REMEDIAL INVESTIGATION

EVERETT SMELTER SITE

EVERETT, WASHINGTON

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September 1995

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EXECUTIVE SUMMARY

ASARCO Incorporated (Asarco) commenced a Remedial Investigation/Feasibility Study (RI/FS) for the Everett Smelter Site following issuance of Enforcement Order No. DE 92TC-N147 by the Washington State Department of Ecology (Ecology) on April 20, 1992. The RI/FS was conducted to satisfy the requirements of Chapter 173-340 WAC. On March 18, 1994, Ecology issued the First Amended Enforcement Order, which included a Supplemental Scope of Work. Additional field investigations were conducted and an Interim Deliverable Report was completed in response to the Amended Order. All work, under both the original and amended orders, was conducted by Hydrometrics, Inc., on behalf of Asarco, with Ecology providing oversight. This section summarizes the RI, which includes an FS as well as a Risk Assessment (RA) prepared by Kleinfelder, Inc.

Remedial Investigation

During the course of the remedial investigation, it became apparent that the original scope of work was not sufficient to define the nature and extent of arsenic and metals in the lowland portion of the site. Available data indicate that soils, surface water, and groundwater in the lowland area have been impacted, but there is not enough information to adequately define feasible cleanup alternatives. As a result, the remedial investigation presents the available data for the entire site, but the feasibility study includes cleanup alternatives only for the residential portion of the site. Additionally, all feasible alternatives include provisions intended to prevent movement of arsenic and metals from the residential, upland, area to the lowland portion of the site. The remedial investigation for the lowland will continue while the cleanup action plan for the residential portion of the site is being developed.

Soils in the residential area which are located in the footprint of the former smelter contain highly elevated levels of arsenic, cadmium, and lead. In general, below a depth of 1 foot, concentrations decrease with depth, although arsenic and cadmium concentrations may exceed their respective natural background values of 7 and 1 ppm to depths in excess of 15 feet. Lead concentrations in smelter soils generally exceed the natural background value of 24 ppm to a depth between 4 and 6 feet. The distribution of metals in the smelter area is highly irregular, related to the variable presence of smelter debris.

Soils in the area outside the former smelter boundary (peripheral area) contain arsenic, cadmium, and lead levels that exceed natural background values, but are significantly lower than those in the smelter area. In peripheral soils, arsenic concentrations may exceed the natural background concentration of 7 ppm to the maximum sampling depth of 6 feet; cadmium and lead concentrations generally are within background ranges below a depth of 1 to 2 feet. The distribution of metals in the peripheral area shows a more regular pattern, related to metals deposition through fugitive and stack emissions. However, areas with anomalously high concentrations exist in the peripheral area.

Although based on limited data from soil samples that generally have TCLP arsenic concentrations well in excess of 5 ppm, TCLP analysis appears to show that an approximately linear relationship exists between the logarithms of the total and TCLP arsenic concentrations in soil. Based on this relationship, soil with an arsenic concentration over approximately 3,700 ppm arsenic is likely to exceed the TCLP criterion for arsenic. The lower 95% confidence limit associated with this value corresponds to a soil arsenic concentration of approximately 2,100 ppm. With the exception of one mercury value, metals other than arsenic do not exceed their respective TCLP criteria at any concentration in the soil samples submitted for TCLP analysis..

In the lowland area, elevated arsenic, cadmium, and lead concentrations appear confined to the fill and slag material present. However, due to the relatively small number of monitoring well locations from which soil samples were obtained, the lateral and vertical distribution of metals in soil has not been delineated adequately. Further collection of soil samples is necessary to satisfactorily characterize the nature and extent of metals in soil and to evaluate their potential role as a source material to surface water and groundwater.

In the residential area, surface water originating within the footprint of the former smelter area exceeds freshwater and marine water acute and chronic criteria for arsenic, cadmium, and lead. Arsenic and cadmium are primarily transported in the dissolved form, whereas lead is almost exclusively transported as total lead. Arsenic and cadmium concentrations are a function of the duration of a precipitation event, which may be related to soil saturation and leaching potential. Lead concentrations appear to be determined by the amount of flow, i.e. the potential of surface runoff to transport particles.

In the lowland area, surface water contains arsenic, cadmium, and lead concentrations in excess of their respective freshwater and marine water acute and chronic criteria. Although slag and upland fill material may act as a limited source of metals to lowland surface water, it appears that an additional local source in the lowland area may be responsible for the elevated arsenic, cadmium, and lead levels. Further investigation will help identify this source and delineate the nature and extent of the area with elevated elements of concern.

Deep groundwater in the residential area is not adversely affected by the presence of soils containing elevated levels of arsenic, cadmium, and lead, suggesting that downward migration of water through the native till material does not occur to a significant extent. Organic constituents other than phthalates (components of labware plastics) were not detected in deep groundwater. Shallow groundwater in the residential appears to occur only as patchy lenses within the fill material. Although the quality of this groundwater has not been investigated, it may contain elevated concentrations or arsenic, cadmium, and lead. Horizontal groundwater flow through the fill material may be a mechanism by which arsenic and metals are transported.

In the lowland area, groundwater data show that elevated arsenic concentrations in excess of their respective freshwater and marine water acute and chronic criteria occur in both the shallow, fill aquifer and the deep, alluvial aquifer. Arsenic concentrations generally are highest in the alluvial aquifer. Although slag and upland fill material may act as a limited source of metals to lowland groundwater, it appears that an additional local source in the lowland area may be responsible for the elevated arsenic, cadmium, and lead levels. Further delineation of the groundwater plumes and aquifer characteristics will require more study.

The household dust sampling effort was very limited in scope and there are no standard methods for collection of household dust samples. With the exception of one location, household dust did not contain detectable amounts of arsenic and lead.

MTCA Risk Assessment

The risk assessment focused on calculating health risks and presenting cleanup levels according to MTCA (WAC 173-340-700 and 173-340-708) for selected chemicals in the residential study area. Former smelter-related chemicals may affect ecological and human receptors in the Snohomish River and lowland areas downgradient of the site if chemicals have migrated to these areas; however, these areas require further study before they can be evaluated.

Based on a screening of maximum soil concentrations, antimony, arsenic, cadmium, lead, mercury, and thallium were selected as chemicals of potential concern for setting cleanup levels. Health-based screening of groundwater indicated that chemicals in groundwater in the residential area are unlikely to be a health concern; however, arsenic, cadmium, copper, lead, and zinc exceeded screening concentrations in groundwater samples from wells in the lowland area. Using a conservative screening of maximum surface water concentrations, arsenic, cadmium, and lead may also be a potential health concern in surface water puddles in the residential area. Lead concentrations in house dust did not exceed screening concentrations. Arsenic concentrations were also low although no screening criteria are available for arsenic in house dust.

As directed by the Department of Ecology, health risks were calculated for arsenic and non-carcinogenic health hazards were calculated for cadmium. Risks and hazards in excess of a background U.S. cancer risk of one chance in three (3×10^{-1}) were calculated using MTCA Method B equations for a child's exposure to soil (WAC 173-340-740). Risks for arsenic range from 5×10^{-6} (a 5-in-a-million chance of developing skin cancer) at a soil concentration of 7 ppm, which is the natural background concentration for arsenic, up to 0.5 (5 chances in 10 of developing cancer) at 720,000 ppm, the maximum soil arsenic concentration, which was located at depth. The maximum concentration in the "peripheral" area of 994 ppm corresponds to a health risk of 7×10^{-4}. All risk estimates exceed MTCA's target risk goal of 1×10^{-6} for a chemical. By comparison, the lowest site soil concentration possibly corresponding to an arsenic dose associated with health effects in the scientific literature was 2,000 ppm for non-carcinogenic skin effects. No studies showing health effects from doses corresponding to an arsenic soil exposure of less than 2,000 ppm were found.

Health hazards from cadmium are expressed as a "hazard quotient" and range from 0.01 to 2.9 for the soil concentration range found at the site of < 1 ppm to 230 ppm. At a hazard quotient of 1.0, the estimated dose equals the upper dose associated with no adverse health effects. MTCA's target hazard goal for non-carcinogenic chemicals is 1.0.

Cleanup levels for the chemicals of concern are as follows:

Chemical	**Soil Cleanup Level (ppm)**	**Source**
Antimony	32	Method B
Arsenic	7	Background
Cadmium	2	Method A (protects plants)
Lead	250	Method A (no Method B level)
Mercury	24	Method B
Thallium	6	Method B

All these chemicals exceed cleanup levels in the area of the former smelter. Arsenic, cadmium, and lead also exceed cleanup levels in the "peripheral" area. No data are available on concentrations of the other metals in the "peripheral" area.

GLOSSARY OF TERMS AND ACRONYMS

Action Level: MTCA recognizes that certain remedies which leave hazardous substances on a site in excess of cleanup levels (see further) may qualify as a cleanup action as long as the conditions outlined in WAC 173-340-700(7)(i) are met. The concentration at which such remedial actions are implemented, is called the action level. These remedial actions in combination with institutional controls (see further) must be protective of human health and the environment.

Aquifer: A geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs.

Area Background: The concentration of a hazardous substance that is consistently present in the environment in the vicinity of a site which is the result of human activities unrelated to releases from that site.

Arithmetic Mean: The sum of all the measurements in a data set divided by the number of measurements in the data set.

Average: See "Arithmetic Mean".

Bioavailability: Biological Availability. The fraction of a substance that can get into the body and potentially cause toxic effects.

Blank: A volume of deionized water that is submitted to the laboratory to identify contamination which is the result of sample handling in the field or laboratory.

Cleanup Level: The concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions. Concentrations above this level trigger remedial actions.

Coefficient of Variation: The standard deviation divided by the mean.

Contour Line: See "Iso-concentration Line".

Correlation Coefficient: A number which indicates the degree of dependence between two variables. Varies between 0 (no correlation) and ± 1 (perfect correlation).

Dangerous Waste: Solid waste designated in WAC 173-303-070 through 173-303-103 as dangerous or extremely hazardous waste.

Detection Limit: The lowest level of a chemical that can be measured.

Dissolved Metals: Analytes that have not been digested prior to analysis and which will pass through a 0.45µm filter.

Duplicate Sample: A second aliquot of a sample that is treated the same as the original sample in order to determine the precision of a sampling and/or analytical method.

Environmental Medium: A category of material found in the physical environment that surrounds or contacts organisms (e.g., surface water, groundwater, soil, or air).

Exposure: Contact of a chemical, physical, or biological agent with the outer boundary of an organism. Exposure is quantified as an average daily dose of chemical in an environmental medium over the period of exposure.

Exposure Pathway: The mechanism or physical course by which chemicals migrate from their source or point of release to the population at risk.

Exposure Route: The point and means by which a chemical enters the body. Examples of exposure routes are inhalation into the lungs, oral ingestion and absorption in the gastrointestinal tract, and absorption of chemicals across the skin.

Extremely Hazardous Waste: Dangerous waste designated in WAC 173-303-070 through 173-303-103 as extremely hazardous.

Geometric Mean: The nth root of the product of n values. Also, the exponential function of the mean or expected value of the natural logarithm of a variable.

Groundwater: Water in a saturated zone or stratum beneath the surface of land or below a surface water.

Institutional Control: A measure undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the site.

Iso-concentration Line: A line connecting, on a map, the estimated locations where the soil concentration is the same. Each iso-concentration line represents a soil concentration. Areas between two iso-concentration lines have soil concentrations which are between the upper and lower iso-concentration line.

Lognormal Distribution: A probability distribution which is symmetric around the mean and has a bell-shaped appearance following a logarithmic conversion.

Median: The middle value in a data set such that half the values are greater and half are less.

MCL: Maximum Contaminant Limit. The federally regulated maximum amount of a chemical allowed in drinking water.

MTCA: Model Toxics Control Act. In March of 1989, a citizen-mandated toxic waste cleanup law went into effect in Washington State. Passed by voters as Initiative 97, this law is known as the Model Toxics Control Act, Chapter 70.105D RCW.

Natural Background: The concentration of a hazardous substance consistently present in the environment which has not been influenced by localized human activities.

Normal Distribution: A probability distribution which is symmetric around the mean and has a bell-shaped appearance. Also: Gaussian distribution.

Percentile: The value where a certain percentage of a population or group have measurements less than this value. One of 100 equal consecutive groups arranged in order of magnitude (therefore, the 75th percentile is the amount which is greater than 75 percent of the population or group and less than 25 percent of the population).

RI/FS: Remedial Investigation and Feasibility Study. Characterization of the nature and extent of chemicals of concern at a particular site, and evaluation of possible means for remediation of the site if necessary.

Risk: The likelihood of adverse health or environmental effects. Risks are evaluated separately for carcinogenic and noncarcinogenic effects. Carcinogenic risks are an incremental chance in addition to background risks of developing cancer in a lifetime. Noncarcinogenic hazards are assessed by evaluating whether site exposure exceeds a reference dose at and below which no health effects are expected.

Sample: A small part of anything or one of a number intended to show the nature or quality of the whole. Exposure-related measurements are usually samples of environmental media, or biological tissue or fluid that are analyzed for chemical content.

Saturated Zone: The area below the water table in which all interstices are filled with water.

Soil: A mixture of organic and inorganic solids, air, water, and biota which exists on the earth's surface above bedrock, including materials of anthropogenic sources such as slag, sludge, etc.

Solid Waste: Any discarded material that is not excluded by WAC 173-303-017(2) or that is not excluded by variance granted under WAC 173-303-017(5).

Split Sample: A second aliquot of a sample that is submitted to a different laboratory than the original sample in order to determine the precision of a sampling and/or analytical method.

Standard Deviation: Represents the spread of a population around the mean. Defined as the square root of the variance.

Surface Water: Lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the state of Washington or under the jurisdiction of the state of Washington.

TCLP: Toxicity Characteristic Leaching Procedure. A leaching test used for designating a solid waste as a Dangerous Waste or an Extremely Hazardous Waste.

Total Metals: Analyte elements which have been digested prior to analysis.

Unsaturated Zone: The zone between the land surface and the water table.

Variance: The average squared devation of all possible observations from the population mean.

