NA
Dieldrin	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
4,4-DDE	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
Endrin	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
Enndosulfan II	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
4,4-DDD	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
Endosulfan Sulfate	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
4,4-DDT	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
Methoxuchlor	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Endrin Ketone	0.1 U	1 U	1 U	NA	1 U	NA	1 U	NA
Chlordane	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Toxaphene	1 U	10 U	10 U	NA	10 U	NA	10 U	NA
Aroclor-1016	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Aroclor-1221	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Aroclor-1232	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Aroclor-1242	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Aroclor-1248	0.5 U	5 U	5 U	NA	5 U	NA	5 U	NA
Aroclor-1254	0.5 U	5 U	5 U	NA	[illegible]	NA	[illegible]	NA
Aroclor-[illegible]	1 U	10 U	10 U	NA	[illegible]	NA	[illegible]	NA

Hart Crowser
J-1639-09

RESULTS OF FEBRUARY 1988
GROUNDWATER ANALYSES
(BY HART CROWSER, INC.)

HART CROWSER INC. SAMPLING RESULTS
FEBRUARY 1988 SAMPLING

ANALYTE / WELL NUMBER	MW3-I	MW-4	MW-5	MW-10	LW-14-S	LW-12-D	LW-12-S	LW-13-D
METALS DISSOLVED (mg/l)								
Arsenic	0.019	0.007 U	0.007 U	0.025	0.008	0.007 U	0.035	0.008
Lead	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U
Chromium	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Nickel	0.031 U	0.048	0.031 U	0.031 U	0.031 U	0.031 U	0.049	0.031 U
Copper	0.006	0.011	0.011	0.01	0.013	0.008	0.006	0.006
Zinc	0.008	0.012	0.006 U	0.01	0.019	0.011	0.018	0.01
VOLATILE ORGANIC COMPOUNDS (ug/l)								
Chloromethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methylene Chloride	5 U	5 U	5 U	5 U	5 U	440 U	5 U	5 U
Acetone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Carbon Disulfide	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trans-1,2-dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Acetate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trans-1,3-dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cis-1,3-dichloropropene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Chloroethylvinylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bromoform	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Tetrachloroethylene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Xylenes (Total)	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug/l)								
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroisopropyl)Ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzyl Alcohol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethyl)Ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-nitroso-di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	14	10 U	10 U
Benzoic Acid	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U

HART CROWSER INC. SAMPLING RESULTS
FEBRUARY 1988 SAMPLING

ANALYTE / WELL NUMBER	MW3-I	MW-4	MW-5	MW-10	LW-14-S	LW-12-D	LW-12-S	LW-13-D
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug/l)								
Bis(2-chloroethoxy)Methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	10 U	10 U	10 U	10 U	10 U	10 U	130	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-Methyphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	190	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Nitroaniline	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Di-Methyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Acenaphthene	10 U	10 U	10 U	10 U	10 U	10 U	TR	10 U
2,4-Dinitrophenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-Nitrophenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-Ethyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl Phenyl Ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	16	10 U
4-Nitroaniline	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4,6-Dinitro-2-methylphenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	14	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-Butyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzidine	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Benzo(a)Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)Phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-Octyl phthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(123-cd)Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzo(a,h)Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(ghi)Perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

HART CROWSER INC. SAMPLING RESULTS
FEBRUARY 1988 SAMPLING

ANALYTE / WELL NUMBER	LW-13-S	OW-1	OW-2	OW-3
METALS DISSOLVED (mg/l)				
Arsenic	0.014	0.009	0.014	0.011
Lead	0.009 U	0.009 U	0.009 U	0.009 U
Chromium	0.003 U	0.003 U	0.003 U	0.003 U
Nickel	0.031 U	0.031 U	0.031 U	0.031 U
Copper	0.011	0.007	0.006	0.009
Zinc	0.021	0.006 U	0.01	0.024
VOLATILE ORGANIC COMPOUNDS (ug/l)				
Chloromethane	10 U			
Bromomethane	10 U			
Vinyl Chloride	1 U			
Chloroethane	1 U			
Methylene Chloride	5 U			
Acetone	21			
Carbon Disulfide	1 U			
1,1-Dichloroethene	1 U			
1,1-Dichloroethane	1 U			
Trans-1,2-dichloropropene	1 U			
Chloroform	1 U			
1,2-Dichloroethane	1 U			
2-Butanone	10 U			
1,1,1-Trichloroethane	1 U			
Carbon Tetrachloride	1 U			
Vinyl Acetate	10 U			
1,1,2,2-Tetrachloroethane	1 U			
1,2-Dichloropropane	1 U			
Trans-1,3-dichloropropene	1 U			
Trichloroethylene	1 U			
Dibromochloromethane	1 U			
1,1,2-Trichloroethane	1 U			
Benzene	1 U			
Cis-1,3-dichloropropene	1 U			
2-Chloroethylvinylether	10 U			
Bromoform	5 U			
2-Hexanone	10 U			
4-Methyl-2-pentanone	10 U			
Tetrachloroethylene	1 U			
Toluene	0.037			
Chlorobenzene	1 U			
Ethylbenzene	0.002			
Xylenes (Total)	0.005			
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug				
N-Nitrosodiphenylamine	10 U			
Phenol	10 U			
Aniline	10 U			
Bis(2-chloroisopropyl)Ether	10 U			
2-Chlorophenol	10 U			
1,3-Dichlorobenzene	10 U			
1,4-Dichlorobenzene	10 U			
Benzyl Alcohol	10 U			
1,2-Dichlorobenzene	10 U			
4-Methylphenol	10 U			
Bis(2-chloroethyl)Ether	10 U			
4-Methylphenol	10 U			
N-nitroso-di-n-propylamine	10 U			
Hexachloroethane	10 U			
Nitrobenzene	10 U			
Isophorone	10 U			
2-Nitrophenol	10 U			
2,4-Dichlorophenol	10 U			
Benzoic Acid	50 U			

HART CROWSER INC. SAMPLING RESULTS
FEBRUARY 1988 SAMPLING

ANALYTE	WELL NUMBER LW-13-S	OW-1	OW-2	OW-3
SEMI-VOLATILE EXTRACTABLE COMPOUNDS (ug				
Bis(2-chloroethoxy)Methane	10 U			
2,4-Dichlorophenol	10 U			
1,2,4-Trichlorobenzene	10 U			
Naphthalene	10 U			
4-Chloroaniline	10 U			
Hexachlorocyclopentadiene	10 U			
4-Chloro-3-Methyphenol	10 U			
2-Methylnaphthalene	10 U			
Hexachlorobutadiene	10 U			
2,4,6-Trichlorophenol	10 U			
2,4,5-Trichlorophenol	50 U			
2-Chloronaphthalene	10 U			
2-Nitroaniline	50 U			
Di-Methyl phthalate	10 U			
Acenaphthylene	10 U			
3-Nitroaniline	50 U			
Acenaphthene	10 U			
2,4-Dinitrophenol	50 U			
4-Nitrophenol	50 U			
Dibenzofuran	10 U			
2,4-Dinitrotoluene	10 U			
2,6-Dinitrotoluene	10 U			
Di-Ethyl phthalate	10 U			
4-Chlorophenyl Phenyl Ether	10 U			
Fluorene	10 U			
4-Nitroaniline	50 U			
4,6-Dinitro-2-methylphenol	50 U			
N-Nitrosodiphenylamine	10 U			
4-Bromophenyl-phenylether	10 U			
Hexachlorobenzene	10 U			
Pentachlorophenol	50 U			
Phenanthrene	10 U			
Anthracene	10 U			
Di-n-Butyl phthalate	10 U			
Fluoranthene	10 U			
Benzidine	100 U			
Pyrene	10 U			
Butylbenzyl phthalate	10 U			
3,3'-Dichlorobenzidine	20 U			
Benzo(a)Anthracene	10 U			
Bis(2-ethylhexyl)Phthalate	10 U			
Chrysene	10 U			
Di-n-Octyl phthalate	10 U			
Benzo(b)Fluoranthene	10 U			
Benzo(k)Fluoranthene	10 U			
Benzo(a)Pyrene	10 U			
Indeno(123-cd)Pyrene	10 U			
Dibenzo(a,h)Anthracene	10 U			
Benzo(ghi)Perylene	10 U			

RESULTS OF JULY 1988
GROUNDWATER ANALYSES

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30)
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-5D	LW-15S	LW-12S
Laucks Lab No.	10740-1	10740-2	10740-3
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88
MISCELLANEOUS INORGANICS			
Dissolved Metals	mg/l	mg/l	mg/l
Copper	0.001 U	0.001 U	0.001
Nickel	0.002	0.002 U	0.002 U
Lead	0.006	0.007	0.007
Chromium	0.001 U	0.003	0.001 U
Zinc	0.034 EB	0.013 B	0.014 B
Arsenic	0.006	0.073	0.016
Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA
VOLATILE ORGANICS			
		ug/l	ug/l
Chloromethane	NA	1 U	1 U
Bromomethane	NA	1 U	1 U
Vinyl Chloride	NA	1 U	1 U
Chloroethane	NA	3 U	3 U
Methylene Chloride	NA	1 U	1 U
Acetone	NA	10	5 U
Carbon Disulfide	NA	1 U	1 U
1,1-Dichloroethene	NA	1 U	1 U
1,1-Dichloroethane	NA	1 U	1 U
trans-1,2-Dichloroethene	NA	1 U	1 U
cis-1,2-Dichloroethene	NA	1 U	1 U
total-1,2-Dichloroethene	NA	1 U	1 U
Chloroform	NA	1 U	1 U
2-Butanone	NA	3 U	3 U
1,2-Dichloroethane	NA	1 U	1 U
1,1,1-Trichloroethane	NA	1 U	1 U
Carbon Tetrachloride	NA	1 U	1 U
Vinyl Acetate	NA	1 U	1 U
Bromodichloromethane	NA	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30)
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-5D	LW-15S	LW-12S
Laucks Lab No.	10740-1	10740-2	10740-3
1,2-Dichloropropane	NA	1 U	1 U
Trichloroethene	NA	1 U	1 U
Benzene	NA	1 U	10
Dibromochloromethane	NA	3 U	3 U
1,1,2-Trichloroethane	NA	1 U	1 U
Bromoform	NA	1 U	1 U
4-Methyl-2-Pentanone	NA	3 U	3 U
2-Hexanone	NA	3 U	3 U
1,1,2,2-Tetrachloroethane	NA	3 U	3 U
Tetrachloroethene	NA	1 U	1 U
Toluene	NA	1 U	1 U
Chlorobenzene	NA	3 U	3 U
trans-1,3-Dichloropropene	NA	3 U	3 U
Ethylbenzene	NA	1 U	3
cis-1,3-Dichloropropene	NA	3 U	3 U
Styrene	NA	1 U	1 U
Total Xylenes	NA	1 U	6
SEMIVOLATILE ORGANICS			
			ug/l
Phenol	NA	NA	2 U
Aniline	NA	NA	10 U
Bis(2-chloroethyl)ether	NA	NA	2 U
2-Chlorophenol	NA	NA	2 U
1,3-Dichlorobenzene	NA	NA	2 U
1,4-Dichlorobenzene	NA	NA	2 U
Benzyl Alcohol	NA	NA	2 U
1,2-Dichlorobenzene	NA	NA	2 U
2-Methylphenol	NA	NA	2 U
Bis(2-chloroisopropyl)ether	NA	NA	2 U
4-Methylphenol	NA	NA	2 U
N-Nitroso-di-n-propylamine	NA	NA	2 U
Hexachloroethane	NA	NA	4 U
Nitrobenzene	NA	NA	2 U
Isophorone	NA	NA	2 U
2-Nitrophenol	NA	NA	4 U
2,4-Dimethylphenol	NA	NA	2 U
Benzoic Acid	NA	NA	50 U
Bis(2-chloroethoxy)methane	NA	NA	2 U
2,4-Dichlorophenol	NA	NA	4 U
1,2,4-Trichlorobenzene	NA	NA	2 U
Naphthalene	NA	NA	92
4-Chloroaniline	NA	NA	2 U
Hexachlorobutadiene	NA	NA	2 U
4-Chloro-3-methylphenol	NA	NA	4 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30)
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No. / Laucks Lab No.	LW-5D 10740-1	LW-15S 10740-2	LW-12S 10740-3
2-Methylnaphthalene	NA	NA	200
Hexachlorocyclopentadiene	NA	NA	4 U
2,4,6-Trichlorophenol	NA	NA	4 U
2,4,5-Trichlorophenol	NA	NA	4 U
2-Chloronaphthalene	NA	NA	2 U
2-Nitroaniline	NA	NA	4 U
Dimethyl phthalate	NA	NA	2 U
Acenaphthylene	NA	NA	2 U
2,6-Dinitrotoluene	NA	NA	4 U
3-Nitroaniline	NA	NA	10 U
Acenaphthene	NA	NA	9
2,4-Dinitrophenol	NA	NA	20 U
4-Nitrophenol	NA	NA	20 U
Dibenzofuran	NA	NA	6
2,4-Dinitrotoluene	NA	NA	4 U
Diethyl phthalate	NA	NA	2 U
4-Chlorophenyl phenylether	NA	NA	2 U
Fluorene	NA	NA	20
4-Nitroaniline	NA	NA	4 U
4,6-Dinitro-2-methylphenol	NA	NA	20 U
N-Nitrosodiphenylamine	NA	NA	2 U
1,2-Diphenylhydrazine	NA	NA	4 U
4-Bromophenyl phenylether	NA	NA	4 U
Hexachlorobenzene	NA	NA	2 U
Pentachlorophenol	NA	NA	20 U
Phenanthrene	NA	NA	23
Anthracene	NA	NA	2 U
Di-n-butyl phthalate	NA	NA	2 U
Fluoranthene	NA	NA	2 U
Pyrene	NA	NA	2 U
Benzidine	NA	NA	50 U
Butylbenzylphthalate	NA	NA	2 U
3-3'-Dichlorobenzidine	NA	NA	20 U
Benzo(a)anthracene	NA	NA	2 U
Chrysene	NA	NA	2 U
Bis(2-ethylhexyl)phthalate	NA	NA	4 B
Di-n-octyl phthalate	NA	NA	2 U
Benzo(b)fluoranthene	NA	NA	4 U
Benzo(k)fluoranthene	NA	NA	4 U
Benzo(a)pyrene	NA	NA	4 U
Indeno(1,2,3-cd)pyrene	NA	NA	4 U
Dibenzo(a,h)anthracene	NA	NA	4 U
Benzo(g,h,i)perylene	NA	NA	4 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-12D	LW-2S	LW-2D
Laucks Lab No.	10740-4	10740-5	10740-6
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88

MISCELLANEOUS INORGANICS

Dissolved Metals	mg/l	mg/l	
Copper	0.001 U	0.001	NA
Nickel	0.002 U	0.002 U	NA
Lead	0.005	0.006	NA
Chromium	0.001 U	0.004	NA
Zinc	0.013 B	0.026 B	NA
Arsenic	0.005 U	0.005 U	NA

Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA

VOLATILE ORGANICS

	ug/l	ug/l	ug/l
Chloromethane	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U
Chloroethane	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U
Acetone	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-12D	LW-2S	LW-2D
Laucks Lab No.	10740-4	10740-5	10740-6
1,2-Dichloropropane	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U
Benzene	52	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U
Toluene	620 D	1 U	1 U
Chlorobenzene	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U
Ethylbenzene	42	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U
Styrene	1 U	1 U	1 U
Total Xylenes	330	1 U	1 U

SEMIVOLATILE ORGANICS

	ug/l	ug/l	
Phenol	2 U	2 U	NA
Aniline	10 U	10 U	NA
Bis(2-chloroethyl)ether	2 U	2 U	NA
2-Chlorophenol	2 U	2 U	NA
1,3-Dichlorobenzene	2 U	2 U	NA
1,4-Dichlorobenzene	2 U	2 U	NA
Benzyl Alcohol	2 U	2 U	NA
1,2-Dichlorobenzene	2 U	2 U	NA
2-Methylphenol	2 U	2 U	NA
Bis(2-chloroisopropyl)ether	2 U	2 U	NA
4-Methylphenol	2 U	2 U	NA
N-Nitroso-di-n-propylamine	2 U	2 U	NA
Hexachloroethane	4 U	4 U	NA
Nitrobenzene	2 U	2 U	NA
Isophorone	2 U	2 U	NA
2-Nitrophenol	4 U	4 U	NA
2,4-Dimethylphenol	10	2 U	NA
Benzoic Acid	50 U	50 U	NA
Bis(2-chloroethoxy)methane	2 U	2 U	NA
2,4-Dichlorophenol	4 U	4 U	NA
1,2,4-Trichlorobenzene	2 U	2 U	NA
Naphthalene	4 U	4 U	NA
4-Chloroaniline	2 U	2 U	NA
Hexachlorobutadiene	2 U	2 U	NA
4-Chloro-3-methylphenol	4 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-12D	LW-2S	LW-2D
Laucks Lab No.	10740-4	10740-5	10740-6
2-Methylnaphthalene	2 U	2 U	NA
Hexachlorocyclopentadiene	4 U	4 U	NA
2,4,6-Trichlorophenol	4 U	4 U	NA
2,4,5-Trichlorophenol	4 U	4 U	NA
2-Chloronaphthalene	2 U	2 U	NA
2-Nitroaniline	4 U	4 U	NA
Dimethyl phthalate	2 U	2 U	NA
Acenaphthylene	2 U	2 U	NA
2,6-Dinitrotoluene	4 U	4 U	NA
3-Nitroaniline	10 U	10 U	NA
Acenaphthene	2 U	2 U	NA
2,4-Dinitrophenol	20 U	20 U	NA
4-Nitrophenol	20 U	20 U	NA
Dibenzofuran	2 U	2 U	NA
2,4-Dinitrotoluene	4 U	4 U	NA
Diethyl phthalate	2 U	2 U	NA
4-Chlorophenyl phenylether	2 U	2 U	NA
Fluorene	2 U	2 U	NA
4-Nitroaniline	4 U	4 U	NA
4,6-Dinitro-2-methylphenol	20 U	20 U	NA
N-Nitrosodiphenylamine	2 U	2 U	NA
1,2-Diphenylhydrazine	4 U	4 U	NA
4-Bromophenyl phenylether	4 U	4 U	NA
Hexachlorobenzene	2 U	2 U	NA
Pentachlorophenol	20 U	20 U	NA
Phenanthrene	2 U	2 U	NA
Anthracene	2 U	2 U	NA
Di-n-butyl phthalate	2 U	2 U	NA
Fluoranthene	2 U	2 U	NA
Pyrene	2 U	2 U	NA
Benzidine	50 U	50 U	NA
Butylbenzylphthalate	2 U	2 U	NA
3-3'-Dichlorobenzidine	20 U	20 U	NA
Benzo(a)anthracene	2 U	2 U	NA
Chrysene	2 U	2 U	NA
Bis(2-ethylhexyl)phthalate	2 B	3 B	NA
Di-n-octyl phthalate	2 U	2 U	NA
Benzo(b)fluoranthene	4 U	4 U	NA
Benzo(k)fluoranthene	4 U	4 U	NA
Benzo(a)pyrene	4 U	4 U	NA
Indeno(1,2,3-cd)pyrene	4 U	4 U	NA
Dibenzo(a,h)anthracene	4 U	4 U	NA
Benzo(g,h,i)perylene	4 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-3S	LW-3D	LW-9D
Laucks Lab No.	10740-7	10740-8	10740-9
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88

MISCELLANEOUS INORGANICS

Dissolved Metals	mg/l	mg/l	mg/l
Copper	0.001 U	0.001 U	0.001 U
Nickel	0.002 U	0.002 U	0.002 U
Lead	0.009	0.005 U	0.007
Chromium	0.003	0.001 U	0.002
Zinc	0.016 B	0.007 EB	0.015 B
Arsenic	0.007	0.005 U	0.008
Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA

VOLATILE ORGANICS

	ug/l	ug/l	ug/l
Chloromethane	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	120
Chloroethane	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U
Acetone	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U
1,1-Dichloroethane	180	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-3S	LW-3D	LW-9D
Laucks Lab No.	10740-7	10740-8	10740-9
1,2-Dichloropropane	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U
Benzene	14	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U
Toluene	1400 D	1 U	1 U
Chlorobenzene	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U
Ethylbenzene	430 D	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U
Styrene	1 U	1 U	1 U
Total Xylenes	960 D	1	1 U'

SEMIVOLATILE ORGANICS

	ug/l	ug/l	ug/l
Phenol	2 U	2 U	2 U
Aniline	10 U	10 U	10 U
Bis(2-chloroethyl)ether	2 U	2 U	2 U
2-Chlorophenol	2 U	2 U	2 U
1,3-Dichlorobenzene	2 U	2 U	2 U
1,4-Dichlorobenzene	2 U	2 U	2 U
Benzyl Alcohol	2 U	2 U	2 U
1,2-Dichlorobenzene	6	2 U	2 U
2-Methylphenol	6	2 U	2 U
Bis(2-chloroisopropyl)ether	2 U	2 U	2 U
4-Methylphenol	4	2 U	2 U
N-Nitroso-di-n-propylamine	2 U	2 U	2 U
Hexachloroethane	4 U	4 U	4 U
Nitrobenzene	2 U	2 U	2 U
Isophorone	2 U	2 U	2 U
2-Nitrophenol	4 U	4 U	4 U
2,4-Dimethylphenol	2 U	32	2 U
Benzoic Acid	50 U	50 U	50 U
Bis(2-chloroethoxy)methane	2 U	2 U	2 U
2,4-Dichlorophenol	4 U	4 U	4 U
1,2,4-Trichlorobenzene	2 U	2 U	2 U
Naphthalene	200	30	4 U
4-Chloroaniline	2 U	2 U	2 U
Hexachlorobutadiene	2 U	2 U	2 U
4-Chloro-3-methylphenol	4 U	4 U	4 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No. / Laucks Lab No.	LW-3S 10740-7	LW-3D 10740-8	LW-9D 10740-9
2-Methylnaphthalene	16	2 U	2 U
Hexachlorocyclopentadiene	4 U	4 U	4 U
2,4,6-Trichlorophenol	4 U	4 U	4 U
2,4,5-Trichlorophenol	4 U	4 U	4 U
2-Chloronaphthalene	2 U	2 U	2 U
2-Nitroaniline	4 U	4 U	4 U
Dimethyl phthalate	2 U	2 U	2 U
Acenaphthylene	2 U	2 U	2 U
2,6-Dinitrotoluene	4 U	4 U	4 U
3-Nitroaniline	10 U	10 U	10 U
Acenaphthene	14	2 U	2 U
2,4-Dinitrophenol	20 U	20 U	20 U
4-Nitrophenol	20 U	20 U	20 U
Dibenzofuran	3	2 U	2 U
2,4-Dinitrotoluene	4 U	4 U	4 U
Diethyl phthalate	2 U	2 U	2 U
4-Chlorophenyl phenylether	2 U	2 U	2 U
Fluorene	5	2 U	2 U
4-Nitroaniline	4 U	4 U	4 U
4,6-Dinitro-2-methylphenol	20 U	20 U	20 U
N-Nitrosodiphenylamine	2 U	2 U	2 U
1,2-Diphenylhydrazine	4 U	4 U	4 U
4-Bromophenyl phenylether	4 U	4 U	4 U
Hexachlorobenzene	2 U	2 U	2 U
Pentachlorophenol	20 U	20 U	20 U
Phenanthrene	2 U	2 U	2 U
Anthracene	2 U	2 U	2 U
Di-n-butyl phthalate	2 U	2 U	2 U
Fluoranthene	2 U	2 U	2 U
Pyrene	2 U	2 U	2 U
Benzidine	50 U	50 U	50 U
Butylbenzylphthalate	2 U	2 U	2 U
3-3'-Dichlorobenzidine	20 U	20 U	20 U
Benzo(a)anthracene	2 U	2 U	2 U
Chrysene	2 U	2 U	2 U
Bis(2-ethylhexyl)phthalate	3 B	2 B	3 B
Di-n-octyl phthalate	2 U	2 U	2 U
Benzo(b)fluoranthene	4 U	4 U	4 U
Benzo(k)fluoranthene	4 U	4 U	4 U
Benzo(a)pyrene	4 U	4 U	4 U
Indeno(1,2,3-cd)pyrene	4 U	4 U	4 U
Dibenzo(a,h)anthracene	4 U	4 U	4 U
Benzo(g,h,i)perylene	4 U	4 U	4 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-9S	LW-5S	DM-3D
Laucks Lab No.	10740-10	10740-11	10740-12
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88

MISCELLANEOUS INORGANICS

Dissolved Metals	mg/l	mg/l	mg/l
Copper	0.001	0.001	0.001 U
Nickel	0.002 U	0.002 U	0.003
Lead	0.009	0.007	0.005 U
Chromium	0.001	0.001 U	0.001 U
Zinc	0.015 B	0.018 B	0.021 B
Arsenic	0.015	0.005 U	0.07

Total Metals	mg/l		
Copper	0.006	NA	NA
Nickel	0.002 U	NA	NA
Lead	0.009	NA	NA
Chromium	0.005	NA	NA
Zinc	0.024 B	NA	NA
Arsenic	0.027	NA	NA

VOLATILE ORGANICS

	ug/l		ug/l
Chloromethane	1 U	NA	1 U
Bromomethane	1 U	NA	1 U
Vinyl Chloride	1 U	NA	1 U
Chloroethane	3 U	NA	3 U
Methylene Chloride	1 U	NA	1 U
Acetone	5 U	NA	5 U
Carbon Disulfide	1 U	NA	1 U
1,1-Dichloroethene	1 U	NA	1 U
1,1-Dichloroethane	1 U	NA	1 U
trans-1,2-Dichloroethene	1 U	NA	1 U
cis-1,2-Dichloroethene	1 U	NA	1 U
total-1,2-Dichloroethene	1 U	NA	1 U
Chloroform	1 U	NA	1 U
2-Butanone	3 U	NA	3 U
1,2-Dichloroethane	1 U	NA	1 U
1,1,1-Trichloroethane	1 U	NA	1 U
Carbon Tetrachloride	1 U	NA	1 U
Vinyl Acetate	1 U	NA	1 U
Bromodichloromethane	1 U	NA	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-9S	LW-5S	DM-3D
Laucks Lab No.	10740-10	10740-11	10740-12
1,2-Dichloropropane	1 U	NA	1 U
Trichloroethene	1 U	NA	1 U
Benzene	1 U	NA	1 U
Dibromochloromethane	3 U	NA	3 U
1,1,2-Trichloroethane	1 U	NA	1 U
Bromoform	1 U	NA	1 U
4-Methyl-2-Pentanone	3 U	NA	3 U
2-Hexanone	3 U	NA	3 U
1,1,2,2-Tetrachloroethane	3 U	NA	3 U
Tetrachloroethene	1 U	NA	1 U
Toluene	1 U	NA	1 U
Chlorobenzene	3 U	NA	3 U
trans-1,3-Dichloropropene	3 U	NA	3 U
Ethylbenzene	1 U	NA	1 U
cis-1,3-Dichloropropene	3 U	NA	3 U
Styrene	1 U	NA	1 U
Total Xylenes	1 U	NA	1 U

SEMIVOLATILE ORGANICS

	ug/l		ug/l
Phenol	2 U	NA	2 UR
Aniline	11 U	NA	10 UE
Bis(2-chloroethyl)ether	2 U	NA	2 UE
2-Chlorophenol	2 U	NA	2 UR
1,3-Dichlorobenzene	2 U	NA	2 UE
1,4-Dichlorobenzene	2 U	NA	2 UE
Benzyl Alcohol	2 U	NA	2 UE
1,2-Dichlorobenzene	2 U	NA	2 UE
2-Methylphenol	2 U	NA	2 UR
Bis(2-chloroisopropyl)ether	2 U	NA	2 UE
4-Methylphenol	2 U	NA	2 UR
N-Nitroso-di-n-propylamine	2 U	NA	2 UE
Hexachloroethane	4 U	NA	4 UE
Nitrobenzene	2 U	NA	2 UE
Isophorone	2 U	NA	2 UE
2-Nitrophenol	4 U	NA	4 UR
2,4-Dimethylphenol	2 U	NA	2 UR
Benzoic Acid	54 U	NA	50 UR
Bis(2-chloroethoxy)methane	2 U	NA	2 UE
2,4-Dichlorophenol	4 U	NA	4 UR
1,2,4-Trichlorobenzene	2 U	NA	2 UE
Naphthalene	4 U	NA	4 UE
4-Chloroaniline	2 U	NA	2 UE
Hexachlorobutadiene	2 U	NA	2 UE
4-Chloro-3-methylphenol	4 U	NA	4 UR

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-9S	LW-5S	DM-3D
Laucks Lab No.	10740-10	10740-11	10740-12
2-Methylnaphthalene	2 U	NA	2 UE
Hexachlorocyclopentadiene	4 U	NA	4 UE
2,4,6-Trichlorophenol	4 U	NA	4 UR
2,4,5-Trichlorophenol	4 U	NA	4 UR
2-Chloronaphthalene	2 U	NA	2 UE
2-Nitroaniline	4 U	NA	4 UE
Dimethyl phthalate	2 U	NA	2 UE
Acenaphthylene	2 U	NA	2 UE
2,6-Dinitrotoluene	4 U	NA	4 UE
3-Nitroaniline	11 U	NA	10 UE
Acenaphthene	2 U	NA	2 UE
2,4-Dinitrophenol	22 U	NA	20 UR
4-Nitrophenol	22 U	NA	20 UR
Dibenzofuran	2 U	NA	2 UE
2,4-Dinitrotoluene	4 U	NA	4 UE
Diethyl phthalate	2 U	NA	2 UE
4-Chlorophenyl phenylether	2 U	NA	2 UE
Fluorene	2 U	NA	2 UE
4-Nitroaniline	4 U	NA	4 UE
4,6-Dinitro-2-methylphenol	22 U	NA	20 UR
N-Nitrosodiphenylamine	2 U	NA	2 UE
1,2-Diphenylhydrazine	4 U	NA	4 UE
4-Bromophenyl phenylether	4 U	NA	4 UE
Hexachlorobenzene	2 U	NA	2 UE
Pentachlorophenol	22 U	NA	20 UR
Phenanthrene	2 U	NA	2 UE
Anthracene	2 U	NA	2 UE
Di-n-butyl phthalate	2 U	NA	2 UE
Fluoranthene	2 U	NA	2 UE
Pyrene	2 U	NA	2 UE
Benzidine	54 U	NA	50 UE
Butylbenzylphthalate	2 U	NA	2 UE
3-3'-Dichlorobenzidine	22 U	NA	20 UE
Benzo(a)anthracene	2 U	NA	2 UE
Chrysene	2 U	NA	2 UE
Bis(2-ethylhexyl)phthalate	3 B	NA	10 E
Di-n-octyl phthalate	2 U	NA	2 UE
Benzo(b)fluoranthene	4 U	NA	4 UE
Benzo(k)fluoranthene	4 U	NA	4 UE
Benzo(a)pyrene	4 U	NA	4 UE
Indeno(1,2,3-cd)pyrene	4 U	NA	4 UE
Dibenzo(a,h)anthracene	4 U	NA	4 UE
Benzo(g,h,i)perylene	4 U	NA	4 UE

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-6D	LW-6S	LW-10D
Laucks Lab No.	10740-13	10740-14	10740-15
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88

MISCELLANEOUS INORGANICS

Dissolved Metals	mg/l	mg/l	mg/l
Copper	0.001	0.001	0.001 U
Nickel	0.002 U	0.002	0.002 U
Lead	0.008	0.005 U	0.005
Chromium	0.001 U	0.003	0.002
Zinc	0.024 B	0.012 B	0.011 B
Arsenic	0.012	0.006	0.008
Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA

VOLATILE ORGANICS

	ug/l	ug/l	ug/l
Chloromethane	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U
Vinyl Chloride	41	1 U	1 U
Chloroethane	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U
Acetone	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-6D	LW-6S	LW-10D
Laucks Lab No.	10740-13	10740-14	10740-15
1,2-Dichloropropane	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U
Benzene	1 U	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U
Toluene	1 U	1 U	1 U
Chlorobenzene	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U
Ethylbenzene	1 U	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U
Styrene	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U

SEMIVOLATILE ORGANICS

	ug/l	ug/l	
Phenol	3 U	2 U	NA
Aniline	14 U	10 U	NA
Bis(2-chloroethyl)ether	3 U	2 U	NA
2-Chlorophenol	3 U	2 U	NA
1,3-Dichlorobenzene	3 U	2 U	NA
1,4-Dichlorobenzene	3 U	2 U	NA
Benzyl Alcohol	3 U	2 U	NA
1,2-Dichlorobenzene	3 U	2 U	NA
2-Methylphenol	3 U	2 U	NA
Bis(2-chloroisopropyl)ether	3 U	2 U	NA
4-Methylphenol	3 U	2 U	NA
N-Nitroso-di-n-propylamine	3 U	2 U	NA
Hexachloroethane	6 U	4 U	NA
Nitrobenzene	3 U	2 U	NA
Isophorone	3 U	2 U	NA
2-Nitrophenol	6 U	4 U	NA
2,4-Dimethylphenol	3 U	2 U	NA
Benzoic Acid	71 U	50 U	NA
Bis(2-chloroethoxy)methane	3 U	2 U	NA
2,4-Dichlorophenol	6 U	4 U	NA
1,2,4-Trichlorobenzene	3 U	2 U	NA
Naphthalene	6 U	4 U	NA
4-Chloroaniline	3 U	2 U	NA
Hexachlorobutadiene	3 U	2 U	NA
4-Chloro-3-methylphenol	6 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-6D	LW-6S	LW-10D
Laucks Lab No.	10740-13	10740-14	10740-15
2-Methylnaphthalene	3 U	2 U	NA
Hexachlorocyclopentadiene	6 U	4 U	NA
2,4,6-Trichlorophenol	6 U	4 U	NA
2,4,5-Trichlorophenol	6 U	4 U	NA
2-Chloronaphthalene	3 U	2 U	NA
2-Nitroaniline	6 U	4 U	NA
Dimethyl phthalate	3 U	2 U	NA
Acenaphthylene	3 U	2 U	NA
2,6-Dinitrotoluene	6 U	4 U	NA
3-Nitroaniline	14 U	10 U	NA
Acenaphthene	3 U	2 U	NA
2,4-Dinitrophenol	28 U	20 U	NA
4-Nitrophenol	28 U	20 U	NA
Dibenzofuran	3 U	2 U	NA
2,4-Dinitrotoluene	6 U	4 U	NA
Diethyl phthalate	3 U	2 U	NA
4-Chlorophenyl phenylether	3 U	2 U	NA
Fluorene	3 U	2 U	NA
4-Nitroaniline	6 U	4 U	NA
4,6-Dinitro-2-methylphenol	28 U	20 U	NA
N-Nitrosodiphenylamine	3 U	2 U	NA
1,2-Diphenylhydrazine	6 U	4 U	NA
4-Bromophenyl phenylether	6 U	4 U	NA
Hexachlorobenzene	3 U	2 U	NA
Pentachlorophenol	28 U	20 U	NA
Phenanthrene	3 U	2 U	NA
Anthracene	3 U	2 U	NA
Di-n-butyl phthalate	3 U	2 U	NA
Fluoranthene	3 U	2 U	NA
Pyrene	3 U	2 U	NA
Benzidine	71 U	50 U	NA
Butylbenzylphthalate	3 U	2 U	NA
3-3'-Dichlorobenzidine	28 U	20 U	NA
Benzo(a)anthracene	3 U	2 U	NA
Chrysene	3 U	2 U	NA
Bis(2-ethylhexyl)phthalate	3 U	2 U	NA
Di-n-octyl phthalate	3 U	2 U	NA
Benzo(b)fluoranthene	6 U	4 U	NA
Benzo(k)fluoranthene	6 U	4 U	NA
Benzo(a)pyrene	6 U	4 U	NA
Indeno(1,2,3-cd)pyrene	6 U	4 U	NA
Dibenzo(a,h)anthracene	6 U	4 U	NA
Benzo(g,h,i)perylene	6 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-10S	MW-2D	RINSE BLANK
Laucks Lab No.	10740-16	10740-17	10740-18
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88