Measurement Abbreviations

cfs	cubic foot per second
cm^2	square centimeter
cm^3	cubic centimeter
day-ug-kg	day - microgram - kilogram
days/week	days per week
days/year	days per year
g	gram
g/cm^3	grams per cubic centimeter
g/day	grams per day
g/kg	grams per kilogram
$g/m^2/year$	grams per square meter per year
kg	kilogram
kg/mg-day	kilograms per milligram - day: also $(mg/kg/day)^{-1}$
kg/day	kilograms per day
L	liter
l	liter
L-mg	liter - milligram
L/day	liters per day
l/day	liters per day
L/m^3	liters per cubic meter
L/ug	liters per microgram
m^2	square meter
m^3	cubic meters
m^3/day	cubic meters per day
$m^3/kg\text{-}day$	cubic meters per kilogram - day
m^3/ug, $m^3/\mu g$	cubic meters per microgram
mg	milligrams
mg/cm^2	milligrams per square centimeter
mg/day	milligrams per day
mg/kg	milligrams per kilogram (equal to ppm)
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter (equal to ppm)
mg/m^3	milligrams per cubic meter
mg/ug	milligrams per microgram

mL	milliliter
ppb	parts per billion
ppm	parts per million
ug, µg	micrograms
ug/dl, µg/dl	micrograms per deciliter (of blood)
ug/g, µg/g	micrograms per gram (equal to ppm)
ug/kg, µg/kg	micrograms per kilogram (equal to ppb)
ug-kg-day	micrograms - kilogram - day
ug/L, µg/L	micrograms per liter (equal to ppb)
ug/l	micrograms per liter
ug/mg, µg/mg	micrograms per milligram
ug/m^2/sec	micrograms per square meter per second
ug/m^3, µg/m^3	micrograms per cubic meter

REMEDIAL INVESTIGATION
EVERETT SMELTER SITE

1.0 INTRODUCTION

ASARCO Incorporated (Asarco) commenced a Remedial Investigation/Feasibility Study (RI/FS) for the Everett Smelter Site, following issuance of Enforcement Order No. DE 92TC-N147 by the Washington State Department of Ecology (Ecology) on April 20, 1992. The RI/FS was conducted to satisfy the requirements of Chapter 173-340 WAC. On March 18, 1994, Ecology issued the First Amended Enforcement Order, which included a Supplemental Scope of Work. Additional field investigations were conducted and an Interim Deliverable Report was completed in response to the Amended Order. All work, under both the original and amended orders, was conducted by Hydrometrics, Inc., on behalf of Asarco, with Ecology providing oversight. This report summarizes the RI, and includes an FS as well as a Risk Assessment (RA) prepared by Kleinfelder, Inc.

The objective of the Remedial Investigation was twofold:

- Characterize the nature and extent of chemicals of concern in on-site media;
- Acquire sufficient information to develop a range of appropriate remedial actions for the site.

During the RI effort, it was determined that the site should be divided into two separate units based on distinctly different characteristics and associated environmental concerns: the residential area on the bluff and the industrial area in the lowlands adjacent to the Snohomish River. Due to the enhanced complexity of the lowlands area relative to the residential area, and Ecology's determination that the residential area should be addressed first, it was decided to continue investigating the former unit while essentially completing the Remedial Investigation for the residential area. This decision was embodied in Ecology's First Amended Enforcement Order. Therefore, although this report addresses both the residential area as well as the lowland, the detail provided for the residential area is much greater than that for the lowland. Both the FS and RA also apply primarily to the residential area.

1.1 SITE DESCRIPTION

The Everett Smelter Site Study Area* is located in northeast Everett, Washington (Figure 1-1). The majority of the site is situated on a steep bluff that faces northeast, overlooking the Snohomish River. The site extends easterly over the hillside and includes a small portion of the river flats west of the Burlington Northern railroad tracks. The Snohomish River flows west at the base of the hill, and enters the Puget Sound approximately 1 mile west. The general topography of the area is shown on Sheet 1-1. Other than runoff during periods of precipitation, no surface water features exist on the upland portion of the site. In the lowland, a drainage ditch system contains water throughout the year, with marshy conditions arising during the wet season.

As shown on Figure 1-2, the Phase I soil study area covered an area of approximately 62 acres. During Phase II, an additional 98 acres were investigated for a total of approximately 160 acres. Also, soil samples were collected from public use locations (e.g., daycares, playfields, schools). This area, along with the lowland area, covered approximately 300 acres.

The number of residential units in the Phase I area is approximately 190. During the Phase II investigation, the study area was expanded to include an additional 250 residential units for a total of approximately 440. Many of the residential units consist of duplexes or apartment buildings with multiple occupancy. Also included in the study area are a small number of commercial establishments, a school, public parks, and a golf course.

Sheet 1-1 shows Asarco-owned property, residential property, commercial property, City of Everett right-of-ways, State of Washington right-of-ways, parks, and schools. The information on land use was correct as of the date of completion of this document. However, due to the transient nature of land use, the information presented on Sheet 1-1 needs to be verified when used at a later date.

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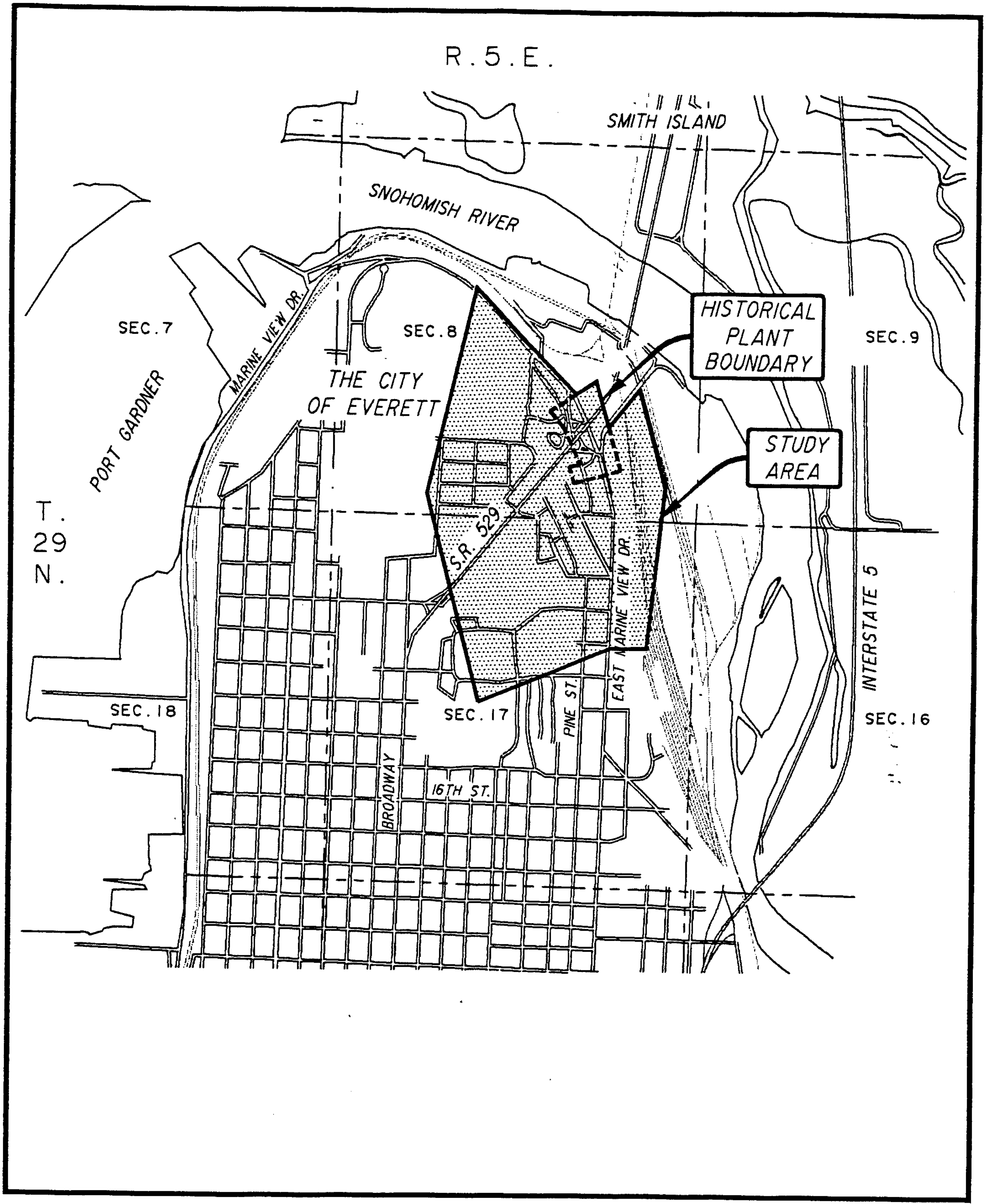
* The term "study area" encompasses the entire area in which samples were collected pursuant to the Enforcement Order. The term "site" is used synonymously throughout this document. However, Ecology has not yet made a determination as to the boundaries of the site.



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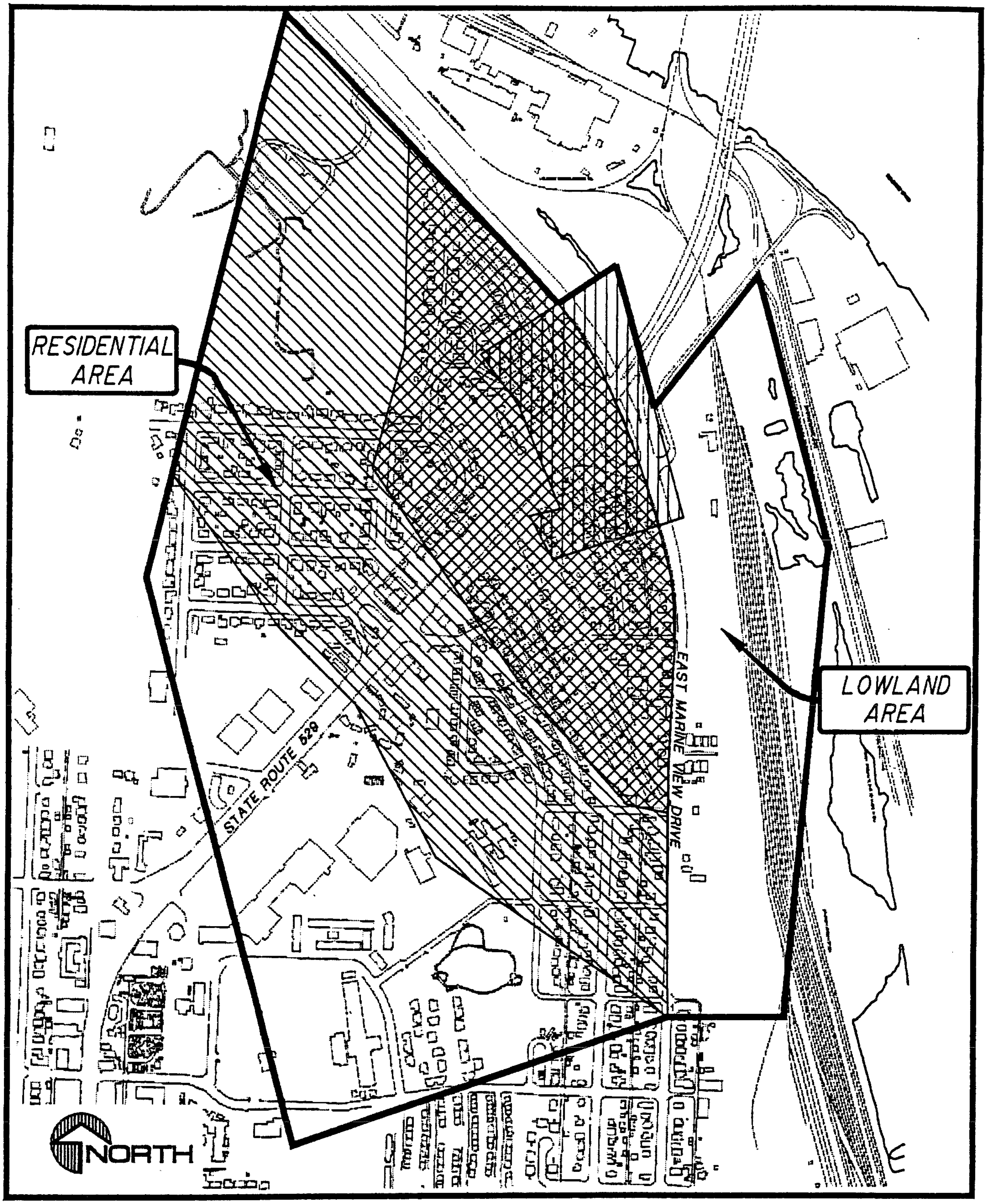
NORTH

Location of Study Area
Figure 1–1



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LEGEND

▨ Phase I Study Area (62 Acres)

▧ Phase II Study Area (160 Acres)

▥ Historic Plant Boundary (19 Acres)

— Total Study Area (300 Acres)

Study Area
Figure 1-2

1.2 SITE HISTORY

Because of the potential ramifications with regard to the nature and extent of the metals distribution, the history of the Everett Smelter Site was investigated extensively. The following sources were used to provide historical information relevant to the site:

- ASARCO Incorporated Archives. All documents stored in archives in Asarco's New York office that were relevant to the site were reviewed. The information found in these archives largely consisted of property transfer documents evidencing the purchase and subsequent sale of real estate at the Everett Smelter Site, along with a few historical maps and a report regarding mining engineering. In addition, a complete review of archives at the Tacoma Smelter Site was performed, which yielded some property maps including slag pile locations and Tacoma Plant ledgers describing the closure of the Everett Smelter and the consolidation of the arsenic operations. Finally, a microfilm search was conducted of all corporate minutes and documents for any references to the Everett Smelter. Very few were found, and none were of any relevance.
- Washington Department of Transportation (DOT) Archives. Pursuant to a request filed under the Washington Public Information Act, DOT produced all documents relevant to the interchange at Broadway and East Marine View Drive. Only a few documents were located, mostly related to construction of the interchange in the 1950s.
- City of Everett Records. A search of permitting files at the City of Everett was conducted, but the City claimed that it did not have records dating back far enough to provide useful information.
- Everett Museum of History. Historical records were reviewed, although nothing of relevance was identified.
- Everett Herald. Using microfilm, the Everett Herald was reviewed from 1893 to 1903. Although a lot of anecdotal information was produced, nothing of particular relevance was located. This search was very time-consuming, and was discontinued at the 1903 edition because of its limited usefulness.
- City of Everett Public Library. Four treatises located at the library were reviewed for relevant information: History a Snohomish County (William Whitefield); Monte Cristo (Philip R. Woodhouse); The Everett and Monte Cristo Railway (Dr. David A. Cameron, and Historical Survey of the Everett Shoreline. Although interesting, the information contained in these works did not pertain to the Remedial Investigation.
- Public Records Review. In addition to the above, the following public repositories were contacted in an effort to determine the availability of file documentation: U.S.

Environmental Protection Agency, Region X (yielded no relevant information); Washington Department of Natural Resources (yielded information relevant to the Monte Cristo Mines only); Snohomish County Health District (yielded no new information); Snohomish County Clerk's Office (yielded no new information); Washington Secretary of State (yielded corporate information, but nothing relevant to the Remedial Investigation).

- Miscellaneous. Two Sanborn Insurance maps were located depicting the smelter location in 1916. In addition, Weyerhaeuser and Burlington Northern company records were searched for historical information but provided little of relevance.