MISCELLANEOUS INORGANICS

Dissolved Metals		mg/l	
Copper	NA	0.001 U	NA
Nickel	NA	0.002 U	NA
Lead	NA	0.017	NA
Chromium	NA	0.001 U	NA
Zinc	NA	0.014	NA
Arsenic	NA	0.006	NA

Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA

VOLATILE ORGANICS

	ug/l	ug/l	
Chloromethane	1 U	1 U	NA
Bromomethane	1 U	1 U	NA
Vinyl Chloride	120	1 U	NA
Chloroethane	3 U	3 U	NA
Methylene Chloride	1 U	1 U	NA
Acetone	5 U	5 U	NA
Carbon Disulfide	1 U	1 U	NA
1,1-Dichloroethene	1 U	1 U	NA
1,1-Dichloroethane	1 U	1 U	NA
trans-1,2-Dichloroethene	1 U	1 U	NA
cis-1,2-Dichloroethene	11	1 U	NA
total-1,2-Dichloroethene	11	1 U	NA
Chloroform	1 U	1 U	NA
2-Butanone	3 U	3 U	NA
1,2-Dichloroethane	1 U	1 U	NA
1,1,1-Trichloroethane	1 U	1 U	NA
Carbon Tetrachloride	1 U	1 U	NA
Vinyl Acetate	1 U	1 U	NA
Bromodichloromethane	1 U	1 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-10S	MW-2D	RINSE BLANK
Laucks Lab No.	10740-16	10740-17	10740-18
1,2-Dichloropropane	1 U	1 U	NA
Trichloroethene	1 U	1 U	NA
Benzene	1 U	1 U	NA
Dibromochloromethane	3 U	3 U	NA
1,1,2-Trichloroethane	1 U	1 U	NA
Bromoform	1 U	1 U	NA
4-Methyl-2-Pentanone	3 U	3 U	NA
2-Hexanone	3 U	3 U	NA
1,1,2,2-Tetrachloroethane	3 U	3 U	NA
Tetrachloroethene	1 U	1 U	NA
Toluene	1 U	1 U	NA
Chlorobenzene	3 U	3 U	NA
trans-1,3-Dichloropropene	3 U	3 U	NA
Ethylbenzene	1 U	1 U	NA
cis-1,3-Dichloropropene	3 U	3 U	NA
Styrene	1 U	1 U	NA
Total Xylenes	1 U	1 U	NA

SEMIVOLATILE ORGANICS

	ug/l	ug/l	
Phenol	2 U	2 U	NA
Aniline	10 U	10 U	NA
Bis(2-chloroethyl)ether	2 U	2 U	NA
2-Chlorophenol	2 U	2 U	NA
1,3-Dichlorobenzene	2 U	2 U	NA
1,4-Dichlorobenzene	2 U	2 U	NA
Benzyl Alcohol	2 U	2 U	NA
1,2-Dichlorobenzene	2 U	2 U	NA
2-Methylphenol	2 U	2 U	NA
Bis(2-chloroisopropyl)ether	2 U	2 U	NA
4-Methylphenol	2 U	2 U	NA
N-Nitroso-di-n-propylamine	2 U	2 U	NA
Hexachloroethane	4 U	4 U	NA
Nitrobenzene	2 U	2 U	NA
Isophorone	2 U	2 U	NA
2-Nitrophenol	4 U	4 U	NA
2,4-Dimethylphenol	2 U	2 U	NA
Benzoic Acid	50 U	51 U	NA
Bis(2-chloroethoxy)methane	2 U	2 U	NA
2,4-Dichlorophenol	4 U	4 U	NA
1,2,4-Trichlorobenzene	2 U	2 U	NA
Naphthalene	4 U	4 U	NA
4-Chloroaniline	2 U	2 U	NA
Hexachlorobutadiene	2 U	2 U	NA
4-Chloro-3-methylphenol	4 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-10S	MW-2D	RINSE BLANK
Laucks Lab No.	10740-16	10740-17	10740-18
2-Methylnaphthalene	2 U	2 U	NA
Hexachlorocyclopentadiene	4 U	4 U	NA
2,4,6-Trichlorophenol	4 U	4 U	NA
2,4,5-Trichlorophenol	4 U	4 U	NA
2-Chloronaphthalene	2 U	2 U	NA
2-Nitroaniline	4 U	4 U	NA
Dimethyl phthalate	2 U	2 U	NA
Acenaphthylene	2 U	2 U	NA
2,6-Dinitrotoluene	4 U	4 U	NA
3-Nitroaniline	10 U	10 U	NA
Acenaphthene	2 U	2 U	NA
2,4-Dinitrophenol	20 U	20 U	NA
4-Nitrophenol	20 U	20 U	NA
Dibenzofuran	2 U	2 U	NA
2,4-Dinitrotoluene	4 U	4 U	NA
Diethyl phthalate	2 U	2 U	NA
4-Chlorophenyl phenylether	2 U	2 U	NA
Fluorene	2 U	2 U	NA
4-Nitroaniline	4 U	4 U	NA
4,6-Dinitro-2-methylphenol	20 U	20 U	NA
N-Nitrosodiphenylamine	2 U	2 U	NA
1,2-Diphenylhydrazine	4 U	4 U	NA
4-Bromophenyl phenylether	4 U	4 U	NA
Hexachlorobenzene	2 U	2 U	NA
Pentachlorophenol	20 U	20 U	NA
Phenanthrene	2 U	2 U	NA
Anthracene	2 U	2 U	NA
Di-n-butyl phthalate	2 U	2 U	NA
Fluoranthene	2 U	2 U	NA
Pyrene	2 U	2 U	NA
Benzidine	50 U	51 U	NA
Butylbenzylphthalate	2 U	2 U	NA
3-3'-Dichlorobenzidine	20 U	20 U	NA
Benzo(a)anthracene	2 U	2 U	NA
Chrysene	2 U	2 U	NA
Bis(2-ethylhexyl)phthalate	2 U	2 U	NA
Di-n-octyl phthalate	2 U	2 U	NA
Benzo(b)fluoranthene	4 U	4 U	NA
Benzo(k)fluoranthene	4 U	4 U	NA
Benzo(a)pyrene	4 U	4 U	NA
Indeno(1,2,3-cd)pyrene	4 U	4 U	NA
Dibenzo(a,h)anthracene	4 U	4 U	NA
Benzo(g,h,i)perylene	4 U	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	MW-2I	LW-13S	LW-13D
Laucks Lab No.	10740-19	10740-20	10740-21
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88
MISCELLANEOUS INORGANICS			
Dissolved Metals		mg/l	mg/l
Copper	NA	0.002	0.001 U
Nickel	NA	0.002 U	0.002 U
Lead	NA	0.007	0.005 U
Chromium	NA	0.002	0.001 U
Zinc	NA	0.016	0.014
Arsenic	NA	0.01	0.005 U
Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA
VOLATILE ORGANICS			
		ug/l	
Chloromethane	NA	1 U	NA
Bromomethane	NA	1 U	NA
Vinyl Chloride	NA	1 U	NA
Chloroethane	NA	3 U	NA
Methylene Chloride	NA	1 U	NA
Acetone	NA	5 U	NA
Carbon Disulfide	NA	1 U	NA
1,1-Dichloroethene	NA	1 U	NA
1,1-Dichloroethane	NA	1 U	NA
trans-1,2-Dichloroethene	NA	1 U	NA
cis-1,2-Dichloroethene	NA	1 U	NA
total-1,2-Dichloroethene	NA	1 U	NA
Chloroform	NA	1 U	NA
2-Butanone	NA	3 U	NA
1,2-Dichloroethane	NA	1 U	NA
1,1,1-Trichloroethane	NA	1 U	NA
Carbon Tetrachloride	NA	1 U	NA
Vinyl Acetate	NA	1 U	NA
Bromodichloromethane	NA	1 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No. Laucks Lab No.	MW-2I 10740-19	LW-13S 10740-20	LW-13D 10740-21
1,2-Dichloropropane	NA	1 U	NA
Trichloroethene	NA	1 U	NA
Benzene	NA	1 U	NA
Dibromochloromethane	NA	3 U	NA
1,1,2-Trichloroethane	NA	1 U	NA
Bromoform	NA	1 U	NA
4-Methyl-2-Pentanone	NA	3 U	NA
2-Hexanone	NA	3 U	NA
1,1,2,2-Tetrachloroethane	NA	3 U	NA
Tetrachloroethene	NA	1 U	NA
Toluene	NA	1 U	NA
Chlorobenzene	NA	3 U	NA
trans-1,3-Dichloropropene	NA	3 U	NA
Ethylbenzene	NA	1 U	NA
cis-1,3-Dichloropropene	NA	3 U	NA
Styrene	NA	1 U	NA
Total Xylenes	NA	1 U	NA

SEMIVOLATILE ORGANICS

		ug/l	
Phenol	NA	2 U	NA
Aniline	NA	10 U	NA
Bis(2-chloroethyl)ether	NA	2 U	NA
2-Chlorophenol	NA	2 U	NA
1,3-Dichlorobenzene	NA	2 U	NA
1,4-Dichlorobenzene	NA	2 U	NA
Benzyl Alcohol	NA	2 U	NA
1,2-Dichlorobenzene	NA	2 U	NA
2-Methylphenol	NA	2 U	NA
Bis(2-chloroisopropyl)ether	NA	2 U	NA
4-Methylphenol	NA	2 U	NA
N-Nitroso-di-n-propylamine	NA	2 U	NA
Hexachloroethane	NA	4 U	NA
Nitrobenzene	NA	2 U	NA
Isophorone	NA	2 U	NA
2-Nitrophenol	NA	4 U	NA
2,4-Dimethylphenol	NA	2 U	NA
Benzoic Acid	NA	50 U	NA
Bis(2-chloroethoxy)methane	NA	2 U	NA
2,4-Dichlorophenol	NA	4 U	NA
1,2,4-Trichlorobenzene	NA	2 U	NA
Naphthalene	NA	4 U	NA
4-Chloroaniline	NA	2 U	NA
Hexachlorobutadiene	NA	2 U	NA
4-Chloro-3-methylphenol	NA	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	MW-2I	LW-13S	LW-13D
Laucks Lab No.	10740-19	10740-20	10740-21
2-Methylnaphthalene	NA	2 U	NA
Hexachlorocyclopentadiene	NA	4 U	NA
2,4,6-Trichlorophenol	NA	4 U	NA
2,4,5-Trichlorophenol	NA	4 U	NA
2-Chloronaphthalene	NA	2 U	NA
2-Nitroaniline	NA	4 U	NA
Dimethyl phthalate	NA	2 U	NA
Acenaphthylene	NA	2 U	NA
2,6-Dinitrotoluene	NA	4 U	NA
3-Nitroaniline	NA	10 U	NA
Acenaphthene	NA	2 U	NA
2,4-Dinitrophenol	NA	20 U	NA
4-Nitrophenol	NA	20 U	NA
Dibenzofuran	NA	2 U	NA
2,4-Dinitrotoluene	NA	4 U	NA
Diethyl phthalate	NA	2 U	NA
4-Chlorophenyl phenylether	NA	2 U	NA
Fluorene	NA	2 U	NA
4-Nitroaniline	NA	4 U	NA
4,6-Dinitro-2-methylphenol	NA	20 U	NA
N-Nitrosodiphenylamine	NA	2 U	NA
1,2-Diphenylhydrazine	NA	4 U	NA
4-Bromophenyl phenylether	NA	4 U	NA
Hexachlorobenzene	NA	2 U	NA
Pentachlorophenol	NA	20 U	NA
Phenanthrene	NA	2 U	NA
Anthracene	NA	2 U	NA
Di-n-butyl phthalate	NA	2 U	NA
Fluoranthene	NA	2 U	NA
Pyrene	NA	2 U	NA
Benzidine	NA	50 U	NA
Butylbenzylphthalate	NA	2 U	NA
3-3'-Dichlorobenzidine	NA	20 U	NA
Benzo(a)anthracene	NA	2 U	NA
Chrysene	NA	2 U	NA
Bis(2-ethylhexyl)phthalate	NA	2 U	NA
Di-n-octyl phthalate	NA	2 U	NA
Benzo(b)fluoranthene	NA	4 U	NA
Benzo(k)fluoranthene	NA	4 U	NA
Benzo(a)pyrene	NA	4 U	NA
Indeno(1,2,3-cd)pyrene	NA	4 U	NA
Dibenzo(a,h)anthracene	NA	4 U	NA
Benzo(g,h,i)perylene	NA	4 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-13D PET.	MW-3I	LW-14S
Laucks Lab No.	10740-22	10740-23	10740-24
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88
MISCELLANEOUS INORGANICS			
Dissolved Metals		mg/l	mg/l
Copper	NA	0.001 U	0.001 U
Nickel	NA	0.002 U	0.002 U
Lead	NA	0.005 U	0.005 U
Chromium	NA	0.001	0.001 U
Zinc	NA	0.023	0.012
Arsenic	NA	0.017	0.005 U
Total Metals		mg/l	
Copper	NA	0.022	NA
Nickel	NA	0.01	NA
Lead	NA	0.016	NA
Chromium	NA	0.014	NA
Zinc	NA	0.088	NA
Arsenic	NA	0.028	NA
VOLATILE ORGANICS			
		ug/l	ug/l
Chloromethane	NA	1 U	1 U
Bromomethane	NA	1 U	1 U
Vinyl Chloride	NA	1 U	1 U
Chloroethane	NA	3 U	3 U
Methylene Chloride	NA	1 U	1 U
Acetone	NA	5 U	18
Carbon Disulfide	NA	1 U	1 U
1,1-Dichloroethene	NA	1 U	1 U
1,1-Dichloroethane	NA	1 U	1 U
trans-1,2-Dichloroethene	NA	1 U	1 U
cis-1,2-Dichloroethene	NA	1 U	1 U
total-1,2-Dichloroethene	NA	1 U	1 U
Chloroform	NA	1 U	1 U
2-Butanone	NA	3 U	3 U
1,2-Dichloroethane	NA	1 U	1 U
1,1,1-Trichloroethane	NA	1 U	1 U
Carbon Tetrachloride	NA	1 U	1 U
Vinyl Acetate	NA	1 U	1 U
Bromodichloromethane	NA	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-13D PET.	MW-3I	LW-14S
Laucks Lab No.	10740-22	10740-23	10740-24
1,2-Dichloropropane	NA	1 U	1 U
Trichloroethene	NA	1 U	1 U
Benzene	NA	1 U	1 U
Dibromochloromethane	NA	3 U	3 U
1,1,2-Trichloroethane	NA	1 U	1 U
Bromoform	NA	1 U	1 U
4-Methyl-2-Pentanone	NA	3 U	3 U
2-Hexanone	NA	3 U	3 U
1,1,2,2-Tetrachloroethane	NA	3 U	3 U
Tetrachloroethene	NA	1 U	1 U
Toluene	NA	1 U	1 U
Chlorobenzene	NA	3 U	3 U
trans-1,3-Dichloropropene	NA	3 U	3 U
Ethylbenzene	NA	1 U	1 U
cis-1,3-Dichloropropene	NA	3 U	3 U
Styrene	NA	1 U	1 U
Total Xylenes	NA	1 U	1 U

SEMIVOLATILE ORGANICS

		ug/l	ug/l
Phenol	NA	2 U	2 UE
Aniline	NA	10 U	10 UE
Bis(2-chloroethyl)ether	NA	2 U	2 UE
2-Chlorophenol	NA	2 U	2 UE
1,3-Dichlorobenzene	NA	2 U	2 UE
1,4-Dichlorobenzene	NA	2 U	2 UE
Benzyl Alcohol	NA	2 U	2 UE
1,2-Dichlorobenzene	NA	2 U	2 UE
2-Methylphenol	NA	2 U	2 UE
Bis(2-chloroisopropyl)ether	NA	2 U	2 UE
4-Methylphenol	NA	2 U	2 UE
N-Nitroso-di-n-propylamine	NA	2 U	2 UE
Hexachloroethane	NA	4 U	4 UE
Nitrobenzene	NA	2 U	2 UE
Isophorone	NA	2 U	2 UE
2-Nitrophenol	NA	4 U	4 UE
2,4-Dimethylphenol	NA	2 U	2 UE
Benzoic Acid	NA	50 U	50 UE
Bis(2-chloroethoxy)methane	NA	2 U	2 UE
2,4-Dichlorophenol	NA	4 U	4 UE
1,2,4-Trichlorobenzene	NA	2 U	2 UE
Naphthalene	NA	4 U	4 UE
4-Chloroaniline	NA	2 U	2 UE
Hexachlorobutadiene	NA	2 U	2 UE
4-Chloro-3-methylphenol	NA	4 U	4 UE