Using all information available from the various sources mentioned above, the history of the Everett Smelter Site was reconstructed as follows:

Construction of the smelter in Everett began in 1892, when the site was purchased by the Puget Sound Reduction Company (PSRC) from the Everett Land Company. This construction was prompted by the discovery of ore deposits in the Cascade mountains of a sufficient size and grade to warrant the development of Everett as a smelting and refining center. The complex, consisting of a sulfide mill, two roasters to remove arsenic, ore bunkers, a dust chamber, a sample building, a furnace house, and an engine house, became operational in 1894 (Woodhouse, 1979). The smelter refined ores from nearly all existing mines in the Northwest. Its main supplier was the Monte Cristo district east of Everett, but, in order to maintain production, additional ore arrived from British Columbia, Montana, Idaho, Oregon, and overseas. The raw material consisted of ores containing lead, silver and gold. The smelter's products were refined lead and Doré bars, a mixture of gold and silver (bullion). Records indicate that the smelter operations were very intermittent.

The local ores were high in arsenic (up to 27%). With the increasing demand for arsenic as an insecticide and industrial agent, PSRC installed an arsenic extraction plant at the smelter in 1898.

In 1901, the smelter was expanded once more to treat larger volumes of the arsenic-containing ores. Arsenic production in 1902 was 1353 tons. In August 1903, the smelter was sold to the Federal Mining & Smelting Company (FMSC). Subsequently, the Everett smelter changed hands from FMSC to the American Smelting and Refining Company (Asarco). The smelter was closed temporarily until March 1904, when the reconditioned smelter was started up by Asarco. As time went by, Asarco consolidated its operations. Doré bars were sent to other Asarco smelters, and the Everett lead operation closed in February 1908. From May 1904 to January 1908, 119,495 tons of ore had been smelted, and 30,733 tons of lead had been produced. Despite closure of the lead smelting operations, the arsenic extraction facility continued to handle ores rich in arsenic. In February 1912, the arsenic roasting plant in Everett shut down and dismantling began, with much of the arsenic plant's machinery contributing to the construction of a new arsenic production facility at the Tacoma smelter. The stacks were toppled in 1915 for salvage of the bricks, and two years later the buildings were moved to the Norwegian-Pacific shipyards to house machinery.

The smelter property covered an area of approximately 26 acres, 19 of which were occupied by the actual plant. Sheet 1-2 shows the 1913 smelter layout superimposed on current topography. Sheet 1-3 is a section of the actual 1913 map, which was recovered from the Asarco archives. As Sheet 1-2 indicates, the flues covered a large portion of Pilchuck Path, with the twin stacks being located near 511 Hawthorne Street. The arsenic kitchens and arsenic dust chambers were situated between Pilchuck Path and the alley. The arsenic bins, arsenic ovens, and arsenic mill were located in the vicinity of 520 and 528 East Marine View Drive. Ore storage and roasting took place on the current location of the southern portion of the highway cloverleaf. The lead refinery and arsenic storage building occupied its northern portion.

Asarco sold the property through a series of transactions in the 1920s. A large parcel was sold to Charles Spreisterbach, who subsequently developed the area for residential use. Homes were built on the site through the 1930s and 1940s, and the area has been used for residential purposes since. Presently, the 19-acre area includes a highway interchange at East Marine View Drive and State Route 529, and the residential area (Sheet 1-2). A major road interchange of East Marine View Drive and State Route 529 was constructed in 1956, covering a significant portion of the former smelter site.

1.3 REGIONAL GEOLOGY AND HYDROGEOLOGY

The Everett Smelter Site Study Area is located on a bluff at the northern boundary of the City of Everett overlooking the lowlands of the Snohomish River flood plain. The site includes the residential area on the bluff as well as the lowland area.

The regional geologic setting has been described by the USGS (Maps MF-1748 and MF-1743, Minard, 1985a,b). Late Pleistocene glacial deposition formed the upland areas in northern Everett between 20,000 and 13,000 years ago. The geology of these upland areas consists of glacial till, underlain by advance outwash sediments. The advance outwash is a thick section of pebbly sand, deposited by melt water in braided streams in front of the advancing glacier. In addition to the pebbly sand, fine-grained sands and silts may be present in the lower part of the deposit, as well as coarse channel deposits cutting into the outwash material, resulting in a complex stratigraphy. The advance outwash may be as thick as 300 feet. It is an excellent source of clean sand, and is one of the thickest and most extensive aquifers in the region (Minard, 1985a,b).

The advance outwash is overlain by glacial till in the upland area in the vicinity of the site. This till is a non-sorted, compacted mixture of clay, silt, sand, pebbles, cobbles, and boulders, with a thickness ranging from 3 to 60 feet. It was deposited directly by the advancing ice, which was up to 1000 meters thick. Compaction of the sediments by the ice resulted in very dense material, which is described by the USGS as a "concrete-like sediment". Mineralogically, both till and advance outwash are very similar, and may contain a wide variety of rock types such as granite, diabase, basalt, sandstone, shale, conglomerate, and quartzite. Due to its hardpan nature, infiltration into the till is very limited, and where it occurs, internal drainage is poor. Locally, water may percolate into the weathered, upper 3 to 6 feet of the till, but the density of the till at greater depths restricts further vertical infiltration. This may result in perched water table conditions that persist for the wetter part of the year. The till is capable of maintaining a steep slope, a feature present at the site. In most cases, it is directly underlain by the advance outwash, but transitional beds may exist (Minard, 1985a,b).

Locally, the glacial till is overlain by anthropogenic fill material. Its composition and thickness vary widely depending on location and origin. Within the footprint of the former smelter, the fill primarily consists of gravely sand, crushed rock, and demolition debris. Surface soils generally have been altered by use of sod and topsoil, as well as horticultural activities such as tilling and application of fertilizers and pesticides.

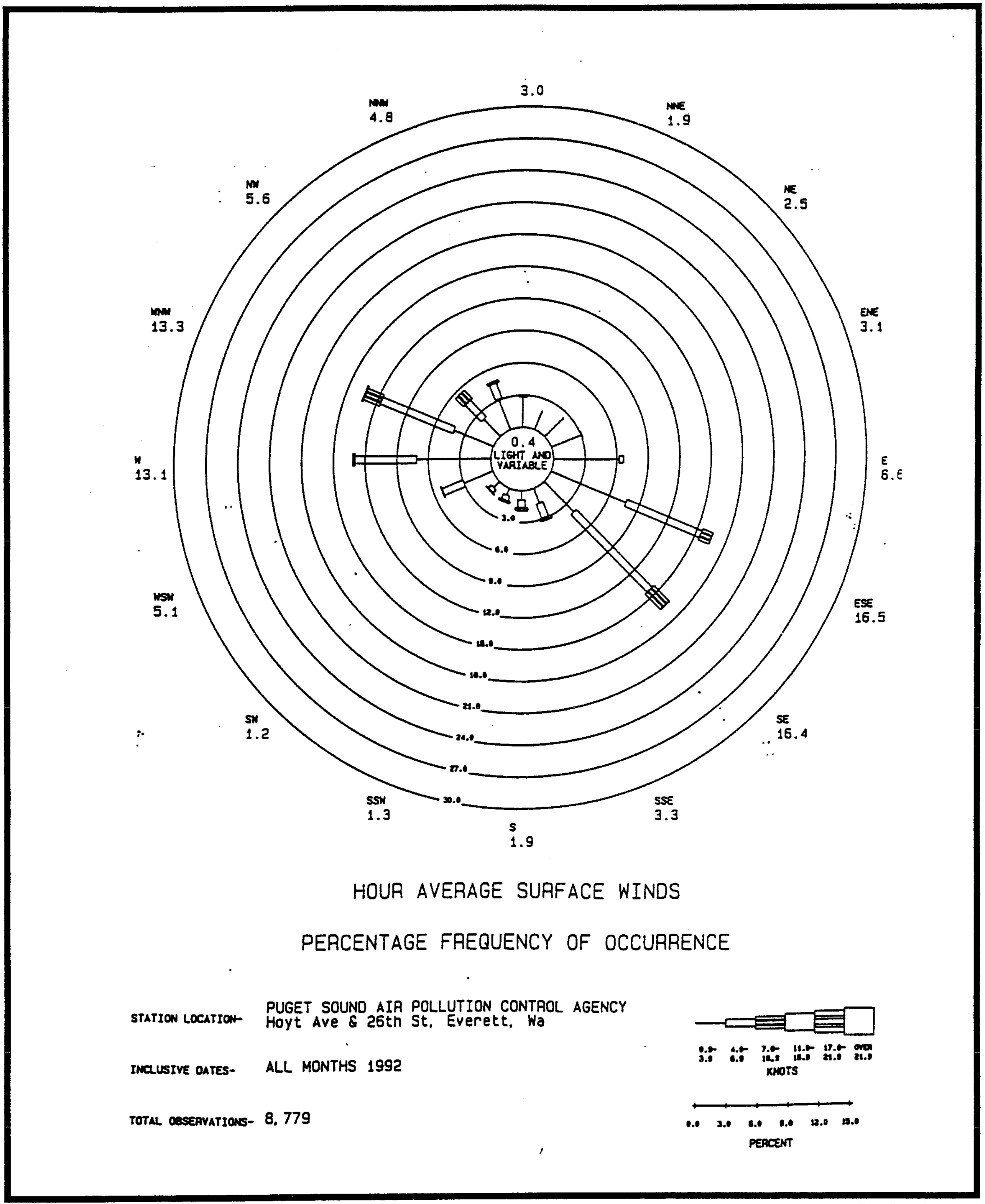
The lowland geology is characterized by the presence of Holocene alluvial and estuarine deposits associated with the Snohomish River. These deposits mainly consist of interfingering sequences of sand, silt, and clay, with considerable amounts of organic matter. The thickness of the alluvial and estuarine deposits probably exceeds 90 feet (Minard, 1985a,b). Hydrogeologic investigations conducted at various Weyerhaeuser facilities in the lowland area describe a relatively consistent stratigraphic sequence. Alluvial sands and gravel are overlain by a laterally extensive layer of estuarine/wetland silt containing abundant organic matter. The silt layer is typically 6 to 12 feet thick, but may be thinner locally. The silt is overlain by surface fill. The surface fill in the lowland area consists of grade fill underlain by dredged fill. The grade fill can be comprised of gravely sand, crushed rock, or bark. The dredged fill consists of fine to coarse sands from the Snohomish River. The average thickness of the grade fill and dredged fill is approximately 3 and 9 feet, respectively.

The occurrence and movement of groundwater on the site is dictated by the distribution and properties of the glacial upland and alluvial/estuarine deposits. Within these groundwater systems, glacial outwash deposits and Snohomish River alluvial deposits form the main groundwater migration routes, whereas less permeable glacial till and estuarine silt act as barriers to vertical and horizontal groundwater flow. Regional groundwater flow directions are towards the Snohomish River in both the upland and the lowland areas.

1.4 CLIMATE

The climate of the study area is maritime, moderated and controlled by the proximity of the Pacific Ocean and the Cascade and Olympic mountain ranges. Winter temperatures generally remain above freezing, and summer temperatures generally remain below 80°F. The average annual temperature ranges between 40 and 60°F.

Average annual precipitation in the area is approximately 38 inches, with approximately 25 inches falling between October and March (NOAA, 1992). August is the driest month of the year, and December the wettest. Evapotranspiration is approximately 10 inches per year. A search for meteorological stations in the vicinity of the study area (including those on Weyerhaeuser property), revealed that the station closest to the site is located at Hoyt Avenue and 26th Street, approximately 2.5 miles southwest of the study area. A representative annual wind rose for 1992 from this station is provided in Figure 1-3 (PSAPCA, 1992). Although local wind directions on the site may vary depending on the immediate topography, the data show that the dominant wind direction as measured in central Everett is from southeast to east-southeast, with secondary winds from west-northwest to west. Wind speeds generally do not exceed 10 knots, with average wind speeds ranging from approximately 4 to 7 knots.



HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION-	PUGET SOUND AIR POLLUTION CONTROL AGENCY Hoyt Ave & 26th St, Everett, Wa
INCLUSIVE DATES-	ALL MONTHS 1992
TOTAL OBSERVATIONS-	8, 779

5/25/94

Wind Rose Data for
1992, Everett
Figure 1–3

1.5 PREVIOUS INVESTIGATIONS

1.5.1 Introduction

The site and its surrounding areas have been studied extensively by a number of investigators for a variety of different purposes. This section contains brief summaries and data compilations of studies performed prior to the current RI/FS activities undertaken by Hydrometrics. Information presented in the tables is limited to data that are thought to be pertinent to the current study area. Sheet 1-4 shows the soil and groundwater sampling locations for the previous studies.

In chronological order, documents which contain information relevant to the site include:

- Hydrogeologic Investigation Demolition Landfill, Everett Kraft Mill, and Hydrogeologic Investigation Weyerhaeuser Landfill, Everett Kraft Mill (Technical Addendum) (Sweet-Edwards/EMCON, March and November, 1988)
- Groundwater Monitoring at Weyerhaeuser's Demolition Landfill, Everett, Washington - First Quarter 1987 through Fourth Quarter 1989 (Sweet-Edwards/EMCON, June, 1990)
- Model Toxics Control Act Site Discovery Report (Hart Crowser, October, 1990)
- Weyerhaeuser New Mill Access (GeoEngineers, October, 1990)
- Unpublished Data (Ecology, December, 1990)
- Phase Ic Site Characterization Report, Weyerhaeuser-Everett Mill E Site, Everett, Washington (Hart Crowser, March, 1991)
- Final Report for the Everett Slag Site, Everett, Washington (SAIC, June, 1991a)
- Household Dust Sampling, Everett Smelter Site (Washington Department of Health/Snohomish Health District, October, 1991)
- Unpublished Data (SAIC, 1991b)
- Interim Actions Summary Report Everett Smelter Site, Everett, Washington (Hydrometrics, November, 1992b)
- Preliminary Results Environmental Audit, Proposed Northeast View Park, Everett, Washington (Dames & Moore, January, 1993)
- Interim Deliverable Report Remedial Investigation/Feasibility Study Everett Smelter Site (Hydrometrics, April, 1994)
- Mill E Split Sampling (EMCON, March, 1995)

1.5.2 Description of Previous Investigations

Hydrogeologic Investigation Demolition Landfill, Everett Kraft Mill, and Hydrogeologic Investigation Weyerhaeuser Landfill, Everett Kraft Mill (Technical Addendum) (Sweet-Edwards/EMCON, March and November, 1988)

Sweet-Edwards/EMCON conducted a hydrogeologic investigation of the demolition landfill on the Weyerhaeuser Everett Kraft Mill property in January-September, 1987, and August-October, 1988. The landfill was operated from approximately 1952 to 1986. Fill material included bricks, wooden boards, wood chips, sawdust, lime, and miscellaneous metal debris.

To determine the potential impact of the landfill on surface water, groundwater, and soil quality, 19 test pits were excavated, 23 soil borings were drilled, and 9 monitoring wells plus 8 piezometers were installed. Six piezometers (P-1 through P-6) and monitoring wells MW-1 through MW-6 were completed in the shallow aquifer, consisting of fill material and alluvial sands. Piezometers B-1 and B-2, and wells MW-7 through MW-9 were installed in the deep aquifer underlying the silt aquitard separating the two groundwater regimes. The deep aquifer is also comprised of alluvial sands.

Six soil samples were collected from four test pits. Seven groundwater sampling rounds were completed, with most monitoring wells and piezometers being sampled several times. Also, the quality of surface water runoff was evaluated using water in the collection ditch north of the landfill. Samples were analyzed for a wide variety of parameters.

Table 1-1 presents arithmetic means for metal concentrations and pH obtained in groundwater samples collected during seven sampling events prior to October 1988. Table 1-2 presents metal concentrations and values for pH in soil samples collected from test pits. Table 1-3 presents metal concentrations and values for pH in surface water runoff from the demolition landfill.

TABLE 1-1 ARITHMETIC MEAN METAL CONCENTRATIONS IN GROUNDWATER SAMPLES PRIOR TO OCTOBER 1988, SWEET-EDWARDS/EMCON (1988)

Sampling Location	**MW-1**	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**MW-6**	**MW-7**	**MW-8**	**MW-9**
Arsenic	0.013	0.020	0.148	0.007	0.01	2.99	0.03	0.006	0.214
Chromium	<0.005	<0.005	0.371	<0.005	0.016	0.964	0.143	0.042	0.036
Lead	0.005	0.004	0.006	0.006	0.003	0.77	0.044	0.007	0.002
Mercury	<0.0001	0.004	0.0012	<0.0001	<0.0003	0.013	0.0006	<0.0002	0.0009
pH	6.6	6.7	11.4	6.5	6.7	11.9	7.0	6.6	10.2
	P-1	**P-2**	**P-3**	**P-4**	**P-5**	**P-6**			
Arsenic	0.004	0.027	0.003	0.042	0.006	0.029			
Chromium	<0.005	<0.005	<0.005	0.013	<0.005	<0.005			
Lead	<0.003	<0.003	<0.003	<0.003	<0.003	0.004			
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			
pH	6.4	6.0	6.1	6.9	7.0	6.7			

Values are in ppm

TABLE 1-2 METAL CONCENTRATIONS SOIL, SWEET-EDWARDS/EMCON (1988)

Sample Location	**TP-14**	**TP-15**	**TP-16**	**TP-17**	**TP-17**
Sample Depth (ft)	11-12	0-5/8-9.5	0-11.5	0-9	9-10
Sample Material	Background Soil	Fill	Fill	Fill	Native Soil
Arsenic	6	5	6	5	7
Barium	41	80	270	124	31
Chromium	32	14	18	38	23
Copper	27	9	25	26	16
Mercury	0.06	ND	ND	ND	ND
Nickel	44	10	16	23	23
Lead	8	19	14	12	3
Zinc	39	73	70	145	45
pH	7.9	12.4	12.5	12.4	10.0

ND - Not Detected
Values are in ppm

TABLE 1-3 METAL CONCENTRATIONS SURFACE WATER RUNOFF, SWEET-EDWARDS/EMCON (1988)

Total Metals	**Sampling Date**	
(ppm)	**12/19/86**	**03/25/87**
Arsenic	0.135	0.272
Barium	n/a	0.052
Chromium	0.026	0.555
Copper	0.048	n/a
Lead	0.019	0.008
Mercury	0.0008	0.002
Nickel	0.065	n/a
Zinc	0.035	n/a
pH	n/a	12.1

n/a - not analyzed

Based on these results, it appeared that metal concentrations in landfill material and native soils were within ranges found in naturally occurring soils. The high values for pH observed in landfill material were attributed to the presence of lime waste. Surface water runoff from the landfill contained elevated levels of arsenic and chromium. The high pH was again thought to be related to the presence of lime waste in the landfill. The groundwater data showed that shallow wells MW-3 and MW-6 and deep well MW-9 contained elevated levels of arsenic. In all three wells, the pH was very similar to values for pH observed in the collection ditch and in landfill soils. Their proximity to the collection ditch suggested that the ditch acted as a recharge source for the shallow aquifer. In addition, the presence of elevated arsenic levels in the deep aquifer at MW-9 indicated that the silt aquitard might be discontinuous where it truncates against the glacial deposits near the southern boundary of the landfill. Although, as mentioned, metal levels in the landfill were low, it was thought that the high pH of the landfill caused metals in the landfill to be very mobile.

Using contour maps of concentration distributions in groundwater, Sweet-Edwards/EMCON postulated that the groundwater plume moved slowly. Based on hydrologic information, the travel time for groundwater from the landfill to the Snohomish River was calculated to be approximately 4 years. Since the landfill had been in operation for over 30 years, and since no metals plume extended to the river, they concluded that significant attenuation occurred downgradient from the landfill. Consequently, the landfill was not considered to have an adverse effect on water quality in the Snohomish River.

Groundwater Monitoring at Weyerhaeuser's Demolition Landfill, Everett, Washington - First Quarter 1987 through Fourth Quarter 1989 (Sweet-Edwards/EMCON, June, 1990)

Sweet-Edwards/EMCON presented summary groundwater quality tables to Weyerhaeuser in June, 1990. The report contained the results of the quarterly groundwater monitoring effort at the demolition landfill on the Weyerhaeuser Everett Kraft Mill property. No data interpretation was given.

Table 1-4 presents arithmetic means for metal concentrations and pH obtained in groundwater samples collected during five sampling events from October 1988 to December 1989. A comparison between Table 1-1 and Table 1-4 shows that the mean metal concentrations in groundwater for the periods prior to and after October 1990 are similar. Therefore, it is reasonable to assume that individual measurements have not varied significantly over that time period. The exception is MW-9, which showed dramatically lower arsenic concentrations combined with a significant decrease in pH.

TABLE 1-4 ARITHMETIC MEAN METAL CONCENTRATIONS IN GROUNDWATER SAMPLE COLLECTED AFTER OCTOBER 1988, SWEET-EDWARDS/EMCON (1990)

Sampling Location	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**MW-6**	**MW-7**	**MW-8**	**MW-9**
Arsenic	0.020	0.108	0.006	0.006	2.05	0.008	<0.003	0.011
Chromium	<0.005	0.404	<0.005	0.011	0.397	0.012	0.006	<0.005
Lead	<0.003	<0.003	<0.003	0.004	<0.003	0.003	<0.003	<0.003
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.0038	0.0003	<0.0002	<0.0002
pH	6.5	10.6	6.1	6.8	11.7	6.8	6.4	8.4
	P-1	**P-2**	**P-3**	**P-5**	**P-6**			
Arsenic	<0.002	0.017	<0.003	<0.003	0.026			
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005			
Lead	<0.003	<0.003	<0.003	<0.003	<0.003			
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002			
pH	6.3	6.0	6.0	6.7	6.5			

Values are in ppm

Model Toxics Control Act Site Discovery Report (Hart Crowser, October, 1990)

Hart Crowser conducted an evaluation of the Weyerhaeuser Mill B property in May, 1990, for the Weyerhaeuser Corporation. The Mill B site is located east of the Everett Smelter Site Study Area and extends to the Snohomish River (Sheet 1-4). The report focuses on the "slag area", an area discovered around the slag outcrop on the hillside below the Weyco-Everett Kraft Mill access road and extending to the Burlington Northern (BN) railroad tracks.

Based on five soil borings (AB-3 through AB-7) and boring B-1 by GeoEngineers (1990), Hart Crowser concluded that fill material ranged in thickness from 8 feet near the BN tracks to 50 feet along the shoulder of the Kraft Mill access road. The fill material mainly consisted of sand and gravel and contained significant amounts of slag. Based on the borings, the area containing elevated metals was estimated to be approximately 200 square feet. However, the volume of fill extending beyond the Weyerhaeuser property was thought to be well in excess of 50,000 cubic yards.

A total of 22 subsurface soil samples was collected at depths from 2.5 to 11.5 feet. Three surface soil composite samples and two slag samples were submitted for analysis as well. The samples were analyzed for total arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. Thirteen samples, including two slag samples, were submitted for the Toxicity Characteristic Leaching Procedure (TCLP) and the Extraction Procedure Toxicity (EP Tox) test. Groundwater samples were collected from monitoring well WP-1 (Sheet 1-4) in May and July, 1990. The samples were analyzed for total and dissolved metals. The well log for monitoring well WP-1 can be found in Appendix F.

Table 1-5 presents total metal concentrations and TCLP and EP Tox metals results for soil and slag. Based on these data, Hart Crowser concluded that arsenic and lead were not derived from the same source. Instead, it was suggested that elevated lead levels were caused by the presence of slag, whereas the source for arsenic might be an off-site deposit and/or prior releases of arsenic from the "slag area" soils. The TCLP results showed that the two slag samples and soil samples AB-4/S-1 and AB-6/S-1 exceeded the criterion for lead (5 ppm), and would be classified as a dangerous waste after excavation according to WAC 173-303-090(8)(c). The TCLP criterion for arsenic (5 ppm) was not exceeded. In groundwater, dissolved and total arsenic were detected at 0.71 ppm and 1.2 ppm, respectively (Table 1-6). These arsenic levels exceeded the federal drinking water standard of 0.05 ppm and marine acute and chronic criteria (0.069 and 0.036 ppm, respectively for trivalent arsenic).

Weyerhaeuser New Mill Access (GeoEngineers, October, 1990)

GeoEngineers conducted a geotechnical investigation for the Weyerhaeuser Paper Company along the embankment of the Weyerhaeuser Everett Kraft Mill access road (Sheet 1-4). They completed two soil borings to depths of 34 and 54 feet, respectively, and excavated two test pits to depths of 4.5 and 7 feet. The logs for these two borings can be found in Appendix F. In the deep boring (B-1) on top of the embankment, slag was encountered between 16 and 51 feet; in the shallow boring (B-2) at the toe of the slope, slag was found to a depth of 22 feet. In test pit TP-1, slag was not encountered. Test pit TP-2 contained slag between 6 and 7 feet. Soil samples collected were not analyzed.

TABLE 1-5 TOTAL, TCLP, AND EP TOX METALS RESULTS FOR SOIL, HART CROWSER (1990)

Sample Location	**Toe of Slag**	**Slag 1**	**AB-5 S-1**	**AB-5 S-2**	**AB-5 S-3**	**AB-5 S-4**	**AB-6 S-1**	**AB-6 S-2**	**AB-6 S-3**	**AB-6 S-5**	**AB-3 S-1**	**AB-3 S-3**
Sample Depth (ft)	Surface	Surface	2.4-4.0	5.0-6.0	7.5-8.5	10.0-11.5	2.5-4.0	5.0-6.0	7.5-9.0	12.5-14.0	2.5-4.0	7.5-8.5
Total Metals												
Arsenic	893	1,010	1,400	188	264	298	120	238	335	12	28	259
Cadmium	15	33	<1	<1	<1	<1	2	2	3	<1	<1	<1
Chromium	16	3	121	27	39	36	33	60	53	34	26	19
Copper	1,860	4,210	1,650	836	74	53	1,030	638	634	57	25	1,000
Mercury	0.14	0.1	<0.1	<0.1	0.2	0.2	0.1	<0.1	0.1	0.1	0.1	<0.1
Nickel	23	16	50	93	35	35	71	83	82	33	42	119
Lead	22,000	25,500	3,110	8,390	365	206	8,535	5,560	5,960	402	21	10,827
Zinc	59,100	106,000	16,900	8,970	571	454	30,400	7,500	5,750	497	61	6,970
TCLP Metals												
Arsenic	<0.2	<0.2	n/a	<0.1	n/a	n/a	<0.1	n/a	<0.1	n/a	n/a	<0.1
Barium	2.1	0.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cadmium	0.13	0.16	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chromium	<0.01	<0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mercury	<0.0005	<0.0005	n/a	<0.001	n/a	n/a	<0.001	n/a	<0.001	n/a	n/a	<0.001
Lead	9.1	54.1	n/a	4.0	n/a	n/a	12.6	n/a	1.0	n/a	n/a	0.3
Selenium	<0.2	<0.2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Silver	<0.01	<0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EP Tox Metals												
Arsenic	n/a	n/a	n/a	<0.1	n/a	n/a	<0.1	n/a	<0.1	n/a	n/a	0.1
Mercury	n/a	n/a	n/a	<0.001	n/a	n/a	<0.001	n/a	<0.001	n/a	n/a	<0.001
Lead	n/a	n/a	n/a	1.4	n/a	n/a	1.4	n/a	1.9	n/a	n/a	3.9

All values are in ppm
n/a - not analyzed

TABLE 1-5. TOTAL, TCLP, AND EP TOX METALS RESULTS FOR SOIL, HART CROWSER (1990) (Continued)

Sample Location	**AB-3 S-5**	**AB-4 S-1**	**AB-4 S-2**	**AB-4 S-3A**	**AB-4 S-3B**	**AB-4 S-4**	**WP-1 S-2A**	**WP-1 S-2B**	**RR-1**	**PC-18A**	**PC-18B**
Sample Depth (ft)	12.5-14.0	2.5-4.0	5.0-6.5	7.5-8.0	8.0-9.0	10.0-11.5	5.0-6.0	6.0-6.5	Surface	Surface	Surface
Total Metals											
Arsenic	49	180	167	42	105	97	115	7,940	26	12	35
Cadmium	<1	<1	<1	<1	<1	<1	1	22	<1	28	24
Chromium	46	66	78	39	<1	35	56	33	59	81	83
Copper	71	1,370	1,340	45	6	31	1,240	264	1,970	758	1,030
Mercury	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.9	1.3
Nickel	37	22	19	35	<3	33	25	34	31	144	130
Lead	316	6,420	5,480	107	11	20	4,850	818	12	1,120	3,440
Zinc	470	38,700	40,100	494	27	49	34,900	4,270	178	4,620	3,790
TCLP Metals											
Arsenic	n/a	0.2	n/a	n/a	<0.1	n/a	<0.2	<0.2	<0.1	n/a	n/a
Barium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cadmium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chromium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mercury	n/a	<0.001	n/a	n/a	<0.001	n/a	<0.001	<0.001	<0.001	n/a	n/a
Lead	n/a	9.3	n/a	n/a	0.1	n/a	2.4	3.5	<0.05	n/a	n/a
Selenium	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Silver	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EP Tox Metals											
Arsenic	n/a	<0.1	n/a	n/a	<0.1	n/a	<0.2	<0.2	<0.1	n/a	n/a
Mercury	n/a	<0.001	n/a	n/a	<0.001	n/a	<0.001	<0.001	<0.001	n/a	n/a
Lead	n/a	0.1	n/a	n/a	0.1	n/a	1.5	<0.5	<0.05	n/a	n/a

All values are in ppm
n/a - not analyzed

TABLE 1-6 ANALYTICAL RESULTS GROUNDWATER WP-1, HART CROWSER (1990)

Sampling Date	**07/09/90**	**05/29/90**
Total Metals		
(ppb)		
Arsenic	715	n/a
Antimony	<20	n/a
Beryllium	<1	n/a
Cadmium	<1	n/a
Chromium	1	n/a
Copper	5	n/a
Lead	38	n/a
Mercury	<1	n/a
Nickel	<3	n/a
Selenium	<2	n/a
Silver	<1	n/a
Thallium	<2	n/a
Zinc	36	n/a
Dissolved Metals		
(ppb)		
Arsenic	710	1,200
Antimony	<20	n/a
Beryllium	<1	n/a
Cadmium	<1	n/a
Chromium	2	n/a
Copper	5	n/a
Lead	7	n/a
Mercury	<1	n/a
Nickel	<3	n/a
Selenium	<2	n/a
Silver	1	n/a
Thallium	<2	n/a
Zinc	4	n/a
Field Parameters		
pH	n/a	7.2
SC (umhos/cm)	n/a	430
Temperature (C)	n/a	13.2
Dissolved Oxygen (ppm)	n/a	1.4

n/a - not analyzed

Unpublished Data (Ecology, December, 1990)

Ecology conducted an investigation of the site in December 1990. The investigation included a site visit, research of historic information relevant to the site, and review of data previously submitted by Weyerhaeuser.