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-13D PET.	MW-3I	LW-14S
Laucks Lab No.	10740-22	10740-23	10740-24
2-Methylnaphthalene	NA	2 U	2 UE
Hexachlorocyclopentadiene	NA	4 U	4 UE
2,4,6-Trichlorophenol	NA	4 U	4 UE
2,4,5-Trichlorophenol	NA	4 U	4 UE
2-Chloronaphthalene	NA	2 U	2 UE
2-Nitroaniline	NA	4 U	4 UE
Dimethyl phthalate	NA	2 U	2 UE
Acenaphthylene	NA	2 U	2 UE
2,6-Dinitrotoluene	NA	4 U	4 UE
3-Nitroaniline	NA	10 U	10 UE
Acenaphthene	NA	2 U	2 UE
2,4-Dinitrophenol	NA	20 U	20 UE
4-Nitrophenol	NA	20 U	20 UE
Dibenzofuran	NA	2 U	2 UE
2,4-Dinitrotoluene	NA	4 U	4 UE
Diethyl phthalate	NA	2 U	2 UE
4-Chlorophenyl phenylether	NA	2 U	2 UE
Fluorene	NA	2 U	2 UE
4-Nitroaniline	NA	4 U	4 UE
4,6-Dinitro-2-methylphenol	NA	20 U	20 UE
N-Nitrosodiphenylamine	NA	2 U	2 UE
1,2-Diphenylhydrazine	NA	4 U	4 UE
4-Bromophenyl phenylether	NA	4 U	4 UE
Hexachlorobenzene	NA	2 U	2 UE
Pentachlorophenol	NA	20 U	20 UE
Phenanthrene	NA	2 U	2 UE
Anthracene	NA	2 U	2 UE
Di-n-butyl phthalate	NA	2 U	2 UE
Fluoranthene	NA	2 U	2 UE
Pyrene	NA	2 U	2 UE
Benzidine	NA	50 U	50 UE
Butylbenzylphthalate	NA	2 U	2 UE
3-3'-Dichlorobenzidine	NA	20 U	20 UE
Benzo(a)anthracene	NA	2 U	2 UE
Chrysene	NA	2 U	2 UE
Bis(2-ethylhexyl)phthalate	NA	2	2 UE
Di-n-octyl phthalate	NA	2 U	2 UE
Benzo(b)fluoranthene	NA	4 U	4 UE
Benzo(k)fluoranthene	NA	4 U	4 UE
Benzo(a)pyrene	NA	4 U	4 UE
Indeno(1,2,3-cd)pyrene	NA	4 U	4 UE
Dibenzo(a,h)anthracene	NA	4 U	4 UE
Benzo(g,h,i)perylene	NA	4 U	4 UE

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-1S	LW-1D	RINSE BLANK
Laucks Lab No.	10740-25	10740-26	10740-27
Date Entered:	08/18/88	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88
MISCELLANEOUS INORGANICS			
Dissolved Metals	mg/l	mg/l	
Copper	0.003	0.001 U	NA
Nickel	0.002 U	0.003	NA
Lead	0.005 U	0.007	NA
Chromium	0.001 U	0.004	NA
Zinc	0.015	0.026	NA
Arsenic	0.009	0.005 U	NA
Total Metals			
Copper	NA	NA	NA
Nickel	NA	NA	NA
Lead	NA	NA	NA
Chromium	NA	NA	NA
Zinc	NA	NA	NA
Arsenic	NA	NA	NA
VOLATILE ORGANICS			
	ug/l	ug/l	
Chloromethane	1 U	1 U	NA
Bromomethane	1 U	1 U	NA
Vinyl Chloride	1 U	1 U	NA
Chloroethane	3 U	3 U	NA
Methylene Chloride	1 U	1 U	NA
Acetone	5 U	5 U	NA
Carbon Disulfide	1 U	1 U	NA
1,1-Dichloroethene	1 U	1 U	NA
1,1-Dichloroethane	1 U	1 U	NA
trans-1,2-Dichloroethene	1 U	1 U	NA
cis-1,2-Dichloroethene	1 U	1	NA
total-1,2-Dichloroethene	1 U	1	NA
Chloroform	1 U	1 U	NA
2-Butanone	3 U	3 U	NA
1,2-Dichloroethane	1 U	1 U	NA
1,1,1-Trichloroethane	1 U	1 U	NA
Carbon Tetrachloride	1 U	1 U	NA
Vinyl Acetate	1 U	1 U	NA
Bromodichloromethane	1 U	1 U	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-1S	LW-1D	RINSE BLANK
Laucks Lab No.	10740-25	10740-26	10740-27
1,2-Dichloropropane	1 U	1 U	NA
Trichloroethene	1 U	1 U	NA
Benzene	1 U	1 U	NA
Dibromochloromethane	3 U	3 U	NA
1,1,2-Trichloroethane	1 U	1 U	NA
Bromoform	1 U	1 U	NA
4-Methyl-2-Pentanone	3 U	3 U	NA
2-Hexanone	3 U	3 U	NA
1,1,2,2-Tetrachloroethane	3 U	3 U	NA
Tetrachloroethene	1 U	1 U	NA
Toluene	1 U	1 U	NA
Chlorobenzene	3 U	3 U	NA
trans-1,3-Dichloropropene	3 U	3 U	NA
Ethylbenzene	1 U	1 U	NA
cis-1,3-Dichloropropene	3 U	3 U	NA
Styrene	1 U	1 U	NA
Total Xylenes	2	1 U	NA

SEMIVOLATILE ORGANICS

	ug/l		
Phenol	2 U	NA	NA
Aniline	10 U	NA	NA
Bis(2-chloroethyl)ether	2 U	NA	NA
2-Chlorophenol	2 U	NA	NA
1,3-Dichlorobenzene	2 U	NA	NA
1,4-Dichlorobenzene	2 U	NA	NA
Benzyl Alcohol	2 U	NA	NA
1,2-Dichlorobenzene	2 U	NA	NA
2-Methylphenol	2 U	NA	NA
Bis(2-chloroisopropyl)ether	2 U	NA	NA
4-Methylphenol	2 U	NA	NA
N-Nitroso-di-n-propylamine	2 U	NA	NA
Hexachloroethane	4 U	NA	NA
Nitrobenzene	2 U	NA	NA
Isophorone	2 U	NA	NA
2-Nitrophenol	4 U	NA	NA
2,4-Dimethylphenol	2 U	NA	NA
Benzoic Acid	51 U	NA	NA
Bis(2-chloroethoxy)methane	2 U	NA	NA
2,4-Dichlorophenol	4 U	NA	NA
1,2,4-Trichlorobenzene	2 U	NA	NA
Naphthalene	4 U	NA	NA
4-Chloroaniline	2 U	NA	NA
Hexachlorobutadiene	2 U	NA	NA
4-Chloro-3-methylphenol	4 U	NA	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No. Laucks Lab No.	LW-1S 10740-25	LW-1D 10740-26	RINSE BLANK 10740-27
2-Methylnaphthalene	2 U	NA	NA
Hexachlorocyclopentadiene	4 U	NA	NA
2,4,6-Trichlorophenol	4 U	NA	NA
2,4,5-Trichlorophenol	4 U	NA	NA
2-Chloronaphthalene	2 U	NA	NA
2-Nitroaniline	4 U	NA	NA
Dimethyl phthalate	2 U	NA	NA
Acenaphthylene	2 U	NA	NA
2,6-Dinitrotoluene	4 U	NA	NA
3-Nitroaniline	10 U	NA	NA
Acenaphthene	2 U	NA	NA
2,4-Dinitrophenol	20 U	NA	NA
4-Nitrophenol	20 U	NA	NA
Dibenzofuran	2 U	NA	NA
2,4-Dinitrotoluene	4 U	NA	NA
Diethyl phthalate	2 U	NA	NA
4-Chlorophenyl phenylether	2 U	NA	NA
Fluorene	2 U	NA	NA
4-Nitroaniline	4 U	NA	NA
4,6-Dinitro-2-methylphenol	20 U	NA	NA
N-Nitrosodiphenylamine	2 U	NA	NA
1,2-Diphenylhydrazine	4 U	NA	NA
4-Bromophenyl phenylether	4 U	NA	NA
Hexachlorobenzene	2 U	NA	NA
Pentachlorophenol	20 U	NA	NA
Phenanthrene	2 U	NA	NA
Anthracene	2 U	NA	NA
Di-n-butyl phthalate	2 U	NA	NA
Fluoranthene	2 U	NA	NA
Pyrene	2 U	NA	NA
Benzidine	51 U	NA	NA
Butylbenzylphthalate	2 U	NA	NA
3-3'-Dichlorobenzidine	20 U	NA	NA
Benzo(a)anthracene	2 U	NA	NA
Chrysene	2 U	NA	NA
Bis(2-ethylhexyl)phthalate	2 U	NA	NA
Di-n-octyl phthalate	2 U	NA	NA
Benzo(b)fluoranthene	4 U	NA	NA
Benzo(k)fluoranthene	4 U	NA	NA
Benzo(a)pyrene	4 U	NA	NA
Indeno(1,2,3-cd)pyrene	4 U	NA	NA
Dibenzo(a,h)anthracene	4 U	NA	NA
Benzo(g,h,i)perylene	4 U	NA	NA

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-8D	MW-1	RINSE BLANK
Laucks Lab No.	10740-28	10740-29	10740-30
Date Entered:	3	08/18/88	08/18/88
By:	JE	JE	JE
Date Checked:	08/18/88	08/18/88	08/18/88
By:	KRH	KRH	KRH
Updated by BG:	09/02/88	09/02/88	09/02/88
MISCELLANEOUS INORGANICS			
Dissolved Metals		mg/l	mg/l
Copper	NA	0.008	0.002
Nickel	NA	0.002 U	0.002 U
Lead	NA	0.005 U	0.005 U
Chromium	NA	0.001 U	0.001 U
Zinc	NA	0.018	0.001 U
Arsenic	NA	0.005 U	0.005 U
Total Metals			mg/l
Copper	NA	NA	0.002
Nickel	NA	NA	0.002 U
Lead	NA	NA	0.005 U
Chromium	NA	NA	0.001 U
Zinc	NA	NA	0.001 U
Arsenic	NA	NA	0.005 U
VOLATILE ORGANICS			
	ug/l	ug/l	ug/l
Chloromethane	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U
Chloroethane	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U
Acetone	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No.	LW-8D	MW-1	RINSE BLANK
Laucks Lab No.	10740-28	10740-29	10740-30
1,2-Dichloropropane	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U
Benzene	1 U	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U
Toluene	1 U	1 U	1 U
Chlorobenzene	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U
Ethylbenzene	1 U	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U
Styrene	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U

SEMIVOLATILE ORGANICS

		ug/l	ug/l
Phenol	NA	2 U	2 U
Aniline	NA	10 U	11 U
Bis(2-chloroethyl)ether	NA	2 U	2 U
2-Chlorophenol	NA	2 U	2 U
1,3-Dichlorobenzene	NA	2 U	2 U
1,4-Dichlorobenzene	NA	2 U	2 U
Benzyl Alcohol	NA	2 U	2 U
1,2-Dichlorobenzene	NA	2 U	2 U
2-Methylphenol	NA	2 U	2 U
Bis(2-chloroisopropyl)ether	NA	2 U	2 U
4-Methylphenol	NA	2 U	2 U
N-Nitroso-di-n-propylamine	NA	2 U	2 U
Hexachloroethane	NA	4 U	4 U
Nitrobenzene	NA	2 U	2 U
Isophorone	NA	2 U	2 U
2-Nitrophenol	NA	4 U	4 U
2,4-Dimethylphenol	NA	2 U	2 U
Benzoic Acid	NA	50 U	54 U
Bis(2-chloroethoxy)methane	NA	2 U	2 U
2,4-Dichlorophenol	NA	4 U	4 U
1,2,4-Trichlorobenzene	NA	2 U	2 U
Naphthalene	NA	4 U	4 U
4-Chloroaniline	NA	2 U	2 U
Hexachlorobutadiene	NA	2 U	2 U
4-Chloro-3-methylphenol	NA	4 U	4 U

Job No. 1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems (Samples 1-30
AUGUST, 1988
Laucks Testing Lab No. 10740

Project Sample No. / Laucks Lab No.	LW-8D 10740-28	MW-1 10740-29	RINSE BLANK 10740-30
2-Methylnaphthalene	NA	2 U	2 U
Hexachlorocyclopentadiene	NA	4 U	4 U
2,4,6-Trichlorophenol	NA	4 U	4 U
2,4,5-Trichlorophenol	NA	4 U	4 U
2-Chloronaphthalene	NA	2 U	2 U
2-Nitroaniline	NA	4 U	4 U
Dimethyl phthalate	NA	2 U	2 U
Acenaphthylene	NA	2 U	2 U
2,6-Dinitrotoluene	NA	4 U	4 U
3-Nitroaniline	NA	10 U	11 U
Acenaphthene	NA	2 U	2 U
2,4-Dinitrophenol	NA	20 U	22 U
4-Nitrophenol	NA	20 U	22 U
Dibenzofuran	NA	2 U	2 U
2,4-Dinitrotoluene	NA	4 U	4 U
Diethyl phthalate	NA	2 U	2 U
4-Chlorophenyl phenylether	NA	2 U	2 U
Fluorene	NA	2 U	2 U
4-Nitroaniline	NA	4 U	4 U
4,6-Dinitro-2-methylphenol	NA	20 U	22 U
N-Nitrosodiphenylamine	NA	2 U	2 U
1,2-Diphenylhydrazine	NA	4 U	4 U
4-Bromophenyl phenylether	NA	4 U	4 U
Hexachlorobenzene	NA	2 U	2 U
Pentachlorophenol	NA	20 U	22 U
Phenanthrene	NA	2 U	2 U
Anthracene	NA	2 U	2 U
Di-n-butyl phthalate	NA	2 U	2 U
Fluoranthene	NA	2 U	2 U
Pyrene	NA	2 U	2 U
Benzidine	NA	50 U	54 U
Butylbenzylphthalate	NA	2 U	2 U
3-3'-Dichlorobenzidine	NA	20 U	22 U
Benzo(a)anthracene	NA	2 U	2 U
Chrysene	NA	2 U	2 U
Bis(2-ethylhexyl)phthalate	NA	2 U	2 U
Di-n-octyl phthalate	NA	2 U	2 U
Benzo(b)fluoranthene	NA	4 U	4 U
Benzo(k)fluoranthene	NA	4 U	4 U
Benzo(a)pyrene	NA	4 U	4 U
Indeno(1,2,3-cd)pyrene	NA	4 U	4 U
Dibenzo(a,h)anthracene	NA	4 U	4 U
Benzo(g,h,i)perylene	NA	4 U	4 U

NOTES:

1. U indicates the analyte was not detected. The value reported is less than the detection limit shown.

2. J indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.

3. B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.

4. D indicates the value reported is based on analysis of a diluted sample extract or digest.

5. T1 indicates the reported result is the sum of the flagged analytes, due to chromatographic co-elution. Two or more analytes which are not chromatographically resolved are denoted by the flag T1.

6. X indicates the value reported has been blank-corrected.

7. E indicates the value has been qualified as estimated.

8. R indicates the value has been qualified as not useable.

RESULTS OF OCTOBER 1988
GROUNDWATER ANALYSES

J-1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OW-BLANK	MW-2D"R"	OW-5S	OW-4S	OW-4D	FIELD BLANK	OW-5D	DM-2D	OSP-1S	OSP-1D	OSP-2D	FIELD BLANK
LAUCKS LAB NO:	11800-1	11800-2	11800-3	11800-4	11800-5	11800-6	11800-7	11800-8	11800-9	11800-10	11800-11	11800-12
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
MISCELLANEOUS INORGANIC ANALYSIS												
DISSOLVED METALS												
		mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	
Copper	NA	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001	0.001	0.001 U	NA
Nickel	NA	0.002 U	0.002 U	0.002 U	0.002 U	NA	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	NA
Lead	NA	0.005 U	0.007	0.005 U	0.005 U	NA	0.005 U	0.005 U	0.005	0.005 U	0.005 U	NA
Chromium	NA	0.001 U	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001	0.001 U	0.001 U	NA
Zinc	NA	0.021 B	0.019 B	0.028 B	0.019 B	NA	0.39 B	0.013 BE	0.013 BE	0.014 BE	0.01 BE	NA
Arsenic	NA	0.005 U	0.021	0.005 U	0.013	NA	0.005 U	0.016	0.005 U	0.005 U	0.005 U	NA
TOTAL METALS												
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADDITIONAL TESTS												
									mg/L		mg/L	
Iron	NA	NA	NA	NA	NA	NA	NA	NA	47 B	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	0.94	NA	NA	NA
Hardness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	190	NA

J-1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OW-BLANK	MW-2D"R"	OW-5S	OW-4S	OW-4D	FIELD BLANK	OW-5D	DM-2D	OSP-1S	OSP-1D	OSP-2D	FIELD BLANK
LAUCKS LAB NO:	11800-1	11800-2	11800-3	11800-4	11800-5	11800-6	11800-7	11800-8	11800-9	11800-10	11800-11	11800-12
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
VOLATILE ORGANIC COMPOUNDS												
	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L		ug/L	ug/L	ug/L	ug/L
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	4	NA	1 U	1 U	1 U	1 U
Chloroethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Acetone	5 U	5 U	6	6	5 U	5 U	5 U	NA	5 U	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Chlorobenzene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U	3 U	3 U	3 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U	1 U	1 U	1 U

J-1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OW-BLANK	MW-2D"R"	OW-5S	OW-4S	OW-4D	FIELD BLANK	OW-5D	DM-2D	OSP-1S	OSP-1D	OSP-2D	FIELD BLANK
LAUCKS LAB NO:	11800-1	11800-2	11800-3	11800-4	11800-5	11800-6	11800-7	11800-8	11800-9	11800-10	11800-11	11800-12
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH

EXTRACTABLE ORGANIC COMPOUNDS

		ug/L	ug/L	ug/L	ug/L		ug/L		ug/L	ug/L	ug/L	
Phenol	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Aniline	NA	10 U	10 UE	10 U	10 U	NA	36 UE	NA	10 U	10 U	10 U	NA
Bis(2-chloroethyl)ether	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2-Chlorophenol	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
1,3-Dichlorobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
1,4-Dichlorobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Benzyl Alcohol	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
1,2-Dichlorobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2-Methylphenol	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Bis(2-chloroisopropyl)ether	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
4-Methylphenol	NA	4	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
N-Nitroso-di-n-propylamine	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Hexachloroethane	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Nitrobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Isophorone	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2-Nitrophenol	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
2,4-Dimethylphenol	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Benzoic Acid	NA	50 U	50 UE	51 U	50 U	NA	180 UE	NA	52 U	50 U	50 U	NA
Bis(2-chloroethoxy)methane	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2,4-Dichlorophenol	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
1,2,4-Trichlorobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Naphthalene	NA	4 U	4 UE	4	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
4-Chloroaniline	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Hexachlorobutadiene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
4-Chloro-3-methylphenol	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
2-Methylnaphthalene	NA	2 U	2 UE	7	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Hexachlorocyclopentadiene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
2,4,6-Trichlorophenol	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
2,4,5-Trichlorophenol	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
2-Chloronaphthalene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2-Nitroaniline	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Dimethyl phthalate	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Acenaphthylene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2,6-Dinitrotoluene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
3-Nitroaniline	NA	10 U	10 UE	10 U	10 U	NA	36 UE	NA	10 U	10 U	10 U	NA
Acenaphthene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2,4-Dinitrophenol	NA	20 U	20 UE	20 U	20 U	NA	71 UE	NA	21 U	20 U	20 U	NA
4-Nitrophenol	NA	20 U	20 UE	20 U	20 U	NA	71 UE	NA	21 U	20 U	20 U	NA
Dibenzofuran	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
2,4-Dinitrotoluene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OW-BLANK	MW-2D"R"	OW-5S	OW-4S	OW-4D	FIELD BLANK	OW-5D	DM-2D	OSP-1S	OSP-1D	OSP-2D	FIELD BLANK
LAUCKS LAB NO:	11800-1	11800-2	11800-3	11800-4	11800-5	11800-6	11800-7	11800-8	11800-9	11800-10	11800-11	11800-12
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH

EXTRACTABLE ORGANIC COMPOUNDS

		ug/L	ug/L	ug/L	ug/L		ug/L		ug/L	ug/L	ug/L	
Diethyl phthalate	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
4-Chlorophenyl phenylether	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Fluorene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
4-Nitroaniline	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
4,6-Dinitro-2-methylphenol	NA	20 U	20 UE	20 U	20 U	NA	71 UE	NA	21 U	20 U	20 U	NA
N-Nitrosodiphenylamine	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
1,2-Diphenylhydrazine	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
4-Bromophenyl phenylether	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Hexachlorobenzene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Pentachlorophenol	NA	20 U	20 UE	20 U	20 U	NA	71 UE	NA	21 U	20 U	20 U	NA
Phenanthrene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Anthracene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Di-n-butyl phthalate	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Fluoranthene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Pyrene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Benzidine	NA	50 U	50 UE	51 U	50 U	NA	180 UE	NA	52 U	50 U	50 U	NA
Butylbenzylphthalate	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
3,3'-Dichlorobenzidine	NA	20 U	20 UE	20 U	20 U	NA	71 UE	NA	21 U	20 U	20 U	NA
Benzo(a)anthracene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Chrysene	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Bis(2-ethylhexyl)phthalate	NA	2 U	2 UE	3	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Di-n-octyl phthalate	NA	2 U	2 UE	2 U	2 U	NA	7 UE	NA	2 U	2 U	2 U	NA
Benzo(b)fluoranthene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Benzo(k)fluoranthene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Benzo(a)pyrene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Indeno(1,2,3-cd)pyrene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Dibenzo(a,h)anthracene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA
Benzo(g,h,i)perylene	NA	4 U	4 UE	4 U	4 U	NA	14 UE	NA	4 U	4 U	4 U	NA

NOTES:

1. DB indicates value reported is calculated to the dry basis (soils only).
2. AR indicates value reported is on the as-received basis (soils only).
3. U indicates the analyte was not detected. The value reported is less than the detection limit shown.
4. J indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.
5. B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.
6. D indicates the value reported is based on analysis of a diluted sample extract or digest.
7. TI indicates the reported result is the sum of the flagged analytes, due to chromatographic co-elution.
8. X indicates the value reported has been blank-corrected.

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-2S	MW-10	MW-10R	OSP-3D	FIELD BLANK	OSP-4S	OSP-4SR	OSP-4D	FIELD BLANK	OSP-5S	OSP-5D	OSP-6S
LAUCKS LAB NO:	11800-13	11800-14	11800-15	11800-16	11800-17	11800-18	11800-19	11800-20	11800-21	11800-22	11800-23	11800-24
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
MISCELLANEOUS INORGANIC ANALYSIS												
DISSOLVED METALS												
	mg/L	mg/L		mg/L		mg/L	mg/L	mg/L		mg/L	mg/L	mg/L
Copper	0.001 U	0.001 U	NA	0.001 U	NA	0.001	0.001 U	0.002	NA	0.003	0.001 U	0.002
Nickel	0.002 U	0.002 U	NA	0.002 U	NA	0.004	0.002 U	0.002 U	NA	0.002 U	0.002	0.002 U
Lead	0.005 U	0.006	NA	0.005 U	NA	0.005 U	0.006	0.005 U	NA	0.005 UE	0.005 U	0.011
Chromium	0.001 U	0.001 U	NA	0.001 U	NA	0.001 U	0.001 U	0.001 U	NA	0.001 U	0.001 U	0.001 U
Zinc	0.05 B	0.018	NA	0.008	NA	0.02	0.008	0.011	NA	0.016 E	0.016	0.016
Arsenic	0.005 U	0.027	NA	0.006	NA	0.005 U	0.005 U	0.042	NA	0.005 U	0.005 U	0.007
TOTAL METALS												
	mg/L											
Copper	0.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	0.08	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	0.014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	0.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	0.23 B	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.005 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADDITIONAL TESTS												
	mg/L									mg/L	mg/L	
Iron	28 B	NA	NA	NA	NA	NA	NA	NA	NA	30 B	NA	NA
Manganese	1.4	NA	NA	NA	NA	NA	NA	NA	NA	1.5	NA	NA
Hardness	67	NA	NA	NA	NA	NA	NA	NA	NA	110	220	NA

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NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-2S	MW-10	MW-10R	OSP-3D	FIELD BLANK	OSP-4S	OSP-4SR	OSP-4D	FIELD BLANK	OSP-5S	OSP-5D	OSP-6S
LAUCKS LAB NO:	11800-13	11800-14	11800-15	11800-16	11800-17	11800-18	11800-19	11800-20	11800-21	11800-22	11800-23	11800-24
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
VOLATILE ORGANIC COMPOUNDS												
	ug/L	ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Chloromethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	4	1 U
Chloroethane	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Acetone	5 U	5 U	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	NA	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	NA	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
2-Hexanone	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	NA	1 U	1 U	1	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Ethylbenzene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	NA	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Styrene	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	NA	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

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HART CROWSER AND ASSOCIATES
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NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-2S	MW-10	MW-10R	OSP-3D	FIELD BLANK	OSP-4S	OSP-4SR	OSP-4D	FIELD BLANK	OSP-5S	OSP-5D	OSP-6S
LAUCKS LAB NO:	11800-13	11800-14	11800-15	11800-16	11800-17	11800-18	11800-19	11800-20	11800-21	11800-22	11800-23	11800-24
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
EXTRACTABLE ORGANIC COMPOUNDS												
	ug/L	ug/L		ug/L		ug/L	ug/L	ug/L		ug/L	ug/L	ug/L
Phenol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
Aniline	10 U	10 U	NA	10 U	NA	10 U	10 U	10 UE	NA	10 U	10 U	10 U
Bis(2-chloroethyl)ether	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
2-Chlorophenol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
1,3-Dichlorobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
1,4-Dichlorobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Benzyl Alcohol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
1,2-Dichlorobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2-Methylphenol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
Bis(2-chloroisopropyl)ether	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
4-Methylphenol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
N-Nitroso-di-n-propylamine	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Hexachloroethane	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Nitrobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Isophorone	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2-Nitrophenol	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UR	NA	4 U	4 U	4 U
2,4-Dimethylphenol	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UR	NA	2 U	2 U	2 U
Benzoic Acid	50 U	51 U	NA	50 U	NA	50 U	50 U	50 UR	NA	50 U	50 U	50 U
Bis(2-chloroethoxy)methane	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2,4-Dichlorophenol	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UR	NA	4 U	4 U	4 U
1,2,4-Trichlorobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Naphthalene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
4-Chloroaniline	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Hexachlorobutadiene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
4-Chloro-3-methylphenol	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UR	NA	4 U	4 U	4 U
2-Methylnaphthalene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Hexachlorocyclopentadiene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	2 U	2 U	2 U
2,4,6-Trichlorophenol	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UR	NA	4 U	4 U	4 U
2,4,5-Trichlorophenol	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UR	NA	4 U	4 U	4 U
2-Chloronaphthalene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2-Nitroaniline	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Dimethyl phthalate	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Acenaphthylene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2,6-Dinitrotoluene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
3-Nitroaniline	10 U	10 U	NA	10 U	NA	10 U	10 U	10 UE	NA	10 U	10 U	10 U
Acenaphthene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2,4-Dinitrophenol	20 U	20 U	NA	20 U	NA	20 U	20 U	20 UR	NA	20 U	20 U	20 U
4-Nitrophenol	20 U	20 U	NA	20 U	NA	20 U	20 U	20 UR	NA	20 U	20 U	20 U
Dibenzofuran	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
2,4-Dinitrotoluene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U

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LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-2S	MW-10	MW-10R	OSP-3D	FIELD BLANK	OSP-4S	OSP-4SR	OSP-4D	FIELD BLANK	OSP-5S	OSP-5D	OSP-6S
LAUCKS LAB NO:	11800-13	11800-14	11800-15	11800-16	11800-17	11800-18	11800-19	11800-20	11800-21	11800-22	11800-23	11800-24
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE	JE
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH
EXTRACTABLE ORGANIC COMPOUNDS												
	ug/L	ug/L		ug/L		ug/L	ug/L	ug/L		ug/L	ug/L	ug/L
Diethyl phthalate	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
4-Chlorophenyl phenylether	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Fluorene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
4-Nitroaniline	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
4,6-Dinitro-2-methylphenol	20 U	20 U	NA	20 U	NA	20 U	20 U	20 UR	NA	20 U	20 U	20 U
N-Nitrosodiphenylamine	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
1,2-Diphenylhydrazine	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
4-Bromophenyl phenylether	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Hexachlorobenzene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Pentachlorophenol	20 U	20 U	NA	20 U	NA	20 U	20 U	20 UR	NA	20 U	20 U	20 U
Phenanthrene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Anthracene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Di-n-butyl phthalate	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Fluoranthene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Pyrene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Benzidine	50 U	51 U	NA	50 U	NA	50 U	50 U	50 UE	NA	50 U	50 U	50 U
Butylbenzylphthalate	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
3,3'-Dichlorobenzidine	20 U	20 U	NA	20 U	NA	20 U	20 U	20 UE	NA	20 U	20 U	20 U
Benzo(a)anthracene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Chrysene	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Bis(2-ethylhexyl)phthalate	3	3	NA	2 U	NA	2	2 U	2 UE	NA	3	2 U	3
Di-n-octyl phthalate	2 U	2 U	NA	2 U	NA	2 U	2 U	2 UE	NA	2 U	2 U	2 U
Benzo(b)fluoranthene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Benzo(k)fluoranthene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Benzo(a)pyrene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Indeno(1,2,3-cd)pyrene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Dibenzo(a,h)anthracene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U
Benzo(g,h,i)perylene	4 U	4 U	NA	4 U	NA	4 U	4 U	4 UE	NA	4 U	4 U	4 U

NOTES:

1. DB indicates value reported is calculated to the dry basis (soils only).
2. AR indicates value reported is on the as-received basis (soils only).
3. U indicates the analyte was not detected. The value reported is less than the detection limit shown.
4. J indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.
5. B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.
6. D indicates the value reported is based on analysis of a diluted sample extract or digest.
7. T1 indicates the reported result is the sum of the flagged analytes, due to chromatographic co-elution.
8. X indicates the value reported has been blank-corrected.

J-1639-09
HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-6D	OSP-6DR	FIELD BLANK	OSP-7S	OSP-7D	FIELD BLANK	SW-1	SW-1R	FIELD BLANK	SE-1
LAUCKS LAB NO:	11800-25	11800-26	11800-27	11800-28	11800-29	11800-30	12727-1	12727-2	12727-3	13000
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	01/11/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	CEV
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	01/11/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	MJH
MISCELLANEOUS INORGANIC ANALYSIS										
DISSOLVED METALS										
	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L		mg/L
Copper	0.001	0.001 U	NA	0.001	0.001 U	NA	0.011	0.008	NA	0.005
Nickel	0.005	0.002 U	NA	0.002 U	0.002 U	NA	0.002 U	0.002 U	NA	0.002 U
Lead	0.005 U	0.005 U	NA	0.018	0.005 U	NA	0.005 U	0.005 U	NA	0.005 U
Chromium	0.001 U	0.001 U	NA	0.001 U	0.001 U	NA	0.001	0.001 U	NA	0.001
Zinc	0.021	0.012	NA	0.019	0.013	NA	0.37	0.36	NA	0.04
Arsenic	0.01	0.01	NA	0.011	0.005 U	NA	0.005 U	0.005 U	NA	0.005 U
TOTAL METALS										
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADDITIONAL TESTS										
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hardness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-6D	OSP-6DR	FIELD BLANK	OSP-7S	OSP-7D	FIELD BLANK	SW-1	SW-1R	FIELD BLANK	SE-1
LAUCKS LAB NO:	11800-25	11800-26	11800-27	11800-28	11800-29	11800-30	12727-1	12727-2	12727-3	13000
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	01/11/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	CEV
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	01/11/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	MJH
MISCELLANEOUS INORGANIC ANALYSIS										
DISSOLVED METALS										
	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L		mg/L
Copper	0.001	0.001 U	NA	0.001	0.001 U	NA	0.011	0.008	NA	0.005
Nickel	0.005	0.002 U	NA	0.002 U	0.002 U	NA	0.002 U	0.002 U	NA	0.002 U
Lead	0.005 U	0.005 U	NA	0.018	0.005 U	NA	0.005 U	0.005 U	NA	0.005 U
Chromium	0.001 U	0.001 U	NA	0.001 U	0.001 U	NA	0.001	0.001 U	NA	0.001
Zinc	0.021	0.012	NA	0.019	0.013	NA	0.37	0.36	NA	0.04
Arsenic	0.01	0.01	NA	0.011	0.005 U	NA	0.005 U	0.005 U	NA	0.005 U
TOTAL METALS										
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ADDITIONAL TESTS										
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hardness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-6D	OSP-6DR	FIELD BLANK	OSP-7S	OSP-7D	FIELD BLANK	SW-1	SW-1R	FIELD BLANK	SE-1
LAUCKS LAB NO:	11800-25	11800-26	11800-27	11800-28	11800-29	11800-30	12727-1	12727-2	12727-3	13000
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	01/11/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	CEV
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	01/11/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	MJH
VOLATILE ORGANIC COMPOUNDS	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Chloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromomethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Methylene Chloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Acetone	5 U	5 U	130	5 U	5	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
total-1,2-Dichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chloroform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
2-Butanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vinyl Acetate	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromodichloromethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Benzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dibromochloromethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,1,2-Trichloroethane	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Bromoform	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
2-Hexanone	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Tetrachloroethene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chlorobenzene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
trans-1,3-Dichloropropene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Ethylbenzene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,3-Dichloropropene	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
Styrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-6D	OSP-6DR	FIELD BLANK	OSP-7S	OSP-7D	FIELD BLANK	SW-1	SW-1R	FIELD BLANK	SE-1
LAUCKS LAB NO:	11800-25	11800-26	11800-27	11800-28	11800-29	11800-30	12727-1	12727-2	12727-3	13000
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	01/11/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	CEV
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	01/11/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	MJH
EXTRACTABLE ORGANIC COMPOUNDS										
	ug/L	ug/L		ug/L	ug/L		ug/L	ug/L		ug/L
Phenol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Aniline	10 U	10 U	NA	10 U	10 U	NA	13 U	10 U	NA	10 U
Bis(2-chloroethyl)ether	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2-Chlorophenol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
1,3-Dichlorobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
1,4-Dichlorobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Benzyl Alcohol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
1,2-Dichlorobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2-Methylphenol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Bis(2-chloroisopropyl)ether	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
4-Methylphenol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
N-Nitroso-di-n-propylamine	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Hexachloroethane	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Nitrobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Isophorone	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2-Nitrophenol	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
2,4-Dimethylphenol	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Benzoic Acid	50 U	50 U	NA	50 U	50 U	NA	67 U	51 U	NA	50 U
Bis(2-chloroethoxy)methane	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2,4-Dichlorophenol	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
1,2,4-Trichlorobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Naphthalene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
4-Chloroaniline	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Hexachlorobutadiene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
4-Chloro-3-methylphenol	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
2-Methylnaphthalene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Hexachlorocyclopentadiene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
2,4,6-Trichlorophenol	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
2,4,5-Trichlorophenol	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
2-Chloronaphthalene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2-Nitroaniline	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Dimethyl phthalate	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Acenaphthylene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2,6-Dinitrotoluene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
3-Nitroaniline	10 U	10 U	NA	10 U	10 U	NA	13 U	10 U	NA	10 U
Acenaphthene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2,4-Dinitrophenol	20 U	20 U	NA	20 U	20 U	NA	27 U	20 U	NA	20 U
4-Nitrophenol	20 U	20 U	NA	20 U	20 U	NA	27 U	20 U	NA	20 U
Dibenzofuran	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
2,4-Dinitrotoluene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U