Phase Ic Site Characterization Report, Weyerhaeuser-Everett Mill E Site, Everett, Washington (Hart Crowser, March 1991)

Hart Crowser performed a Phase Ic site characterization of the Weyerhaeuser Mill E site between May and August, 1990, for the Weyerhaeuser Corporation. The Mill E site is a former wood treatment facility located southeast of the Everett Smelter Site Study Area and extends to the Snohomish River (Sheet 1-4). It borders the south end of the former Mill B property. The purpose of this work was to provide data required to characterize soil and shallow groundwater conditions. Although the investigation performed by Hart Crowser was quite extensive, the summary provided in this report only presents the results from four shallow monitoring wells located west of the Mill E site and closest to the smelter site study area (HC-24, HC-25, HC-26, and WP-1, see Appendix F for well logs and Sheet 1-4 for well locations). WP-1 was installed approximately 1500 feet northwest of HC-26, close to the base of the Kraft Mill access road embankment.

In HC-24 through HC-26, dredge sand (Upper Sand Aquifer) was encountered to a depth of approximately 6 feet. In WP-1, the upper 10 feet consisted of fill material containing slag. Groundwater was typically encountered between 3 and 4 feet.

Nine soil samples were collected from the four monitoring wells at depths from 2.5 to 9 feet. The samples were analyzed for total arsenic. Three samples from WP-1 were also submitted for TCLP and EP Tox analysis. Groundwater samples were collected in May, 1990. The samples were analyzed for total arsenic.

Table 1-7 presents total, TCLP, and EP Tox arsenic concentrations in soils. Except for the soil samples from WP-1, all soil samples were within the expected regional background concentrations of approximately 1 to 20 ppm. The samples from WP-1 ranged from 115 to 7940 ppm arsenic. Arsenic was not detected in the TCLP and EP Tox tests. In groundwater, dissolved arsenic ranged from 0.01 ppm in HC-25 to 1.2 ppm in WP-1 (Table 1-8). The results shown for WP-1 in Table 1-8 are identical to those of the May sampling effort presented in Table 1-6.

TABLE 1-7 TOTAL, TCLP, AND EP TOX ARSENIC RESULTS SOIL, HART CROWSER (1991)

	Sample	Total	TCLP	EP Toxicity
	Depth	Arsenic	Arsenic	Arsenic
Sample Number	(feet)	(ppm)	(ppm)	(ppm)
HC-24/S-1	2.5-4.0	17.0	n/a	n/a
HC-24/S-3	7.5-9.0	10.2	n/a	n/a
HC-25/S-1	2.5-4.0	4.8	n/a	n/a
HC-25/S-4	6.5-8.0	11.7	n/a	n/a
HC-26/S-1	2.5-4.0	16.1	n/a	n/a
HC-26/S-4	6.5-8.0	8.9	n/a	n/a
WP-1/S-2A	5.0-5.75	115	<0.2	<0.2
WP-1/S-2B	5.75-6.5	7,940	<0.2	<0.2
WP-1/S-3 (S-2A)	5.0-5.75	134	<0.2	<0.2

n/a - not analyzed

TABLE 1-8 ANALYTICAL RESULTS GROUNDWATER, HART CROWSER (1991)

Well Number	HC-24	HC-25	HC-26	WP-1
Dissolved Arsenic (ppm)	0.382	0.01	0.611	1.2
pH	6.1	6.2	7.0	7.2
SC (umhos/cm)	270	410	570	430
Temperature (C)	14.8	14.2	15.0	13.2
Dissolved Oxygen (ppm)	1.4	1.2	1.2	1.4

On the Mill E site itself, soils contained up to 340 ppm arsenic. Metal concentrations generally were highest in samples collected from 2.5 to 4 feet, immediately below the top layer consisting of gravel ballast material. In the Upper Sand Aquifer, dissolved arsenic concentrations ranged from 0.013 to 16.9 ppm, and in the Lower Sand Aquifer from <0.002 to 3.08 ppm. Seep samples collected near the Snohomish River contained between 0.004 and 0.158 ppm arsenic.

Based on the distribution of arsenic concentrations and historic data for the Mill E site, Hart Crowser concluded that the primary source of arsenic to the groundwater appeared to be releases associated with the use of arsenic-based wood preservatives such as

Chromated Copper Arsenate (CCA). However, although arsenic concentrations declined upgradient from the site (i.e. towards the slag outcrop), Hart Crowser postulated the presence of a regional source of arsenic, possibly related to the historic smelter operations and fill activities. Also, although slag was not encountered in HC-24 through HC-26, Hart Crowser postulated that slag might have been used as fill in the vicinity of Mills B and E.

Final Report for the Everett Slag Site, Everett, Washington (SAIC, June, 1991a)
Science Applications International Corporation (SAIC) performed a site hazard assessment in February, 1991, for Ecology. The primary objective was to collect preliminary data to determine if arsenic, and metals such as lead and cadmium, were located in surface soils in the vicinity of the Everett Smelter Site Study Area. The site hazard assessment consisted of the collection of 20 surface soil samples and a geophysical survey aimed at delineating the vertical and horizontal extent of the slag.

Eleven samples were collected in or near the former plant site, and nine samples were taken at locations that were considered by SAIC to be representative of background conditions. Samples were analyzed for arsenic, cadmium, chromium, copper, lead, nickel, and zinc. Analytical results are presented in Table 1-9. Also shown are averages and standard deviations for the background samples and the remaining samples, designated "smelter" for the purpose of comparison. SAIC's report did not provide an interpretation of the findings.

The geophysical survey consisted of measuring total-field magnetic values and magnetic gradients at 174 stations established over a 7-acre area at accessible locations. It was anticipated that magnetic anomalies would be associated with the iron-rich slag.

Magnetic readings obtained east of the BN tracks were considered regional background. Background values were also observed in the northernmost cloverleaf of the East Marine View Drive - State Route 529 intersection, and just south of SR 529. In the southernmost cloverleaf, it was not possible to determine whether the magnetic readings were caused by small pieces of slag in the near-surface, or cultural features such as buried utility lines. The area between East Marine View Drive and the BN tracks was characterized by high readings. However, these anomalies could be attributed to both cultural features (e.g. scrap metal, utility lines) and slag deposits. The highest values were recorded at known

TABLE 1-9 ANALYTICAL RESULTS SOIL, SAIC (1991a)

Sample Number	Sample Depth	Sample Location	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
	(inches)		(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
SS1	0-2	smelter	7.2	2.0	13.4	29.8	29.3	16.6	85.5
SS2	0-6	smelter	6.2	8.9	9.3	46.0	114	18	312
SS3	0-6	smelter	7.2	0.98	23.3	45.6	82.4	31.5	169
SS4	0-2	background[#]	14.0	0.32	20.3	17.8	13.2	34.6	41.3
SS5	0-2	smelter	541	6.1	13.9	56.0	480	22.2	229
SS6	0-24	smelter	131	0.51	16.9	26.8	34.3	26.2	42.5
SS7	0-2	background	7.3	0.42	18.8	20.2	78.2	36.5	88.5
SS8	0-2	smelter	345	8.3	15.7	78.4	209	27.2	185
SS9	0-2	smelter	182	0.71	14.7	14.3	87.3	19.6	51.9
SS10	0-2	smelter	381	4.7	12	30.3	257	18.9	187
SS11	0-24	smelter	4,670	6.2	15.1	73.7	425	43.2	138
SS12	0-2	smelter	864	5.2	15.7	42.0	864	27.5	157
SS13	0-2	smelter	476	17.0	20.6	96.2	688	25.0	179
SS14	0-2	background	20.4	0.59	22.2	15.6	31.2	25.8	131
SS15	0-2	background	36.4	0.78	18.1	13	42.0	22.3	43.7
SS16	0-2	background	13	0.58	24.8	25.0	63.1	27.0	75.4
SS17	0-2	background	19.5	0.25	22.8	15.9	27.4	23.4	101
SS18	2-15	background	13.1	0.062	28.9	18.3	10	29.9	31.9
SS19	0-2	background	11	0.34	19.8	19.6	24.7	26.1	88.0
SS20	2-15	background	18.2	0.47	28.7	18.7	34.3	28.0	53.3
Avg. smelter			691	6	16	49	297	25	158
St. dev. smelter			1,346	5	4	25	282	8	78
Avg. background			17	0.4	23	18	36	28	73
St. dev. background			8	0.2	4	3	22	5	33

Avg. - Average
St. Dev. - Standard Deviation

[#] The term "background" was used by SAIC in its report. Some of SAIC's "background" samples were collected in the peripheral area.

slag deposits such as the slag outcrop below the Kraft Mill access road, exposed slag along drainage channels, and Hart Crowser borings. Based on these results, SAIC concluded that magnetic surveying had limited applicability in delineating the slag deposits. They suggested that a systematic placement of borings would be more effective than use of geophysical techniques.

Household Dust Sampling, Everett Smelter Site (Washington Department of Health/Snohomish Health District, October, 1991)

The Washington Department of Health and the Snohomish Health District conducted household sampling in October, 1991. Samples were collected from five residences within the former plant area (HS3 through HS7), and two "control' houses in central Everett (HS1 and HS2), using an air sampler with external filter cassettes. Locations HS3 through HS7 are shown on Sheet 1-4. Three individual areas of 2 ft^2 each were sampled in each residence. Samples were analyzed for arsenic and lead by Atomic Absorption Spectroscopy (AA) and Inductively Coupled Plasma Spectroscopy (ICP). Results are listed in Table 1-10. No interpretation was provided.

Unpublished Data (SAIC, 1991b)

SAIC conducted a Pre-Remedial Investigation (Pre-RI) in May, 1991, for Ecology. The purpose of the investigation was to further characterize the nature and extent of soil likely associated with former smelter operations.

The Pre-RI consisted of collection of 264 soil samples at 85 different locations (Sheet 1-4). All sampling locations were in the residential area (lawns, flower gardens, vegetable beds, berms, medians, etc.). At all locations, surface soil samples were collected (0 to 2 inches). Deeper soil samples (6 inches, 1 foot, 2 feet, and 3 feet) were collected at 45 selected sampling locations. In addition, 21 samples were collected from 7 trenches located within the interchange between East Marine View Drive and State Route 529. All samples were analyzed for arsenic, cadmium, and lead. In addition, six samples were analyzed for TCLP arsenic.

TABLE 1-10 ANALYTICAL RESULTS HOUSEHOLD DUST SAMPLING, WA DEPARTMENT OF HEALTH/SNOHOMISH COUNTY HEALTH DISTRICT (1991)

Location	ICP		AA	
	Arsenic	Lead	Arsenic	Lead
	(ppm)	(ppm)	(ppm)	(ppm)
HS1-01	0	464	19.6	n/a
HS1-02	0	628	25.1	n/a
HS1-03	0	700	102	726
HS2-01	0	1660	23.2	n/a
HS2-02	0	1420	57.2	n/a
HS2-03	182	481	109	n/a
HS3-01	0	n/a	n/a	n/a
HS3-02	0	n/a	43.4	n/a
HS3-03	0	n/a	32.7	n/a
HS4-01	285	n/a	n/a	n/a
HS4-02	261	n/a	n/a	n/a
HS4-03	421	n/a	n/a	n/a
HS5-01	180	n/a	236	n/a
HS5-02	349	n/a	n/a	n/a
HS5-03	216	n/a	n/a	n/a
HS6-01	0	n/a	53.5	n/a
HS6-02	0	n/a	66.3	n/a
HS6-03	0	n/a	59.5	n/a
HS7-01	0	n/a	306	n/a
HS7-02	2830	n/a	739	n/a
HS7-03	0	n/a	n/a	n/a

n/a - not analyzed

The analytical results for arsenic, cadmium, and lead are presented in Table 1-11. Table 1-12 shows the TCLP arsenic results. SAIC did not provide any data interpretation, but the results indicated that elevated arsenic, cadmium, and lead concentrations occurred throughout the entire study area. The highest levels were found in the proximity of the former smelter site. Generally, arsenic and metal concentrations decreased with distance from the smelter site. The depth profiles showed that arsenic and metal concentrations were quite variable. In many instances, highest concentrations were found at depth, possibly associated with the presence of smelter debris. Four of the six samples analyzed for TCLP arsenic exceeded the TCLP criterion of 5 ppm for a designation of dangerous waste (WAC 173-303-090(8)).