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HART CROWSER AND ASSOCIATES
PACCAR Defense Systems
NOVEMBER, 1988
LAUCKS TESTING LABORATORIES LAB NO. 11800, 12727, 13000

HC STATION NO:	OSP-6D	OSP-6DR	FIELD BLANK	OSP-7S	OSP-7D	FIELD BLANK	SW-1	SW-1R	FIELD BLANK	SE-1
LAUCKS LAB NO:	11800-25	11800-26	11800-27	11800-28	11800-29	11800-30	12727-1	12727-2	12727-3	13000
DATE:	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	11/18/88	01/11/88
ENTERED BY:	JE	JE	JE	JE	JE	JE	JE	JE	JE	CEV
DATE:	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	11/21/88	01/11/88
ENTERED BY:	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	KRH	MJH
EXTRACTABLE ORGANIC COMPOUNDS										
	ug/L	ug/L		ug/L	ug/L		ug/L	ug/L		ug/L
Diethyl phthalate	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
4-Chlorophenyl phenylether	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Fluorene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
4-Nitroaniline	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
4,6-Dinitro-2-methylphenol	20 U	20 U	NA	20 U	20 U	NA	27 U	20 U	NA	20 U
N-Nitrosodiphenylamine	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
1,2-Diphenylhydrazine	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
4-Bromophenyl phenylether	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Hexachlorobenzene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Pentachlorophenol	20 U	20 U	NA	20 U	20 U	NA	27 U	20 U	NA	20 U
Phenanthrene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Anthracene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Di-n-butyl phthalate	4	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Fluoranthene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Pyrene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Benzidine	50 U	50 U	NA	50 U	50 U	NA	67 U	51 U	NA	50 U
Butylbenzylphthalate	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
3,3'-Dichlorobenzidine	20 U	20 U	NA	20 U	20 U	NA	27 U	20 U	NA	20 U
Benzo(a)anthracene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Chrysene	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Bis(2-ethylhexyl)phthalate	2 U	2 U	NA	2	2 U	NA	3 U	2 U	NA	10 B
Di-n-octyl phthalate	2 U	2 U	NA	2 U	2 U	NA	3 U	2 U	NA	2 U
Benzo(b)fluoranthene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Benzo(k)fluoranthene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Benzo(a)pyrene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Indeno(1,2,3-cd)pyrene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Dibenzo(a,h)anthracene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U
Benzo(g,h,i)perylene	4 U	4 U	NA	4 U	4 U	NA	5 U	4 U	NA	4 U

NOTES:

1. DB indicates value reported is calculated to the dry basis (soils only).
2. AR indicates value reported is on the as-received basis (soils only).
3. U indicates the analyte was not detected. The value reported is less than the detection limit shown.
4. J indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.
5. B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.
6. D indicates the value reported is based on analysis of a diluted sample extract or digest.
7. T1 indicates the reported result is the sum of the flagged analytes, due to chromatographic co-elution.
8. X indicates the value reported has been blank-corrected.

Hart Crowser
J-1639-09

RESULTS OF FEBRUARY 1989
GROUNDWATER ANALYSES

Project Number J-1639-09
PACCAR Defense System
February 1989
Laucks Testing Laboratories Lab No. 14398

HC STATION NO:		OW-5S	OW-5D	OSP-4D	MW-31	LW-12S	LW-12D	LW-12DR	OW-4S	OW-4D	LW-3S	LW-3D	LW-13D
LAUCKS LAB NO:		14398-1	14398-2	14398-3	14398-4	14398-5	14398-6	14398-7	14398-8	14398-9	14398-10	14398-11	14398-12
DISSOLVED METALS													
Lead	mg/l	NA	NA	NA	0.007	0.007	0.005 U	0.007	NA	NA	0.006	0.008	0.005 U
Zinc	mg/l	NA	NA	NA	0.03 BE	0.015 BE	0.028 BE	0.068 BE	NA	NA	0.021 BE	0.11 BE	0.033 BE
Arsenic (Hydride)	mg/l	NA	NA	0.042	0.017	0.028	0.005 U	0.006	NA	NA	0.005 U	0.005 U	0.005 U
Arsenic (Furnace)	mg/l	NA	NA	0.045	NA	0.029	NA	NA	NA	NA	NA	NA	NA
VOLATILE ORGANIC COMPOUNDS													
Chloromethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Bromomethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Vinyl Chloride	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	10	1 U	1 U
Chloroethane	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	24	3 U	3 U
Methylene Chloride	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	81 D	1 U	1 U
Acetone	ug/l	NA	NA	NA	5 U	8	5 U	5 U	NA	NA	5 U	5 U	5 U
Carbon Disulfide	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
1,1-Dichloroethene	ug/l	NA	NA	NA	1 UE	1 UE	1 UE	1 UE	NA	NA	1 UE	1 UE	1 UE
1,1-Dichloroethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	61 D	1 U	1 U
trans-1,2-Dichloroethene	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
cis-1,2-Dichloroethene	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	2	1 U	1 U
total-1,2-Dichloroethene	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	2	1 U	1 U
Chloroform	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
2-Butanone	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
1,2-Dichloroethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
1,1,1-Trichloroethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Carbon Tetrachloride	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Vinyl Acetate	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Bromodichloromethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
1,2-Dichloropropane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Trichloroethene	ug/l	NA	NA	NA	1 UE	1 UE	1 UE	1 UE	NA	NA	1 UE	1 UE	1 UE
Benzene	ug/l	NA	NA	NA	1 U	3	1 U	1 U	NA	NA	6	1 U	1 U
Dibromochloromethane	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
1,1,2-Trichloroethane	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Bromoform	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
4-Methyl-2-Pentanone	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
2-Hexanone	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
1,1,2,2-Tetrachloroethane	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
Tetrachloroethene	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Toluene	ug/l	NA	NA	NA	1 UE	1 UE	1 UE	1 UE	NA	NA	590 DE	1 E	1 UE
Chlorobenzene	ug/l	NA	NA	NA	3 UE	3 UE	3 UE	3 UE	NA	NA	3 UE	3 UE	3 UE
trans-1,3-Dichloropropene	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
Ethylbenzene	ug/l	NA	NA	NA	1 U	1	1 U	1 U	NA	NA	300 D	1	1 U
cis-1,3-Dichloropropene	ug/l	NA	NA	NA	3 U	3 U	3 U	3 U	NA	NA	3 U	3 U	3 U
Styrene	ug/l	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	1 U	1 U	1 U
Total Xylenes	ug/l	NA	NA	NA	1 U	2	1 U	1 U	NA	NA	570 D	4	1 U

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HC STATION NO:		OW-5S	OW-5D	OSP-4D	MW-3I	LW-12S	LW-12D	LW-12DR	OW-4S	OW-4D	LW-3S	LW-3D	LW-13D
LAUCKS LAB NO:		14398-1	14398-2	14398-3	14398-4	14398-5	14398-6	14398-7	14398-8	14398-9	14398-10	14398-11	14398-12
SEMI-VOLATILE ORGANIC COMPOUNDS													
Phenol	ug/l	2 U	2 U	NA	2 UE	2 UR	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Aniline	ug/l	10 U	10 U	NA	10 UE	10 UE	10 U	10 U	11 U	11 U	10 U	10 U	10 U
Bis(2-chloroethyl)ether	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-Chlorophenol	ug/l	2 U	2 U	NA	2 UE	2 UR	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3-Dichlorobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,4-Dichlorobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Benzyl Alcohol	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Dichlorobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	4	2 U	2 U
2-Methylphenol	ug/l	2 U	2 U	NA	2 UE	2 UR	2 U	2 U	2 U	2 U	3	2 U	2 U
Bis(2-chloroisopropyl)ether	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
4-Methylphenol	ug/l	2 U	2 U	NA	2 UE	2 UR	2 U	2 U	2 U	2 U	4	2 U	2 U
N-Nitroso-di-n-propylamine	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Hexachloroethane	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Nitrobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Isophorone	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-Nitrophenol	ug/l	4 U	4 U	NA	4 UE	4 UR	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2,4-Dimethylphenol	ug/l	2 U	2 U	NA	2 UE	2 UR	4	3	2 U	2 U	2 U	17	2 U
Benzoic Acid	ug/l	52 U	52 U	NA	50 UE	50 UR	52 U	51 U	53 U	53 U	52 U	50 U	50 U
Bis(2-chloroethoxy)methane	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-Dichlorophenol	ug/l	4 U	4 U	NA	4 UE	4 UR	4 U	4 U	4 U	4 U	4 U	4 U	4 U
1,2,4-Trichlorobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Naphthalene	ug/l	4 U	4 U	NA	4 UE	17 E	4 U	4 U	4 U	4 U	170	36	4 U
4-Chloroaniline	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Hexachlorobutadiene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
4-Chloro-3-methylphenol	ug/l	4 U	4 U	NA	4 UE	4 UR	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2-Methylnaphthalene	ug/l	2 U	2 U	NA	2 UE	140 E	2 U	2 U	3	2 U	10	2 U	2 U
Hexachlorocyclopentadiene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2,4,6-Trichlorophenol	ug/l	4 U	4 U	NA	4 UE	4 UR	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2,4,5-Trichlorophenol	ug/l	4 U	4 U	NA	4 UE	4 UR	4 U	4 U	4 U	4 U	4 U	4 U	4 U
2-Chloronaphthalene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-Nitroaniline	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Dimethyl phthalate	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Acenaphthylene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,6-Dinitrotoluene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
3-Nitroaniline	ug/l	10 U	10 U	NA	10 UE	10 UE	10 U	10 U	11 U	11 U	10 U	10 U	10 U
Acenaphthene	ug/l	2 U	2 U	NA	2 UE	8 E	2 U	2 U	2 U	2 U	2 U	2 U	2 U

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HC STATION NO:		OW-5S	OW-5D	OSP-4D	MW-3I	LW-12S	LW-12D	LW-12DR	OW-4S	OW-4D	LW-3S	LW-3D	LW-13D
LAUCKS LAB NO:		14398-1	14398-2	14398-3	14398-4	14398-5	14398-6	14398-7	14398-8	14398-9	14398-10	14398-11	14398-12
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)													
2,4-Dinitrophenol	ug/l	21 U	21 U	NA	20 UE	20 UR	21 U	20 U	21 U	21 U	21 U	20 U	20 U
4-Nitrophenol	ug/l	21 U	21 U	NA	20 UE	20 UR	21 U	20 U	21 U	21 U	21 U	20 U	20 U
Dibenzofuran	ug/l	2 U	2 U	NA	2 UE	4 E	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-Dinitrotoluene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Diethyl phthalate	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
4-Chlorophenyl phenylether	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Fluorene	ug/l	2 U	2 U	NA	2 UE	19 E	2 U	2 U	2 U	2 U	3	2 U	2 U
4-Nitroaniline	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
4,6-Dinitro-2-methylphenol	ug/l	21 U	21 U	NA	20 UE	20 UR	21 U	20 U	21 U	21 U	21 U	20 U	20 U
N-Nitrosodiphenylamine	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,2-Diphenylhydrazine	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
4-Bromophenyl phenylether	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Hexachlorobenzene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Pentachlorophenol	ug/l	21 U	21 U	NA	20 UE	20 UR	21 U	20 U	21 U	21 U	21 U	20 U	20 U
Phenanthrene	ug/l	2 U	2 U	NA	2 UE	19 E	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Anthracene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Di-n-butyl phthalate	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Fluoranthene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Pyrene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Benzidine	ug/l	52 U	52 U	NA	50 UE	50 UE	52 U	51 U	53 U	53 U	52 U	50 U	50 U
Butylbenzylphthalate	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
3,3'-Dichlorobenzidine	ug/l	21 U	21 U	NA	20 UE	20 UE	21 U	20 U	21 U	21 U	21 U	20 U	20 U
Benzo(a)anthracene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Chrysene	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Bis(2-ethylhexyl)phthalate	ug/l	12	3	NA	2 BE	3 BE	9	7	7	10	4	5	2
Di-n-octyl phthalate	ug/l	2 U	2 U	NA	2 UE	2 UE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Benzo(b)fluoranthene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Benzo(k)fluoranthene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Benzo(a)pyrene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Indeno(1,2,3-cd)pyrene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Dibenzo(a,h)anthracene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Benzo(g,h,i)perylene	ug/l	4 U	4 U	NA	4 UE	4 UE	4 U	4 U	4 U	4 U	4 U	4 U	4 U

NOTES:

B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.
D indicates the value reported is based on analysis of a diluted sample extract or digest.
E indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.
NA indicates parameter or analyte was not measured.
R indicates the flagged data point is not useable for reasons discussed in the Quality Assurance Report.
U indicates analyte not detected. Value expressed is the detection limit.

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HC STATION NO:		LW-6S	LW-6D	LW-9S	LW-9D	VOA Trip Blk	OSP-7S	OSP-7D	OSP-5D	OSP-2D	MW-10	VOA Trip Blk
LAUCKS LAB NO:		14398-13	14398-14	14398-15	14398-16	14398-17	14398-18	14398-19	14398-20	14398-21	14398-22	14398-23
DISSOLVED METALS												
Lead	mg/l	0.005 U	0.011	0.007	0.006	NA	0.022	0.012	NA	0.005 U	NA	NA
Zinc	mg/l	0.011 BE	0.016 BE	0.013 BE	0.017 BE	NA	0.029 BE	0.029 BE	NA	0.025 BE	NA	NA
Arsenic (Hydride)	mg/l	0.005 U	0.01	0.015	0.008	NA	0.01	0.005 U	NA	0.005 U	0.025	NA
Arsenic (Furnace)	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.025	NA
VOLATILE ORGANIC COMPOUNDS												
Chloromethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Bromomethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Vinyl Chloride	ug/l	1 U	38	1 U	62	1 U	1 U	1 U	5	1 U	NA	1 U
Chloroethane	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
Methylene Chloride	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Acetone	ug/l	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	NA	5 U
Carbon Disulfide	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
1,1-Dichloroethene	ug/l	1 UE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
1,1-Dichloroethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
trans-1,2-Dichloroethene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
cis-1,2-Dichloroethene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
total-1,2-Dichloroethene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Chloroform	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
2-Butanone	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
1,2-Dichloroethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
1,1,1-Trichloroethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Carbon Tetrachloride	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Vinyl Acetate	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Bromodichloromethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
1,2-Dichloropropane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Trichloroethene	ug/l	1 UE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Benzene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Dibromochloromethane	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
1,1,2-Trichloroethane	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Bromoform	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
4-Methyl-2-Pentanone	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
2-Hexanone	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
1,1,2,2-Tetrachloroethane	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
Tetrachloroethene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Toluene	ug/l	1 UE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Chlorobenzene	ug/l	3 UE	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
trans-1,3-Dichloropropene	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
Ethylbenzene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
cis-1,3-Dichloropropene	ug/l	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U	NA	3 U
Styrene	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U
Total Xylenes	ug/l	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	NA	1 U

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HC STATION NO:		LW-6S	LW-6D	LW-9S	LW-9D	VOA Trip Blk	OSP-7S	OSP-7D	OSP-5D	OSP-2D	MW-10	VOA Trip Blk
LAUCKS LAB NO:		14398-13	14398-14	14398-15	14398-16	14398-17	14398-18	14398-19	14398-20	14398-21	14398-22	14398-23
SEMI-VOLATILE ORGANIC COMPOUNDS												
Phenol	ug/l	2 U	2 U	2 UR	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Aniline	ug/l	10 U	10 U	10 UE	10 U	NA	10 U	10 U	NA	10 U	NA	NA
Bis(2-chloroethyl)ether	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2-Chlorophenol	ug/l	2 U	2 U	2 UR	2 U	NA	2 U	2 U	NA	2 U	NA	NA
1,3-Dichlorobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
1,4-Dichlorobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Benzyl Alcohol	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
1,2-Dichlorobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2-Methylphenol	ug/l	2 U	2 U	2 UR	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Bis(2-chloroisopropyl)ether	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
4-Methylphenol	ug/l	2 U	2 U	2 UR	2 U	NA	2 U	2 U	NA	2 U	NA	NA
N-Nitroso-di-n-propylamine	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Hexachloroethane	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Nitrobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Isophorone	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2-Nitrophenol	ug/l	4 U	4 U	4 UR	4 U	NA	4 U	4 U	NA	4 U	NA	NA
2,4-Dimethylphenol	ug/l	2 U	2 U	2 UR	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Benzoic Acid	ug/l	50 U	51 U	52 UR	51 U	NA	51 U	51 U	NA	51 U	NA	NA
Bis(2-chloroethoxy)methane	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2,4-Dichlorophenol	ug/l	4 U	4 U	4 UR	4 U	NA	4 U	4 U	NA	4 U	NA	NA
1,2,4-Trichlorobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Naphthalene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
4-Chloroaniline	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Hexachlorobutadiene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
4-Chloro-3-methylphenol	ug/l	4 U	4 U	4 UR	4 U	NA	4 U	4 U	NA	4 U	NA	NA
2-Methylnaphthalene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Hexachlorocyclopentadiene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
2,4,6-Trichlorophenol	ug/l	4 U	4 U	4 UR	4 U	NA	4 U	4 U	NA	4 U	NA	NA
2,4,5-Trichlorophenol	ug/l	4 U	4 U	4 UR	4 U	NA	4 U	4 U	NA	4 U	NA	NA
2-Chloronaphthalene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2-Nitroaniline	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Dimethyl phthalate	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Acenaphthylene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2,6-Dinitrotoluene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
3-Nitroaniline	ug/l	10 U	10 U	10 UE	10 U	NA	10 U	10 U	NA	10 U	NA	NA
Acenaphthene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA

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HC STATION NO:		LW-6S	LW-6D	LW-9S	LW-9D	VOA Trip Blk	OSP-7S	OSP-7D	OSP-5D	OSP-2D	MW-10	VOA Trip Blk
LAUCKS LAB NO:		14398-13	14398-14	14398-15	14398-16	14398-17	14398-18	14398-19	14398-20	14398-21	14398-22	14398-23
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)												
2,4-Dinitrophenol	ug/l	20 U	20 U	21 UR	20 U	NA	20 U	20 U	NA	20 U	NA	NA
4-Nitrophenol	ug/l	20 U	20 U	21 UR	20 U	NA	20 U	20 U	NA	20 U	NA	NA
Dibenzofuran	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
2,4-Dinitrotoluene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Diethyl phthalate	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
4-Chlorophenyl phenylether	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Fluorene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
4-Nitroaniline	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
4,6-Dinitro-2-methylphenol	ug/l	20 U	20 U	21 UR	20 U	NA	20 U	20 U	NA	20 U	NA	NA
N-Nitrosodiphenylamine	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
1,2-Diphenylhydrazine	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
4-Bromophenyl phenylether	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Hexachlorobenzene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Pentachlorophenol	ug/l	20 U	20 U	21 UR	20 U	NA	20 U	20 U	NA	20 U	NA	NA
Phenanthrene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Anthracene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Di-n-butyl phthalate	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Fluoranthene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Pyrene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Benzidine	ug/l	50 U	51 U	52 UE	51 U	NA	51 U	51 U	NA	51 U	NA	NA
Butylbenzylphthalate	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
3,3'-Dichlorobenzidine	ug/l	20 U	20 U	21 UE	20 U	NA	20 U	20 U	NA	20 U	NA	NA
Benzo(a)anthracene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Chrysene	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Bis(2-ethylhexyl)phthalate	ug/l	3	2	2 BE	2	NA	3	6	NA	2 U	NA	NA
Di-n-octyl phthalate	ug/l	2 U	2 U	2 UE	2 U	NA	2 U	2 U	NA	2 U	NA	NA
Benzo(b)fluoranthene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Benzo(k)fluoranthene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Benzo(a)pyrene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Indeno(1,2,3-cd)pyrene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Dibenzo(a,h)anthracene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA
Benzo(g,h,i)perylene	ug/l	4 U	4 U	4 UE	4 U	NA	4 U	4 U	NA	4 U	NA	NA

NOTES:

B indicates the analyte of interest was detected in the method blank associated with this sample, as well as in the sample itself.
D indicates the value reported is based on analysis of a diluted sample extract or digest.
E indicates the analyte was detected at a concentration greater than the MDL but less than the SDL. The value reported should be considered an estimate.
NA indicates parameter or analyte was not measured.
R indicates the flagged data point is not useable for reasons discussed in the Quality Assurance Report.
U indicates analyte not detected. Value expressed is the detection limit.

Hart Crowser
J-1639-09

RESULTS OF OFF-SITE GROUNDWATER ANALYSES
LANDAU ASSOCIATES, INC. (1989)

TABLE 2.1
TOTAL PETROLEUM HYDROCARBONS (TPH) IN
SOIL AND GROUND WATER
RENTON PROPERTIES

Soil Samples: Well Identifier and Sample Depth(a)	Soil Samples: TPH(b) (ppm)	Ground Water Samples: Well Identifier	Ground Water Samples: TPH(b) (ppm)
		LMW-1S	ND
LMW-1D/5.5	ND		
LMW-1D/8.5	ND		
LMW-1D/32.5	ND		
		LMW-2S	NA
LMW-2D/5.5	ND		
LMW-2D/7.0	ND		
LMW-2D/8.5	ND		
LMW-2D/32.5	ND		
LMW-4/4.0	ND	LMW-4	ND
LMW-4/5.5	ND		
LMW-4/7.0	ND		
		LMW-6	56
LMW-7/5.5	160	LMW-7	ND
LMW-7/7.0	ND		
LMW-7/12.5	ND		
		HC-10-71-C	ND
		Equipment Blank #1	ND
		Equipment Blank #2	ND

ND = Not detected (less than 20 ppm [soil]; less than 0.5 ppm [water]).
NA = Not analyzed.

NOTES:
a) Sample ID for soil samples is the boring number and beginning of sample interval. For example, LMW-1D/5.5 is the sample from Boring LMW-1D beginning at a depth of 5.5 feet. The sample interval is 1.5 feet.
b) TPH was determined by EPA method 418.1.

TABLE 2.2
SUMMARY OF DETECTED VOLATILE AND SEMI-VOLATILE
ORGANIC COMPOUNDS IN SOIL AND GROUND WATER,
RENTON PROPERTIES

Well Identifier and Sample ID	Medium	Volatile Organics Compounds (VOC)(a) Methylene Chloride (ppb)	Acetone (ppb)	Vinyl Chloride (ppb)	1,1-Dichloroethene (ppb)	Tetra Chloroethene (ppb)	Chloroform (ppb)	Semi-Volatile Organics (ABN)(a) Phthalates (Total) ppb
LMW-1S	Water	<1	<5	<1	<1	<1	<1	NA
LMW-1D	Water	<1	<5	<1	<1	<1	<1	NA
LMW-1D/32.5	Soil	<2	82	<2	<2	<2	<2	
LMW-2S	Water	<1	<5	<1	<1	<1	<1	3
LMW-2D	Water	<1	<5	45	<1	<2	1	NA
LMW-2D/8.5	Soil	4	51	<2	<2	<2	<2	NA
3S/0.0	Soil	4	<9	<2	<2	6	<2	1868
3S/2.0	Soil	<2	<10	<2	<2	<2	<2	130
LMW-4	Water	<1	<5	<1	1	<1	<1	5
LMW-6	Water	<1	<5	<1	<1	<1	<1	NA
LMW-7	Water	<1	<5	<1	<1	<1	<1	NA
HC-10-71-C	Water	<1	<5	<1	<1	<1	<1	NA
Equipment Blank #1		<1	<5	<1	<1	<1	<1	NA
Equipment Blank #2		<1	<5	<1	<1	<1	<1	NA

NOTES:
NA = Not analyzed

a) VOCs were determined by EPA method 8240. ABNs were determined by EPA method 8270.
b) Sample ID for soils is the boring number followed by the beginning of the 1.5' sample interval, except for Sample 3 which included a 0.5' sample interval.

TABLE 2.3
SUMMARY OF DETECTED PRIORITY POLLUTANT METALS IN GROUND WATER,
RENTON PROPERTIES

Monitoring Well Identifier

Analyte	LMW-1S ppb	LMW-1D ppb	LMW-2S ppb	LMW-2D ppb	LMW-4 ppb	Equipment Blank ppb	MCL(1) ppb
Arsenic	10	5	9	<5	8	<5	50
Antimony(2)	NA	NA	NA	NA	NA	NA	None
Cadmium	<1	<1	<1	<1	<1	<1	10
Chromium	<1	<1	<1	<1	<1	<1	50
Copper	<1	<1	<1	<1	<1	<1	None
Lead	<5	5	<5	<5	<5	<5	50
Mercury	<1	<1	<1	<1	<1	<1	2
Nickel	<2	2	4	<2	<2	<2	None
Selenium	<5	<5	<5	<5	<5	<5	10
Silver	<1	<1	<1	<1	<1	<1	50
Thallium(2)	NA	NA	NA	NA	NA	NA	None
Zinc	16	15	14	28	4	6	None

NOTES:

(1) MCL = Maximum Contaminant Level, EPA Primary Drinking Water Standards (Source: 40 CFR 141)
(2) Results for antimony and thallium not available at the time of this report. This data will be provided as a supplement.

NA = Not available
ppb = parts per billion

APPENDIX I
PROBABILISTIC EXPOSURE MODELING

CONTENTS

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APPENDIX I
PROBABILISTIC EXPOSURE MODELING

Introduction

One of the principal objectives of contaminant exposure modeling, and of risk assessments in general, is to estimate the probable range of exposure outcomes which may be associated with site conditions. This statistical information is used to quantify risk probabilities, and to evaluate the degree of confidence which should be placed on model predictions. Such information is often critical to proper interpretation of risk assessments and appropriate selection of remedial alternatives, particularly since a considerable measure of protection is often desired in the decision making process.

By application of several existing and well established statistical techniques to risk assessment, an evaluation of uncertainty in exposure estimations can be achieved. These techniques often rely on methods for approximating actual conditions in the absence of complete data. A description of the statistical methods used in this risk assessment to estimate data distributions and evaluate modeling uncertainties is presented below. The discussion begins with a review of the variance propagation model -- first-order uncertainty analysis -- and addresses the fundamental mechanics of the process.

It should be noted that this evaluation is limited to the exposure assessment component of the chemical risk evaluation process. The other fundamental component of the process -- toxicity assessment -- is not addressed. Toxicity criteria have been formally proposed by the Environmental Protection Agency for use in risk assessments (EPA, 1986 and 1989). These criteria already incorporate a rather large degree of protection (e.g., orders of magnitude uncertainty factors), and are presented in terms of upper-bound (or worst-case) values. The statistical basis of these toxicity criteria has generally not been evaluated by the EPA or other regulatory agencies, and was not attempted herein.

Evaluating Statistical Properties of Functions

Risk assessments, as well as other analytical analyses, require the estimation of statistical properties for mathematical functions. These properties include averages, standard deviations, and distribution percentiles, among other statistical measures. These measures form the basis for statistical evaluations of the functions.

As an example risk assessment component, consider the function for daily intake, or daily dose, of a contaminant which may occur as a result of fugitive dust emissions from surficial soil material at a hazardous waste site. The function providing the daily intake may be approximated by the following (EPA, 1986):

$$(1) \qquad DI = C * TSP * \frac{Ve}{W} \qquad \text{where}$$

DI = daily intake in mg/kg-day,
C = soil contaminant concentration in mg/kg,
TSP = total suspended particulate matter in kg/m^3,
Ve = ventilation rate in m^3/day, and
W = human body weight in kg.

The independent variables, shown on the right side of equation 1, may be interpreted as random variables with probability density functions describing the frequency of each variable to take on certain values. Consequently, the dependent variable, daily intake, also is a random variable and depends on the four independent variables. Note that here the meaning of independent is mathematical and not necessarily statistical; the independent variables may be (and often are) statistically dependent.

If the probability density functions of the independent variables in equation 1 are known in an analytical form, it is possible to write the expression for the probability density function of the daily intake. However, more likely, these probability density functions are unknown, or if known, combining them into a single expression for the daily intake is a formidable task.

Two methods, first-order uncertainty analysis and Monte Carlo simulation, are useful for identifying the statistical properties of a mathematical function, such as the daily intake. These methods are reasonable for obtaining the desired results and are favorable in terms of data requirements and the ease of calculations. The remainder of this section presents these methods in detail along with example applications.

First-Order Uncertainty Analysis

Cornell (1973) has pointed out that in many environmental applications, knowledge of the mean and variance of a quantity in lieu of its complete probability density function may be acceptable, particularly in cases where derivation of the probability density function is difficult or impossible. Such cases occur frequently in risk assessments when probabilistic statements regarding functions (e.g., $y = f(x)$) are desired. Unless the function f has a very simple form, it is often very difficult to arrive at a closed form solution of the probability density function of y. In such cases first-order uncertainty analysis is an extremely useful tool.

The first-order analysis, although it provides statistical information, is mathematical in nature. It relies on both the Taylor polynomial expansion and the notion of mathematical expectation. Simply put, the function, such as equation 1, is expanded to first order terms by a Taylor expansion. The first and second moments of the expanded form are then obtained as expected values (i.e., E(X) and E(X^2)). Excellent documentation for the first-order analysis is provided by Cornell (1973) and for mathematical expectation by Hogg and Craig (1978).

For a function, $f(x)$, of a single variable, x, the value of $f(x + dx)$ is given by the Taylor expansion as follows:

(2) $f(x + dx) = f(x) + f'(x)dx + H.O.T.$
where

dx symbolizes delta x, $f'(x)$ is the first derivative of f with respect to x, and H.O.T. indicates higher order terms (i.e., terms with higher order derivatives). The higher order terms are truncated in the first-order analysis.

We can consider x to be a random variable with small deviations from its mean of magnitude dx (i.e. $dx = x - E(x)$). The expected value of these deviations ($E(dx)$) is zero.

It then follows that the expected value of f(x), written $E(f(x))$, is given by $f(E(x))$. This means that to obtain the expected value of f(x), f(x) is computed using the expected value of x. Following the same mathematical reasoning, the variance of f(x) given by

$$(3) \quad Var(f(x)) = E[(f(x) - f(E(x))^2],$$

is equal to $[f'(E(x))]^2 Var(x)$. This latter solution is most easily obtained by substituting $dx = x - E(x)$ into equation 2 and then following through with the expected value notation. It is necessary to realize that $Var(x) = E[(x - E(x))^2]$.

To this point the method is essentially a nonparametric technique, in that it does not rely on probability distributions for the independent variables. However, the reader may realize that this method can only provide the mean and variance of the function. If more information is sought regarding the function, such as distribution percentiles, it is necessary to assume a distribution. Frequently, the distribution is assumed to be Normal, and standard Normal deviates are used to compute distribution percentiles from the mean and variance.

The first-order method is easily extended to multivariate functions, (e.g., f(X) where $X = (x_1, x_2, \ldots, x_n)$). Under these conditions the expected value of f(X) is given by $f(E(x_1), E(x_2), \ldots, E(x_n))$. The variance of f(X) has similar form to the univariate function, however, the covariances of the independent variables appear in the result. The variance is written in matrix form as

$$(4) \quad Var(f(X)) = grad(f)^T [COV(X)] grad(f)$$

where

grad(f) is the gradient of f(X) (grad(f)= $f'(x_1), f'(x_2), \ldots, f'(x_n)$), a vector of the partial derivatives of f with respect to each independent variable, and [COV(X)] is the covariance matrix for the n independent variables. The superscript T indicates the transpose or row vector of grad(f). Pursuing the matrix multiplication and using summation notation, the variance of f(X) is written

(4) Var(f(X)) =

$$\sum_{i}^{N}[f'(x_i)]^2 Var(x_i) + 2 \sum_{i<j}^{N} f'(x_i)f'(x_j)COV(x_i,x_j)$$

where the derivatives are evaluated at the expected values of the x_i.

In applying the first-order analysis to a multivariate function it is necessary to compute the means, variances, and covariances for the independent variables. These data are then substituted into the function f(X) and equation 4 to obtain the mean and variance of f(X), respectively. Note that if the independent variables are also statistically independent, or assumed to be statistically independent, then all non-diagonal elements of the covariance matrix are zero.

First-order uncertainty analysis also applies to functions of time series variables as well. These applications incorporate the autocorrelations and cross-correlations among the independent variables into the analysis. The method provides similar results and is also detailed in Cornell (1973).

Application

The first-order uncertainty analysis is applied in this example to the daily intake function above (Eq. 1). The independent variables were evaluated for soil lead (C) and total suspended particulate matter (TSP) based on data collected on and near a relatively typical hazardous waste site near Seattle, Washington. This particular site has received considerable study (e.g., 100+ determinations of constituent concentrations in on-site surface soils). The measured cumulative distribution functions of C and TSP are presented on Figures I-1 and I-2. Ventilation rate and body weight used in the example analysis are those for a male adult, 18 to 35 years of age working at a moderate activity level. The source for these data was EPA (1985).

The means and standard deviations for the independent variables are provided in Table I-1. The variables are reasoned in this case to be statistically independent to simplify the discussion. However, body weight and ventilation rate may be positively correlated. The general first-order uncertainty analysis would consider the covariance between all variables, including various chemical exposure routes. Covariance is generally observed spatially between different chemicals (e.g., lead and trinitrotoluene) and is often assumed between different exposure routes (e.g., soil ingestion and dermal contact). Many of the variables which make up a risk assessment, however, are uncorrelated (e.g. constituent concentrations and ventilation rates).

Table I-1 -- Summary Statistics for Independent Variables

Variable	Mean	Standard Deviation
Soil Lead, C	676	2,313
Total Suspended Particulates, TSP	5.84×10^{-8}	3.88×10^{-8}
Ventilation Rate, Ve	58.9	18.0
Body Weight, W	76.4	24.2

Units of measure are given in Equation 1.

The first-order analysis, as presented in Table I-1, yields a mean and standard deviation for the daily intake of 3.04×10^{-5} and 1.04×10^{-4} mg/kg-day, respectively. The 95th percentile (see below) based on the assumption of Normality is 2.01×10^{-4} mg/kg-day.

In this analysis, it is noteworthy that the variance of the daily intake is most influenced by the variance in soil lead concentration. The soil lead concentration is positively skewed with a data range from 5 to 19,000 mg/kg.