TABLE 1-11 ANALYTICAL RESULTS SOIL, SAIC (1991b)

Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)	Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)	Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)
S1-1	319	25.1	489	S15-1	50.6	ND	87.3	S29-1	484	4.5	563
S1-2	215	19.3	657	S15-2	313	0.75	85	S29-2	935	10	1220
S1-3	438	24.2	1290	S15-3	577	2.2	205	S29-3	737	12	27.6
S1-4	1010	15.8	1470	S15-4	2650	4.7	241	S29-4	488	ND	9.8
S1-5	333	6.6	494	S15-5	44700	4.7	632	S29-5	188	0.59	21.2
S2-1	309	5.3	188	S16-1	732	5.5	220	S30-1	432	3.2	284
S2-2	142	4.6	98.9	S17-1	235	1.7	222	S30-2	203	2.2	127
S2-3	112	52.7	2330	S17-2	241	1.3	169	S30-3	319	4.7	403
S2-4	952	62.1	541	S17-3	366	2.9	256	S30-4	338	2.3	41.3
S2-5	865	27	68.9	S17-4	976	0.98	79.3	S30-5	42.9	ND	ND
S3-1	286	12.9	448	S17-5	1190	ND	ND	S31-1	333	4.8	381
S3-2	257	6.5	240	S18-1	131	1.7	190	S31-2	276	3.4	184
S3-3	915	12.9	805	S19-1	14	ND	56.9	S31-3	36.5	ND	11
S3-4	4700	9	8870	S19-2	24	ND	29.3	S31-4	13	ND	9.1
S3-5	2340	6.6	8500	S19-3	159	1.6	122	S31-5	8.1	ND	ND
S4-1	4860	81.2	1570	S19-4	48.1	0.89	69.6	S32-1	47.4	1.2	92.3
S4-2	2380	35	1690	S19-5	25.3	ND	12	S32-2	19	ND	17.9
S4-3	2860	36.8	1610	S20-1	74.3	3.3	200	S32-3	42.5	0.63	42.5
S4-4	5820	53.2	2490	S20-2	167	2.7	179	S32-4	15.1	ND	5.8
S4-5	10500	67.6	618	S20-3	282	3.8	346	S32-5	2.5	ND	ND
S5-1	6890	34.1	2150	S20-4	46.8	ND	12	S33-1	240	1.4	96.1
S6-1	138	5.3	284	S20-5	69.9	ND	ND	S34-1	276	3.2	191
S7-1	480	13.6	772	S21-1	132	ND	159	S34-2	312	2.6	181
S8-1	917	4	644	S22-1	1490	112	2540	S34-3	415	4.3	223
S9-1	1030	3.3	238	S22-2	4230	51.3	1240	S34-4	1550	6.6	342
S9-2	7210	4.8	213	S22-3	3590	24.4	96.2	S34-5	1160	5.7	344
S9-3	6170	2.4	57.8	S22-4	1710	22	122	S35-1	298	1.3	72
S9-4	3300	1.2	19.3	S22-5	455	14.8	ND	S35-2	435	1.2	52.1
S9-5	1080	1.1	ND	S23-1	475	23.8	1500	S35-3	239	ND	8.6
S10-1	194	5.5	226	S24-1	395	12	632	S35-4	727	2.7	199
S10-2	32.2	7.3	195	S24-2	456	15.2	443	S35-5	717	3.1	99.3
S10-3	34.1	5	224	S24-3	152	6.5	278	S36-1	764	6.9	194
S10-4	147	5.6	348	S24-4	47.6	ND	ND	S36-2	1100	4.3	119
S10-5	24.9	1.7	7.2	S24-5	3.2	ND	ND	S36-3	994	4.7	52.6
S11-1	114	4.8	285	S25-1	311	5.4	446	S36-4	1420	3.8	86.4
S11-2	130	13	433	S25-2	146	1.7	117	S36-5	849	0.96	17.9
S11-3	355	13.9	350	S25-3	272	2.1	97.5	S37-1	857	3.8	405
S11-4	192	12.6	500	S25-4	80	ND	33.3	S37-2	1900	4.3	15.3
S11-5	336	7.7	341	S25-5	4.5	ND	ND	S37-3	1550	3.5	9.8
S12-1	38.1	2.9	285	S26-1	421	5.7	513	S37-4	328	ND	ND
S12-2	412	5.8	378	S26-2	800	6.8	533	S37-5	99.4	ND	7.3
S12-3	266	11	635	S26-3	642	9	86.4	S38-1	130	0.76	63.9
S12-4	255	9.9	266	S26-4	80.5	ND	17.1	S39-1	147	1.2	58
S12-5	758	4.9	303	S26-5	61.7	ND	ND	S39-2	118	0.72	49
S13-1	1350	3.7	1190	S27-1	2600	3.4	301	S39-3	203	1.2	72.6
S13-2	1500	3.8	488	S27-2	2090	ND	19.8	S39-4	71.9	ND	22.3
S13-3	9150	4.3	732	S27-3	3010	ND	ND	S39-5	272	1.2	66.2
S13-4	6100	1.2	671	S27-4	930	ND	ND	S40-1	18.6	ND	60.2
S13-5	2620	2.6	28.6	S27-5	1880	ND	5.9	S40-2	39.2	0.76	42.1
S14-1	833	2	197	S28-1	1190	4.3	388	S40-3	35.9	ND	39.9
S14-2	2190	5.3	384	S28-2	1800	5.3	500	S40-4	68.4	0.73	48.4
S14-3	3330	3.8	218	S28-3	4810	8.1	1300	S40-5	47.5	0.73	37.5
S14-4	6490	6.2	216	S28-4	6230	4	90.9				
S14-5	2410	ND	16.9	S28-5	6020	ND	7.2				

ND - Not Detected (Detection Limits: As: 0.5 ppm; Cd: 0.5 ppm; Pb: 5ppm)

Sampling Depth S-# Samples				Sampling Horizon T-# Samples (Trench Samples)	
S-1	0-2 inches	S-4	2 feet	T-1	A Horizon
S-2	6 inches	S-5	3 feet	T-2	B Horizon
S-3	1 foot			T-3	C Horizon

TABLE 1-11. ANALYTICAL RESULTS SOIL, SAIC (1991b) (Continued)

Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)	Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)	Sample Number	Arsenic (ppm)	Cadmium (ppm)	Lead (ppm)
S41-1	124	2	201	S59-1	4	ND	179	T1-1	1.4	ND	ND
S41-2	145	2.7	305	S60-1	23.3	1.7	666	T1-2	3.5	ND	8.4
S41-3	222	4.1	209	S61-1	80	3.2	4540	T1-3	6.2	ND	181
S41-4	78.9	1.2	64.6	S62-1	90	2.7	150	T2-1	100	6.2	ND
S41-5	6.3	ND	ND	S63-1	141	2.9	178	T2-2	20.3	2.3	46.2
S42-1	178	1.9	233	S64-1	151	6.5	384	T2-3	47	0.76	77
S42-2	212	2	200	S64-2	776	14.3	1160	T3-1	49.5	4.4	ND
S42-3	858	3.6	496	S64-3	363	11	27.6	T3-2	17.5	ND	28.9
S42-4	55.9	ND	11	S64-4	11	ND	7	T3-3	5.1	ND	44.4
S42-5	18.7	ND	ND	S64-5	1.8	ND	ND	T4-1	6	1.1	ND
S43-1	239	2	143	S65-1	131	1.7	111	T4-2	45.5	4	14.6
S43-2	231	2.9	184	S66-1	134	2.7	129	T4-3	68.3	0.85	48.7
S43-3	528	3.7	198	S67-1	143	2.5	35	T5-1	131	3.4	ND
S43-4	104	ND	22.6	S67-2	63.6	0.76	26	T5-2	285	2.2	56.5
S43-5	13	ND	6.6	S67-3	21.2	ND	8.9	T5-3	35.7	0.73	301
S44-1	341	2.4	209	S67-4	1.9	ND	ND	T6-1	23.9	6.3	311
S45-1	7450	7.7	452	S67-5	1.7	ND	ND	T6-2	42.2	0.72	834
S45-2	7740	7.1	396	S68-1	100	1.3	90.4	T6-3	5.1	ND	189
S45-3	13700	10	581	S69-1	66.7	1.2	248	T7-1	931	25.8	461
S45-4	4730	3.9	447	S69-2	121	3.4	3940	T7-2	1050	112	130
S45-5	1940	2.1	26.9	S69-3	40.7	4.8	330	T7-3	468	5	121
S46-1	1860	4.8	268	S69-4	3.5	0.89	12.7				
S46-2	2590	6.3	383	S69-5	4.4	1.7	ND				
S46-3	3170	6.5	361	S70-1	51.2	0.82	217				
S46-4	3120	5.7	410	S71-1	333	1.9	630				
S46-5	2440	8.7	568	S72-1	891	1.2	82.4				
S47-1	3880	6.3	626	S72-2	1140	1.6	119				
S47-2	4080	12	1130	S72-3	5360	4.7	268				
S47-3	5380	14.8	1390	S72-4	11500	20	374				
S47-4	5130	12.4	1640	S72-5	53100	22	161				
S47-5	2150	6.1	15.9	S73-1	70.9	1.7	57.9				
S48-1	791	6.2	492	S73-2	80.6	1.6	65.8				
S48-2	584	9.6	376	S73-3	84.5	1.2	44.4				
S48-3	780	9.2	338	S73-4	27.8	ND	ND				
S48-4	48.8	ND	13.5	S73-5	26.8	ND	5.8				
S48-5	96.7	ND	12	S74-1	788	4.9	323				
S49-1	2010	5.3	233	S75-1	8080	5.1	386				
S50-1	264	1.1	82.6	S76-1	556	6.3	419				
S50-2	298	1.2	90.4	S77-1	114	2.1	71.8				
S50-3	374	0.95	68.2	S77-2	9.5	ND	27.6				
S50-4	994	2.8	198	S77-3	33.8	ND	53.6				
S50-5	62.1	ND	44.7	S77-4	23.5	ND	49.1				
S51-1	49.3	ND	261	S78-1	1460	137	827				
S52-1	9.6	ND	131	S79-1	33.5	1.4	71.6				
S53-1	145	0.79	306	S80-1	39.6	1.1	152				
S54-1	34.8	ND	242	S81-1	53.9	1.8	67.1				
S55-1	24	1.3	132	S82-1	54.9	0.82	89.4				
S56-1	10	ND	103	S83-1	276	1.6	175				
S57-1	18	ND	167	S84-1	22.8	0.69	74.1				
S58-1	16	ND	253	S85-1	119	ND	7				
S58-2	8	ND	34.9								
S58-3	3.5	ND	ND								
S58-4	3.1	ND	ND								
S58-5	4.1	ND	ND								

ND - Not Detected (Detection Limits: As: 0.5 ppm; Cd: 0.5 ppm; Pb: 5ppm)

Sampling Depth S-# Samples

S-1	0-2 inches	S-4	2 feet
S-2	6 inches	S-5	3 feet
S-3	1 foot		

Sampling Horizon T-# Samples (Trench Samples)

T-1	A Horizon
T-2	B Horizon
T-3	C Horizon

TABLE 1-12 TCLP ARSENIC RESULTS SOIL,SAIC (1991b)

Sample Number	Depth (feet)	TCLP Arsenic (ppm)
S3-4	2	2.4
S13-3	1	23.9
S15-5	3	39
S47-2	0.5	3.8
S-72-4	2	15.6
S-72-5	3	22.6

Interim Actions Summary Report Everett Smelter Site, Everett, Washington (Hydrometrics, November 1992b)

Hydrometrics conducted soil sampling as part of interim remedial activities in September and October, 1992 (Sheet 1-4). The remedial activities took place in residential yards in which anomalously high arsenic levels had been found during SAIC's Pre-RI sampling (SAIC, 1991b). At six locations, activities consisted of removal of soil containing elevated metal levels, and subsequent replacement. Other activities included adding pavement, gravel, sod, or bark.

Hydrometrics collected a total of 38 composite samples at depths ranging from 0 to 25 inches. Two samples collected at location IA-5 were analyzed for total metals; three samples were analyzed for TCLP arsenic, cadmium, and lead. The remainder was analyzed for arsenic, cadmium, and lead. The duplicate samples at location IA-5 were collected at a depth between 8 and 12 inches to further characterize the white material that had been encountered during previous sampling. Sample 1 consisted of a white, hard substance that appeared to contain crystals. Sample 2 consisted of a mixture of red and white material with a musty odor that had the appearance of decomposing brick.

The analytical results are presented in Tables 1-13 and 1-14. Hydrometrics did not provide any data interpretation, but the results indicated that arsenic and metal concentrations were highly variable with sampling depth and location. Two samples, containing 3400 ppm and 28000 ppm arsenic, respectively, exceeded the TCLP criterion of arsenic (5 ppm, WAC 173-303-090(8)). The TCLP criteria for cadmium (1 ppm) and lead (5 ppm) were not exceeded. The two samples collected at location IA-5 contained 35% and 51% arsenic, respectively (Table 1-14). In addition, these samples contained elevated levels of antimony, lead, and mercury.

TABLE 1-13 ANALYTICAL RESULTS SOIL, HYDROMETRICS (1992)

	Sample	**Sample Depth**	**Arsenic**	**Cadmium**	**Lead**
Location	**Number**	**(inches)**	**(ppm)**	**(ppm)**	**(ppm)**
IA-1	100	0-3	300	2.1	61
	101	11-13	990	3.7	170
	102	23-25	3,100	15	530
IA-2	103	0-3	510	4.2	180
	104	11-13	3,400	7.7	270
	105	23-25	6,800	15	1,600
IA-3	106	0-3	230	3.8	140
	107	11-13	360	4.2	180
	108	23-25	650	6.4	300
	109	0-3	270	3.8	140
	110	11-13	520	4.1	130
	111	23-25	570	4.3	180
IA-4	112	0-3	320	4.5	180
	113	11-13	520	5.2	250
	114	23-25	400	4.4	140
	115	0-3	170	3.0	130
	116	11-13	260	2.7	120
	117	23-25	170	2.1	59
	118	0-3	230	2.9	120
	119	11-13	360	3.2	79
	120	23-25	210	1.1	8.4
	121	0-3	160	2.9	150
	122	11-13	260	3.6	180
	123	23-25	250	2.0	52
IA-5	124	0-3	23,000	350	2,300
	125	11-13	28,000	23	540
	126	23-25	20,000	6.9	120
	132	0-25	4,000	14	400
IA-6	127	0-3	16,000	5.1	79
	128	11-13	1,400	3.4	440
	129	23-25	3,500	7.2	360
IA-7	130	0-2	160	2.5	160
	131	0-2	86	2.7	170
IA-8	3	0-2	1,300	2.0	58
IA-9	4	0-2	14	0.82	6.3
IA-10		0-2	78	0.32	26

TABLE 1-13 ANALYTICAL RESULTS SOIL, HYDROMETRICS (1992) (Continued)

Location	Sample Number	Sample Depth (inches)	TCLP Arsenic (ppm)	TCLP Cadmium (ppm)	TCLP Lead (ppm)
IA-2	104	11-13	6.9	<0.1	<0.1
IA-4	117	23-25	0.4	<0.1	<0.1
IA-5	125	11-13	80	<0.1	<0.1

TABLE 1-14 ANALYTICAL RESULTS FILL MATERIAL, HYDROMETRICS (1992)

	Sample 1	Sample 2
Antimony	1,700	15,000
Arsenic	510,000	350,000
Beryllium	<0.08	<0.16
Cadmium	3.9	84
Chromium	3.7	17
Copper	3.3	460
Lead	92	11,000
Mercury	1.1	380
Nickel	<0.62	21
Selenium	<1.6	140
Silver	0.32	53
Thallium	15	200
Zinc	4.1	310

<u>Preliminary Results Environmental Audit, Proposed Northeast View Park, Everett, Washington (Dames & Moore, January, 1993)</u>

Dames & Moore conducted an Environmental Audit (EA) for the City of Everett at the site for the Proposed Northeast View Park and Sidewalk Improvement along East Marine View Drive in January, 1993 (Sheet 1-4). The purpose of this audit was to evaluate if an environmental risk existed based on the potential presence of chemicals in site soils.

Dames & Moore collected seven composite soil samples from six soil borings at depths between 1 and 3 feet, one surface soil sample, and 18 samples from four test pits up to 6 feet in depth. The samples were analyzed for arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

Table 1-15 presents metals concentrations in soils. One test pit sample consisting of fill material in TP-3-2, and the native soil samples from borings HA-3 through HA-6 contained elevated arsenic and lead concentrations. Based on these results, it appeared that high arsenic and lead levels were located along the embankment east of the proposed park location.

Interim Deliverable Report Remedial Investigation/Feasibility Study Everett Smelter Site (Hydrometrics, April, 1994)

In response to the First Amended Enforcement Order issued by Ecology on March 18, 1994, Hydrometrics prepared an interim report. This report contained a description of the ongoing Remedial investigation and outlines of the future Feasibility Study and the Risk Assessment. Since the present RI/FS and RA include all information presented in the Interim Deliverable, no further evaluation of the latter document is provided here.

Mill E Split Sampling (EMCON, March, 1995)

In August 1994, Hydrometrics and EMCON collaborated during a groundwater sampling program that encompassed monitoring wells in the smelter site study area as well as on Weyerhaeuser's former Mill E facility. As part of this effort, EMCON sampled wells HC-24, HC-25, and HC-26 (see Sheet 1-4 for locations and Appendix F for logs). Samples were analyzed for total and dissolved arsenic, chromium, copper, and lead, as well as for the common ions calcium, magnesium, potassium, and sodium. The metals results are presented in Table 1-16.

A comparison between the dissolved arsenic concentrations presented in Tables 1-8 and 1-16 shows that in well HC-24 arsenic levels have remained relatively constant over the last four years. However, in wells HC-25 and HC-26, arsenic levels have decreased by a factor of approximately two between May 1990 and August 1994.

TABLE 1-15 METAL CONCENTRATIONS SOIL, DAMES & MOORE (1993)

Sample Location	Sample Depth (feet)	Arsenic (ppm)	Barium (ppm)	Cadmium (ppm)	Chromium (ppm)	Lead (ppm)	Mercury (ppm)	Selenium (ppm)	Silver (ppm)
Test Pit									
TP-1-1	2	27	102	<1.7	28.8	103	0.066	<0.3	<2.5
TP-1-2	6	2.8	70.7	<1.7	25.3	67	0.045	<0.3	<2.5
TP-1-A-1	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-1-A-2	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-1-B-1	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-1-B-2	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-2-1	2	2.7	63.9	1.64	25.7	18	0.043	<0.3	<2.5
TP-2-2	8	<3	72.6	<1.6	33.4	15	0.06	<0.3	<2.5
TP-3-1	2	2.6	56.2	<1.7	41.4	<7.3	0.017	<0.3	<2.4
TP-3-2	4	43	154	<1.6	31.2	270	0.33	<0.3	<2.5
TP-3A-1	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-3A-2	4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-3B-1	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-3B-2	4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-3C-1	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-3C-2	5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
TP-4-1	2	23	74.9	<1.7	29.4	31	0.052	<0.3	<2.5
TP-4-2	4	9.5	67.7	<1.7	27.1	19	0.057	<0.3	<2.5
Surface Soil									
SS-1	0.5	5.6	35.3	<1.7	20.4	<7.4	0.022	<0.3	<2.5
Boring									
HA-1	1 - 3	13	81.5	<1.6	24	97.2	0.14	<0.3	<2.5
HA-2	1 - 3	2.7	89	1.7	36.6	25	0.03	<0.3	<2.5
HA-3	1 - 3	81	238	2.2	26.1	889	0.42	<0.3	<2.5
HA-4	1 - 3	380	197	<1.7	23	470	0.51	0.42	<2.5
HA-5	1 - 3	273	1.06	9.4	56.5	1,500	0.64	0.5	2.5
HA-6	1 - 3	505	1.17	5.9	33.6	1,910	0.46	0.5	6.1

n/a - not analyzed

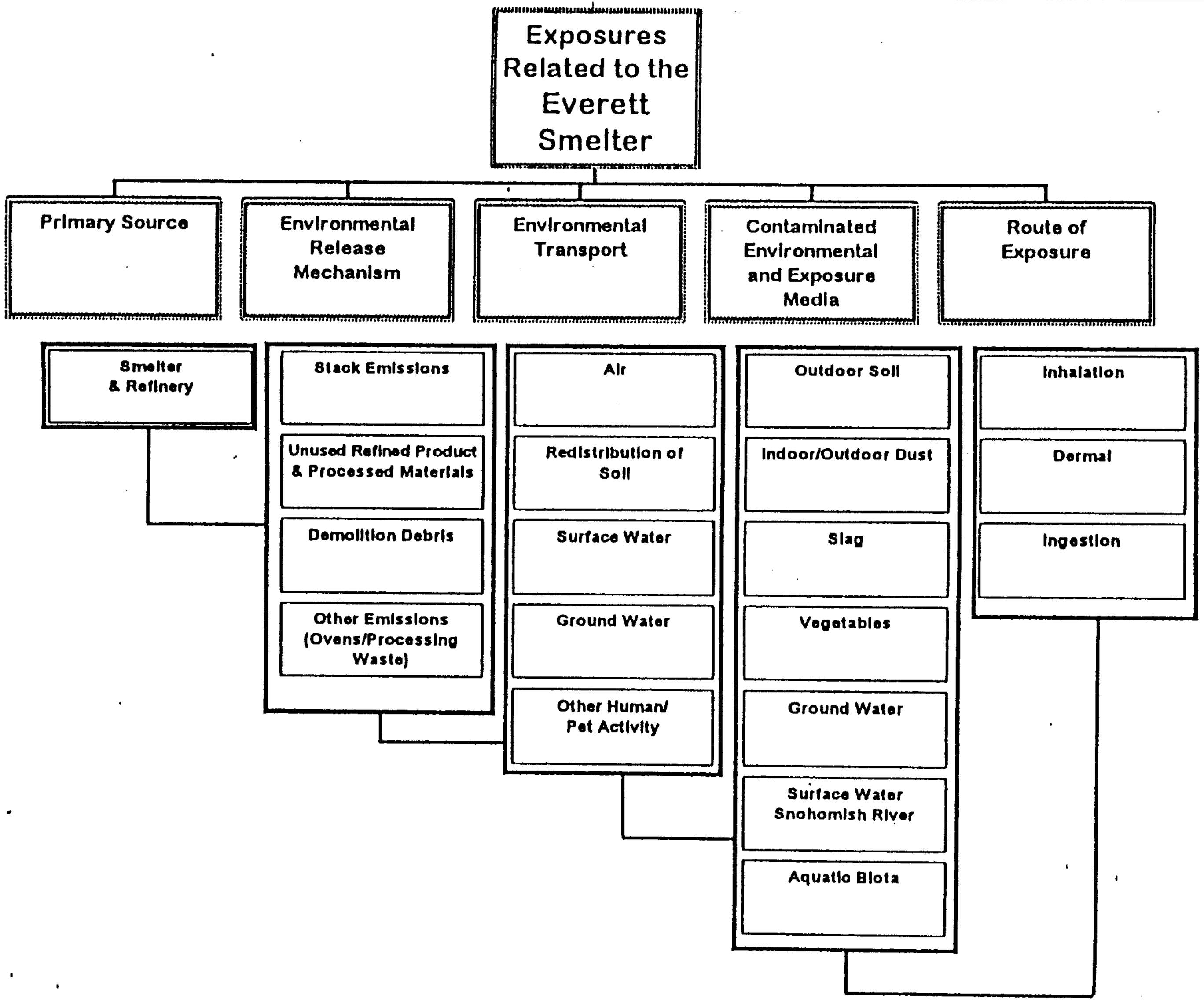
TABLE 1-16 METAL CONCENTRATIONS GROUNDWATER, EMCON (1994)

Well	HC-24	HC-25	HC-26
Arsenic (dis)	0.350	0.004	0.373
Arsenic (tot	0.329	0.0038	0.290
Chromium(dis)	0.0011	0.0017	0.00099
Chromium (tot)	< 0.00085	0.001	0.00095
Copper (dis)	0.0024	0.003	0.003
Copper (tot)	< 0.0011	0.0013	0.0013
Lead (dis)	< 0.0006	< 0.0006	0.0006
Lead (tot)	< 0.0006	0.0008	0.0008

All values are in ppm

1.6 SITE PATHWAY MODEL

A schematic conceptual pathway model for the Everett Smelter Site Study Area is presented in Figure 1-4. The pathway model was developed and provided by the Northwest Office of the Washington State Department of Ecology.



Proj. No: ASEV01
Dwg. No: 03095T30
Drawn By: S.T.R.
Last Update: 8/4/95
Ref. Dwg:
Rev. Date:

Hydrometrics, Inc.

Figure 1–4
Exposures Related to the Everett Smelter
(Provided By Ecology)

2.0 INVESTIGATIVE METHODS

The overall objective of the RI was to characterize the distribution of hazardous materials present at the site pursuant to WAC 713-340-350(c). The RI in the residential area included several investigative tasks to determine the nature and extent of contamination on the site and to address data needs as identified in Section 1.6 of the RI/FS Workplan prepared for and approved by Ecology for the Everett Smelter site (Hydrometrics, 1992a). This chapter describes the media investigated and the methodology used to obtain the required information. Media investigated include slag, soil, surface water, groundwater, and household dust. Details of the sampling procedures are presented in the Workplan (Hydrometrics, 1992a).

2.1 SLAG INVESTIGATION

Observations regarding slag were included in the soil sampling and monitoring well installation efforts whenever slag was encountered. In addition, the delineation of the slag deposit as well as slag characteristics were determined by completing three borings near the access road to the Weyerhaeuser Kraft Mill. The three borings (SL-1, SL-3, and SL-4, Sheet 2-1) reached depths of 31, 60, and 34 feet, respectively, and encountered lead slag deposited during operation of the smelter. In each boring, one slag sample was collected at the total depth of the boring. The slag samples were submitted to Asarco's Technical Services Center (TSC) for analysis of total metals, TCLP metals, and SPLP metals (EPA Method 1312).

2.2 SOIL INVESTIGATION

2.2.1 Residential Area

Soils were investigated in an attempt to adequately characterize the areal and vertical distribution and concentrations of hazardous substances in the soils due to historic smelter operations. See WAC 173-340-350(c)(ii). The following describes the field investigations performed by Hydrometrics. Prior soil sampling conducted by SAIC (1991b) during the Pre-RI investigation is discussed in Section 1.5.2 (Description of Previous Investigations), but is not included in this section.

In the residential area, as part of the RI work performed by Hydrometrics, soil quality was investigated by collecting soil samples at the following locations:

- four deep soil borings (≥ 15 feet);
- two monitoring wells;
- sixty shallow soil borings (≤ 15 feet);
- twenty public use locations (≤ 2 feet).

2.2.1.1 Deep Soil Borings

Two deep soil borings were completed at the proposed location of monitoring well EV-2 on Pilchuck Path (EV-2A and EV-2B), and two in the cloverleaf of the East Marine View Drive/State Route 529 interchange (B-1 and B-2). The four deep borings are shown on Sheet 2-1. Since EV-2B was completed in very close proximity of EV-2A, on Sheet 2-1 their respective locations are combined in boring designation EV-2. Per the Workplan (Hydrometrics, 1992a), boring EV-2 was designed to be a monitoring well. However, the shallow groundwater system of interest was not encountered, and EV-2A was backfilled after collection of the soil samples. Upon receipt of analytical results for soils collected in EV-2A, it was decided to complete EV-2B at the same location. Borings B-1 and B-2 were installed to determine the approximate extent of reworked fill material near the highway interchange. EV-2A, EV-2B, B-1, and B-2 were drilled to depths of 20, 21.5, 21, and 15 feet, respectively.

A total of 42 soil samples was collected from the four borings using a split spoon. All ten samples from B-1 and nine samples from B-2 were submitted to Asarco's TSC laboratory. Eight EV-2A samples were submitted from the following depths: 0 to 1', 1.5 to 3', 4.5 to 6', 6 to 7.5', 9 to 10.5', 12 to 13.5', 13.5 to 15', and 18.5 to 20'. For quality control purposes, three split samples (6 to 7.5', 12 to 13.5', and 18.5 to 20') were also submitted to Sound Analytical Services. Eleven samples collected from EV-2B at two-foot intervals were all submitted for analysis. Samples submitted were analyzed for arsenic, cadmium, and lead. Remaining samples were archived.

2.2.1.2 Monitoring Wells

A total of 29 soil samples was collected during installation of monitoring wells EV-1 and EV-3 (for monitoring well locations and design, see Sheet 2-1 and Section 2.4). The samples were collected with a split spoon at approximately two-foot intervals for the first 20 feet, after which an approximately five- to ten-foot sampling interval was used. In certain instances, additional samples were collected based upon particular soil characteristics and/or location within the stratigraphic sequence.

Sixteen samples were submitted to Asarco's TSC laboratory for analysis of arsenic, cadmium, and lead. Per the Workplan (Hydrometrics, 1992a), the samples analyzed were from the following approximate depths: surface (0 to 2"), 2', 5' 10', and 15'. At depths greater than 15', selection of samples submitted for analysis was based on field observation. The remaining samples were archived.

2.2.1.3 Shallow Soil Borings

The shallow soil sampling program (≤ 15 feet) was designed to delineate more accurately the locations of former smelter structures, as well as provide information on background arsenic and metal concentrations in soil. A total of 60 shallow soil borings was completed during three separate efforts in two phases (Phase I and II). The respective study areas for Phase I and Phase II are shown on Figure 1-2.

Sampling locations are shown on Sheet 2-1. Table 2-1 presents sampling locations, sample numbers, boring depths, and the soil sampling phase during which the samples were collected. As mentioned before, borings are divided into three groups: Phase I borings (borings completed during Phase I and not resampled at greater depth), Phase I/II borings (borings completed during Phase I and resampled during Phase II at greater depth), and Phase II borings (borings completed during Phase II only). Boring logs for Phase I and Phase I/II residential borings are in Appendix C; logs for Phase II borings are in Appendix D. Analytical results are in Appendix A.