Computing Input Values

The mean and standard deviations for the independent variables were obtained from field samples and EPA (1985). The mean values were computed by the conventional method

$$(5) \quad \overline{X} = \frac{i}{N} \sum_{i}^{N} X_i \quad \text{where}$$

the X_i are observations and N is the total number of observations. The standard deviations were computed by the relation

$$(6) \quad s(X) = (X_{.95} - \overline{X})/1.645 \quad \text{where}$$

$X_{.95}$ is the distribution 95th percentile and the value 1.645 is the 95th percentile for a standard Normal distribution. Note that if X is distributed Normally, then $X_{.95} = \overline{X} + 1.645s(X)$. When the 95th percentile is computed as detailed below, the value of s(X) obtained from Eq. 6 is greater than or equal to the value computed from the sample data. The "adjusted" s(X) value reflects uncertainties in estimating the probability density function based on sample data, and is conservative toward protecting public health in a risk assessment context.

The "adjusted" s(X) value was used only for soil lead and total suspended particulate matter in the example application, as data were readily available for these variables. Mean values and standard deviations for ventilation and body weight were obtained from summaries presented in EPA (1985).

The 95th Percentile. The distribution 95th percentile, denoted $X_{.95}$, is the value for which the probability of a value X less than $X_{.95}$ to occur is 0.95. Conventionally, it has been widely used as a measure of significance. For example, often in a t-Test, if the t-statistic exceeds the value $t_{.95}$ (which is provided in tables and is based on sample size) the alternate hypothesis is chosen over the null hypothesis, and vice versa. In terms of a risk assessment, we use the 95th percentile as an estimated upper bound a measurement may take on, for example, daily intake of soil lead.

Our approach to computing the 95th percentile is conservative. We select the maximum value obtained from several independent methods for computing $X_{.95}$. The methods are as follows:

1) Assume Normality and use Eq. 7 (below) with $s(X)$ and $\overline{X}$ as input to solve for $X_{.95}$.

2) Assume log-Normality and use Eq. 7 with the log mean and log standard deviation as input to solve for $X_{.95}$. Note that it is necessary to transform back to the original data units.

3) When sample sizes are greater than 20 use the empirical value for $X_{.95}$ estimated by $X_{.95} = Y(0.95N)$, where $Y(i)$ is the ith ranked data value (including non-detect values evaluated at the reported detection limit) and N is the sample size. When 0.95N is not an integer we choose the nearest integer value.

4) when sample sizes are less than 20 we assign the maximum data value to $X_{.95}$.

$$(7) \quad X_{.95} = \overline{X} + t_{.95}s(X)$$

Use of the t-statistic in Equation 7 incorporates the additional uncertainty resulting from estimation of distribution statistics, which may be based on limited sample data. From these calculations of the 95th percentile we conservatively select the maximum value to represent the 95th percentile for the data distribution of variable X. For the first-order uncertainty analysis we substitute this value of $X_{.95}$ into Eq. 6 to obtain the "adjusted" $s(X)$. This value of $s(X)$ is used in the first-order analyses, as discussed above.

Monte Carlo Simulation

Monte Carlo simulation relies heavily on the computer. It is a method by which the distribution of values a function may take on, such as Eq. 1, is actually computed by performing a sufficient number of iterative calculations using "real" and new input data for each individual calculation.

The input requirements are the cumulative probability density functions for the independent variables. For Eq. 1 these variables are soil lead concentration, total suspended particulate matter, ventilation rate, and body weight. By providing the cumulative distribution functions for these variables, random variates can be selected at appropriate frequencies, and used in repeated calculations to obtain the distribution of daily intake values.

When the independent variables of a function are statistically correlated it is necessary to generate correlated random variates. Methods are available for computing multivariate Normal random variates, and likely other distributions as well. These techniques are mathematically more difficult, however, and computationally more demanding.

Application

A Monte Carlo simulation was conducted for the daily intake of surficial soil lead (Eq. 1). For this simulation we assumed the cumulative probability density functions for ventilation rate (Ve) and body weight (W) to be independent and Normal. The distribution functions for the remaining variables, soil lead (C) and total suspended particulate matter (TSP), were based on measured data. The cumulative probability density functions for soil lead and total suspended particulates are shown on Figures I-1 and I-2.

A total of 1,000 daily intake values were computed in the Monte Carlo simulation. These data provide an estimate of the cumulative probability density function for daily intake of soil lead. This function, shown on Figure I-3, is based on equation 1 and the independent variable cumulative distribution functions which we discussed above.

From the cumulative probability density function, several other statistics describing the daily lead intake are readily available. Among those obtained from this simulation are the median, 5.03×10^{-6} mg/kg-day, and the 95th percentile, 1.42×10^{-4} mg/kg-day.

Discussion

The performance of the first-order model can be evaluated by comparing the completed cumulative distribution function with that of the Monte Carlo simulation. Over the region of the distribution of primary interest in risk assessment (i.e., from 0.50 to 0.95 cumulative probability), the first-order model estimates were greater than those of the Monte Carlo simulation (Figure I-3). Based on this comparison, the first-order model generates more conservative estimates of daily intake values than the more "real" Monte Carlo simulation. This conservative tendency is acceptable in a risk assessment context.

As discussed above, evaluations of covariance between the variables which make up an exposure assessment are also much more tractable in the first-order model, and are not computationally demanding. For these reasons, the first-order model was selected for use in this risk assessment. Comparisons of model output with Monte Carlo simulations were also performed on a subset of the calculations to verify the accuracy or conservative overprediction of chemical exposures.

References

Cornell, C.A. 1973. First-Order Analysis of Model and Parameter Uncertainty, International Symposium on Uncertainties in Hydrologic and Water Resource Systems.

Hogg, R.V. and Craig, A.T. 1978. Introduction to Mathematical Statistics, 4th ed., Macmillan Publishing Company, New York, 438 pages.

EPA. 1985. Development of Statistical Distributions or Ranges of Standard Factors Used in Exposure Assessments, prepared for EPA by GCA Corp., Chapel Hill, NC.

EPA. 1986. Superfund Public Health Evaluation Manual, Office of Emergency and Remedial Response, EPA/540/1-86/060.

EPA. 1989. Draft Exposure Factor Summary, Memorandum from Leigh Woodruff, EPA Region 10, Mar-89.

Soil Lead Concentrations
Cumulative Probability Distribution

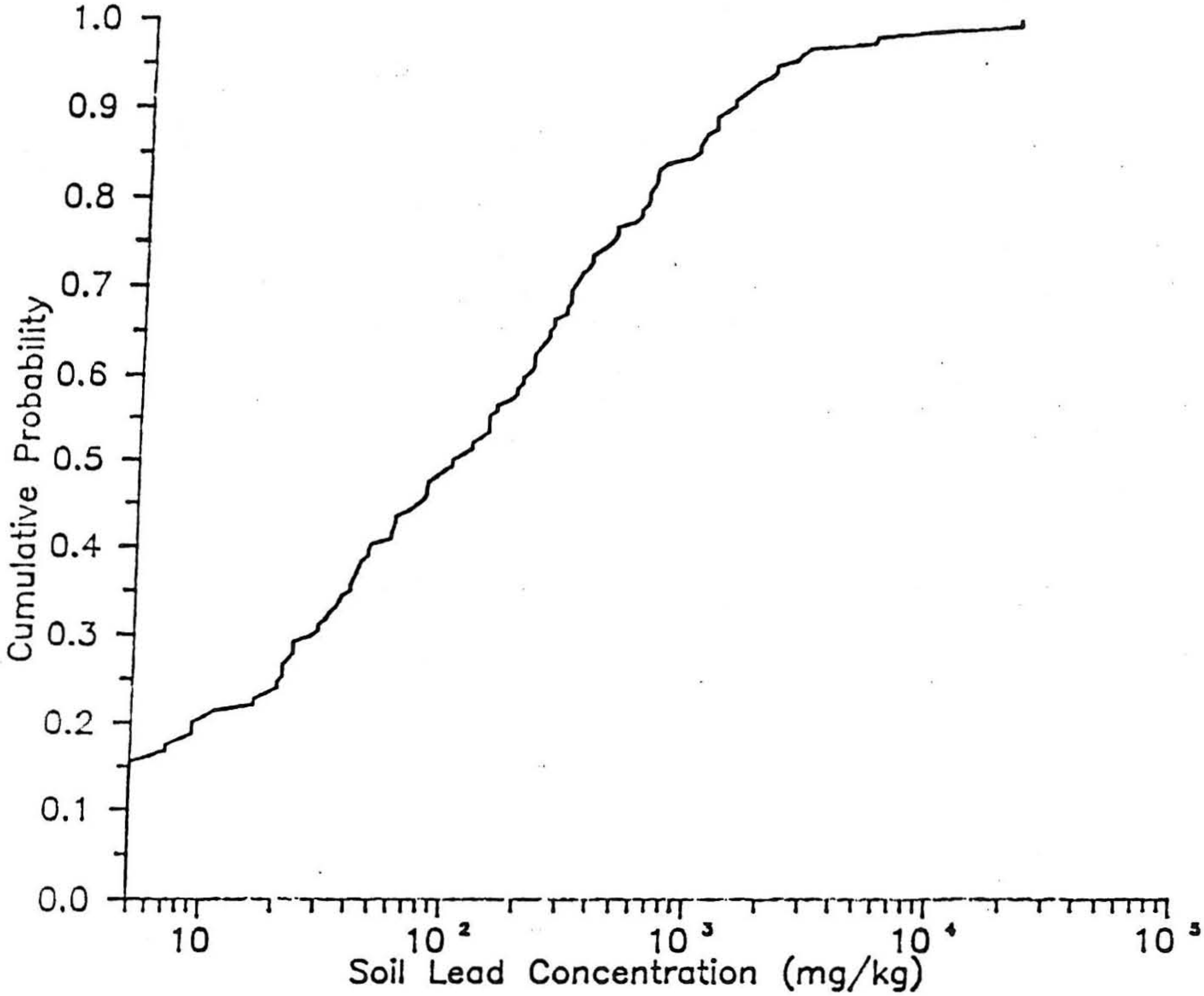

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Figure I-1

Total Suspended Particulate Matter Cumulative Probability Distribution

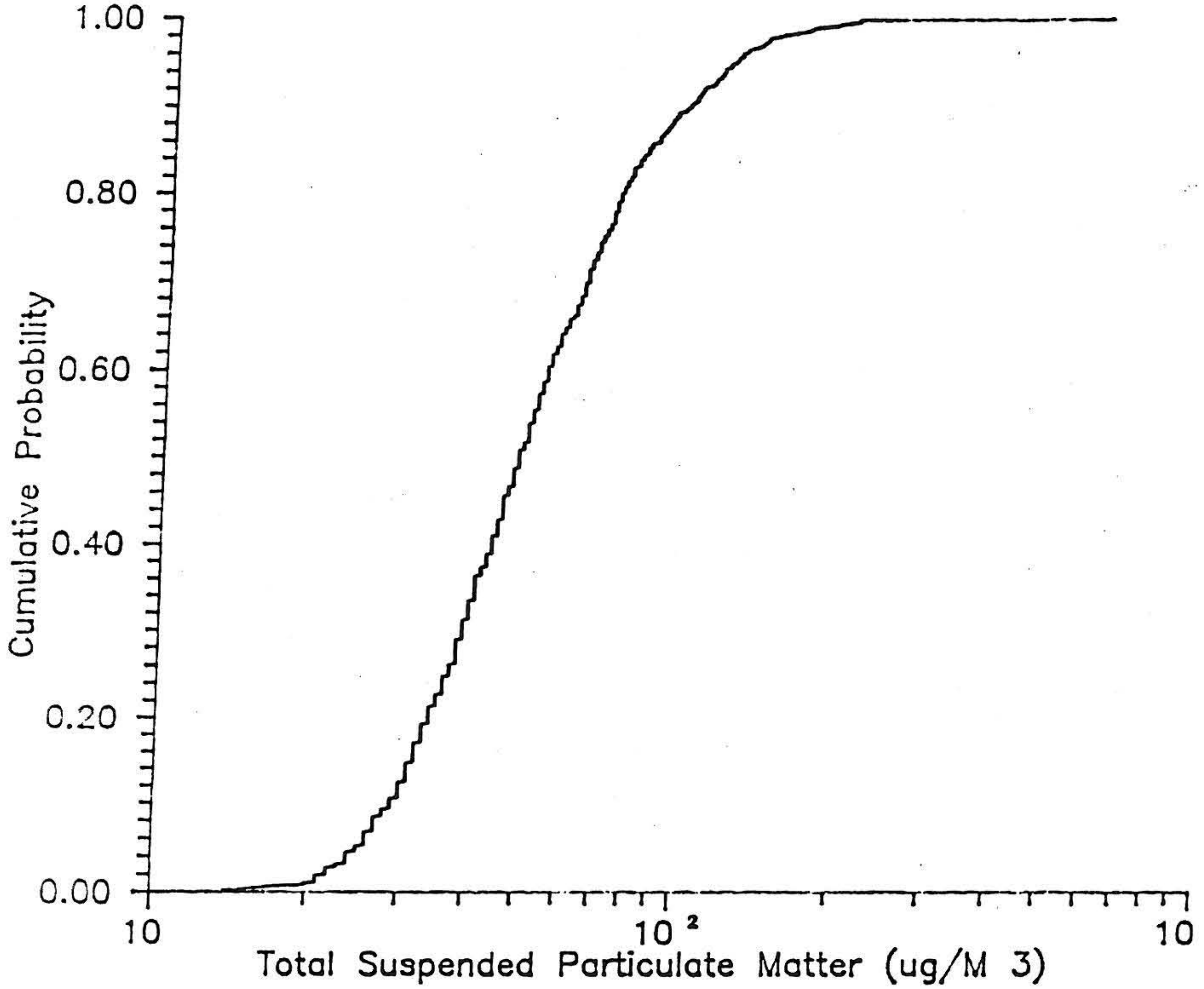

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Figure I-2

Monte Carlo Simulation for Daily Lead Intake
Cumulative Probability Distribution

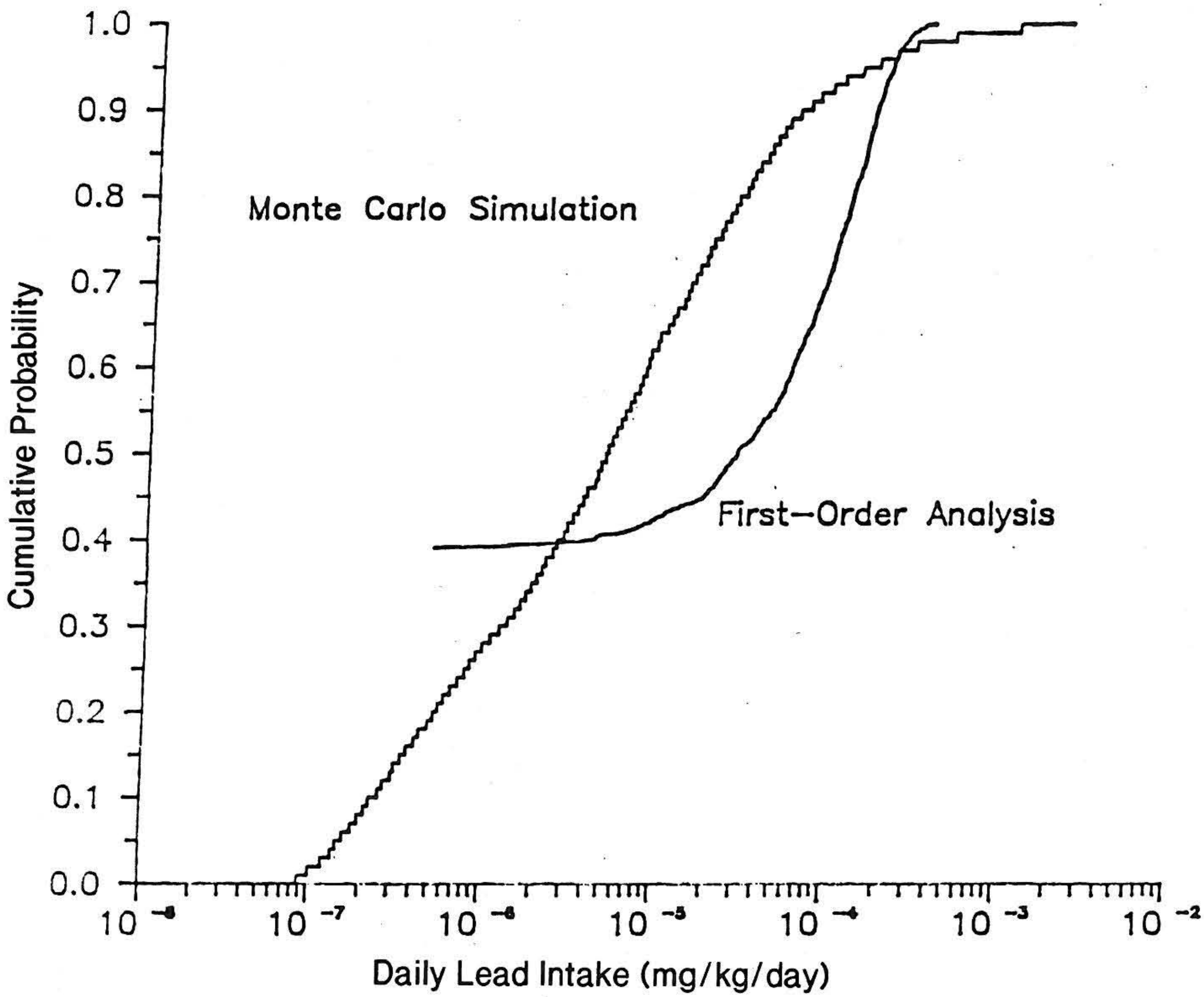

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Figure I-3