During the first round of residential soil sampling (Phase I), samples were collected at nine pre-RI locations (SAIC, 1991b), and at seventeen "new" locations using a hand-held power auger. At pre-RI sites, samples were collected at the following depths: 0 to 2", 6", 1', 2', 3', 4', and 6'. At the "new" locations, samples were collected at the same depth intervals, but only to a depth of 4'. The Phase I sampling effort covered an area of approximately 62 acres (Figure 1-2).

The nine pre-RI locations (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, and S-72) were located in the area of the former arsenic plant. Five of these sites were selected because the arsenic concentrations in samples collected at three feet during the pre-RI sampling effort were the highest overall values found. Seven of the new locations (S-101 through S-107) were selected such that they would delineate the western extent of

TABLE 2-1 RESIDENTIAL SOIL SAMPLING LOCATIONS

Residential Location	Sample	Boring Depth (feet)	Phase
415 Pilchuck Path	S-4	12	I/II
3010 5th Street	S-8	15	I/II
515 Pilchuck Path	S-13	17	I/II
523 Pilchuck Path	S-15, S-112	15, 4	I/II, I
440 Pilchuck Path	S-22	15	II
520 Pilchuck Path	S-27, S-28	10, 7	I/II, I/II
507 Hawthorne Street	S-34	12	II
511 Hawthorne Street	S-36	10	II
515 Hawthorne Street	S-37	8	II
516 Hawthorne Street	S-39	16	II
510 East Marine View Drive	S-46	17	I/II
502 East Marine View Drive	S-47	11	I/II
528 Hawthorne Street	S-50	10	II
514 Pilchuck Path	S-72	9	I/II
215 Medora Way	S-74	4	II
207 Bridgeway	S-83	4	II
232 Bridgeway	S-90	4	II
235 Bridgeway	S-91	4	II
534 East Marine View Drive	S-92	15	II
610 Hawthorne Street	S-93	4	II
2901 Butler Street	S-94	4	II
3004 Butler Street	S-95	4	II
704 East Marine View Drive	S-96	4	II
816 East Marine View Drive	S-97	4	II
108 Skyline Drive	S-101	4	I
221 Skyline Drive	S-102	4	I
308 Skyline Drive	S-103	4	I
512 Winton Avenue	S-104	4	I
617 Legion Drive	S-105	4	I
606 Linden Street	S-106	4	I
724 Linden Street	S-107	4	I
835 Linden Street	S-108	4	I
901 Maple Street	S-109	4	I
812 East Marine View Drive	S-110	4	I
520 East Marine View Drive	S-111	11	I/II
528 East Marine View Drive	S-113	15	I/II
110 Bridgeway	S-114	4	I
302 Bridgeway	S-115	4	I

TABLE 2-1. RESIDENTIAL SOIL SAMPLING LOCATIONS (Continued)

Residential Location	Sample	Boring Depth (feet)	Phase
2909 Whitehorse Trail	S-116	4	I
2832 Medora Way	S 117	4	I
American Legion Golf Course	S-201, S-202, S-203 S-301, S-302, S-303	4, 4, 2 2, 2, 2	II, II, II II, II, II
2315 6th Street	S-204	4	II
718 Legion Drive	S-205	4	II
2720 7th Street	S-206	4	II
836 Locust Street	S-207	4	II
926 Maple Street	S-208	4	II
1014 East Marine View Drive	S-209	4	II
520 Waverly Avenue	S-304	2	II
2404 8th Street	S-305	2	II
815 Broadway	S-306	2	II
2731 10th Street	S-307	2	II
1022 Maple Street	S-308	2	II
1108 East Marine View Drive	S-309	2	II

the study area and provide information on background arsenic and metal concentrations. To determine the southern extent of the study area, S-108 through S-110 were selected. Three sample locations (S-111 through S-113) were used to delineate the vertical distribution of arsenic in the former arsenic plant area. Four sampling sites near Medora Way (S-114 through S-117) were meant to further evaluate the nature of the small area of elevated arsenic and metals concentrations identified during the pre-RI. A total of 176 soil samples was collected from these 26 Phase I shallow borings. All samples were submitted to Asarco's TSC laboratory for analysis of arsenic, cadmium, and lead. Five samples from locations S-111, S-112, S-113, and S-27, were analyzed for total and TCLP metals as well. These samples consisted of material such as brick, slag, and flue dust that appeared to be directly associated with former smelter activities.

The analytical results for the Phase I samples showed that adequate vertical and lateral delineation of the area had not been achieved as is required by WAC 173-340-350(c)(ii). As a result, Phase II soil sampling was initiated, which covered a total area of approximately 160 acres (Figure 1-2). The second round of soil sampling consisted of "revisiting" 17 residential locations within the former smelter area.

Eleven of these locations (Phase I/II borings) corresponded to the 6-foot borings completed by Hydrometrics during the first round: S-4, S-8. S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113. The remaining six locations corresponded to the following SAIC (1991b) locations: S-22, S-34, S-36, S-37, S-39, and S-50. These locations were selected because arsenic concentrations exceeded background values at the maximum sampling depths. Depending on previous maximum sampling depth, samples were collected using a split spoon at two-foot intervals starting at this maximum depth. A total of 88 additional soil samples was collected from these 17 locations. In addition to the 17 "revisited" locations, an eighteenth 15-foot boring was installed just south of the historic plant boundary (S-92). Twelve samples were collected from this location. Samples were submitted to Asarco's TSC laboratory for analysis of arsenic, cadmium, and lead.

As part of the Phase II sampling, a third round of soil sampling was initiated to better define the lateral extent of the study area, as well as fill data gaps observed by Ecology. The lateral extent was investigated by collecting samples from 18 locations along two semicircles approximately 500 and 1000 feet outward from the Phase I "background" samples (samples 201 through 209 in the inner tier; samples 301 through 309 in the outer tier). Sample collection took place at 1 foot intervals using a split spoon to maximum depths of 4 and 2 feet for the inner and outer tiers, respectively. Ninety-six samples were collected and submitted for analysis of arsenic, cadmium, and lead.

Prior to the third round, nine locations were selected by Ecology to provide additional data north and south of the former plant area (S-74, S-83, S-90, S-91, S-93, S-94, S-95, S-96, and S-97). Locations S-74 and S-83 had been sampled previously by SAIC (1991b) during the Pre-RI. Sampling took place using a split spoon to a depth of 4 feet. Sampling depths were 0, 0.5, 1, 2, 3, and 4 feet. Fifty-seven samples were collected and submitted for analysis of arsenic, cadmium, and lead.

2.2.1.4 Public Use Locations

To determine the soil quality in areas of public use (e.g., playgrounds, daycares), 73 soil samples were collected from locations PU-1 through PU-20 at the following depths: 0 to 2”, 6”, 1’, and 2’. The sampling locations are shown on Sheet 2-1. Table 2-2 presents descriptions of the sampling locations and the corresponding sample numbers. Samples were analyzed for arsenic, cadmium, and lead. Analytical results are in Appendix A.

TABLE 2-2 PUBLIC USE SAMPLING LOCATIONS

Sample Number	Location Description
PU-1	Basketball court
PU-2	Exposed soil in private yard
PU-3	Playground
PU-4	Playground
PU-5	Playground
PU-6	Baseball field
PU-7	Debris area
PU-8	Playground
PU-9	Playground
PU-10	Daycare
PU-11	Daycare
PU-12	Daycare
PU-13	Daycare
PU-14	Playground
PU-15	Playground
PU-16	Playground
PU-17	Playground
PU-18	Composite along wall
PU-19	Composite along wall
PU-20	Playground

In total, approximately 430 soil samples were collected and analyzed from 60 soil borings at depths up to 15 feet during the Phase I and II soil sampling efforts in the residential area. In combination with the approximately 50 soil samples from deep soil borings and monitoring wells and the 73 public use samples, approximately 550 residential soil samples were analyzed during the Everett RI effort.

2.2.2 Lowland Area

In the lowland area, soil quality was investigated by collecting soil samples from sixteen monitoring wells (EV-4A/B, EV-5, EV-6A/B, EV-7A/B, EV-8A/B, EV-9A/B, and MW-1 through MW-5) and three slag borings (SL-1, SL-3, and SL-4). Sheet 2-1 shows locations of the monitoring wells and the slag borings.

A total of 139 samples was collected during installation of the monitoring wells. The samples were collected with a split spoon at approximately two-foot intervals for the first 20 feet, after which an approximately five- to ten-foot sampling interval was used. In certain instances, additional samples were collected based upon particular soil characteristics and/or location within the stratigraphic sequence. Eighty-four samples were submitted to Asarco's TSC for analysis of arsenic, cadmium, and lead. Per the Workplan (Hydrometrics, 1992a), the samples analyzed were from the following approximate depths: surface (0 to 2"), 2', 5' 10', and 15'. At depths greater than 15', selection of samples submitted for analysis was based on field observation. The remaining samples were archived.

Three soil samples, consisting of fill material, were collected from slag borings SL-1, SL-3, and SL-4 (see Section 2.1 and Sheet 2-1). The samples were collected at depths of 8 to 14 feet, 18 to 20 feet, and 13 feet, respectively, using the recovery from the air rotary drilling unit. The samples were submitted to Asarco's TSC for analysis of arsenic, cadmium, and lead.

2.3 SURFACE WATER INVESTIGATION

2.3.1 Residential Area

Field investigations of surface water were undertaken to characterize stormwater runoff as an actual or potential hazardous substance migration route. See WAC 173-340-350(c)(i). Surface water in the residential area was investigated by collection of surface water samples from seven locations in the residential area. The sampling locations are shown on Sheet 2-1.

Samples were collected at seven grate cover access points in the combined sanitary and storm sewer. The locations were selected such that they provided full coverage of the residential area and associated former smelter (SW-6 through SW-11). Also, one location (SW-12) was monitored for background purposes. Sample collection took place during and after three storm events on March 22 and December 10, 1993, and January 23, 1994. Field measurements included temperature, pH, and SC. First-round samples were submitted to Asarco's TSC laboratory for analysis of total arsenic, cadmium, and lead. Second and third round samples were analyzed for dissolved arsenic, cadmium, and lead as well. Rainfall was monitored by installation of a rain gauge. Flow was measured through use of a container and stopwatch. In addition, the general direction of surface flow was investigated. Analytical results are in Appendix A.

2.3.2 Lowland Area

Collection of surface water samples in the lowland area was not required by the Workplan (Hydrometrics, 1992a). However, to identify possible migration of metals through surface water, samples were collected from the downgradient drainage ditch system on the Weyerhaeuser property below the Kraft Mill access road. Sample collection took place at five locations (SW-1 through SW-5) on March 18. An additional location (SW-14) was included in the second and third sampling rounds on April 19 and December 10, 1993, respectively. Surface water sampling sites are shown on Sheet 2-1. Field measurements included temperature, pH, and SC. The samples were submitted to Asarco's TSC for analysis of total and dissolved arsenic, cadmium, and lead, and common cations and anions (Rounds 1 and 2 only). Flow, if present, was measured through use of a container and stopwatch.

2.4 GROUNDWATER INVESTIGATION

Field investigations of groundwater and hydrogeology were undertaken to characterize the areal and vertical distribution and concentrations of hazardous substances in the groundwater, and to identify features which may affect fate and transport of these hazardous substances. See WAC 173-340-350(c)(iii). Groundwater conditions in both the upland, residential area west of East Marine View Drive, and the lowland, industrial area were investigated.

2.4.1 Well Installation

Soil borings were initially drilled at five sites in the residential area (EV-1, EV-2, EV-3, B-1 and B-2) to investigate shallow groundwater and soil conditions. Monitoring wells were installed at all locations where groundwater was encountered. EV-1, located southwest of the former smelter site, was the only one of these initial drilling sites where saturated conditions were observed in shallow fill or till. A monitoring well was installed in the shallow till at EV-1 and a second well was installed in the deeper advance outwash unit at EV-3 at the eastern (downgradient) side of the residential area (Sheet 2-1). Since no groundwater was encountered at EV-2, B-1 or B-2, wells were not completed at these locations. A more detailed discussion of the drilling results and the occurrence of groundwater in the residential area is presented in Section 3.1 of this report.

Additional wells were installed downgradient of the Smelter Site in the area east of East Marine View Drive and in the lowland area. Four wells (EV-4A/4B and EV-6A/6B) were installed at the top of the bluff near the Weyerhaeuser access road east of East Marine View Drive (Sheet 2-1) and an additional thirteen wells were installed in the lowlands as part of this investigation. These thirteen lowland monitoring wells are EV-5, EV-7A/7B, EV-8A/8B, EV-9A/9B, MW-1, MW-2, MW-3, MW-4A/4B, and MW-5.

Several deviations from the original Workplan (Hydrometrics, 1992a) occurred with approval from Ecology:

- Monitoring wells MW-2 and MW-3 were installed across the Burlington Northern railroad tracks because of difficulties in obtaining access to the Benson property.

- At location EV-4, paired wells (EV-4A and EV-4B) were installed to determine the vertical hydraulic gradient and examine water quality changes between the shallow and deep groundwater systems. Groundwater quality at this location was of particular interest due to the proximity of these wells to the slag.

- Three additional monitoring wells (MW-4A, MW-4B, and MW-5) were completed on Burlington Northern property to better evaluate groundwater flow and quality downgradient from the smelter site,

- Six additional monitoring wells (EV-7A, EV-7B, EV-8A, EV-8B, EV-9A, and EV-9B) were installed downgradient from the Kraft Mill access road to monitor groundwater originating from the former smelter site, and to investigate a slough identified on the 1913 topographic map (Cutter and Tegtmeier, 1913).

- Two wells near SL-4 (EV-6A and EV-6B) were completed in and below the slag deposit to assess water quality in close proximity to this potential source material and to investigate the presence of a silt layer beneath the slag pile. On December 28, 1993, well MW-4B was found to be damaged beyond repair. It was abandoned in accordance with State of Washington Minimum Standards for Construction and Maintenance of Wells (WAC 173-160) on January 27, 1994.

The monitoring wells were drilled and installed by Holt Drilling of Puyallup, WA, using a combination of hollow stem auger and air-rotary drilling techniques. A hydrogeologist from Hydrometrics was present during drilling to collect samples, log the geology, and observe well installation. The monitoring wells were constructed according to State of Washington monitoring well specifications, however, a variance was required for shallow lowland wells due to the shallow depth to groundwater. Monitoring wells were constructed of 2-inch ID Schedule 40 PVC with sand packs in the annular space around the well screen, bentonite annular seals, a concrete surface seal and a locking protective casing at the ground surface. Well completion details are provided on well logs in Appendix F.

Special precautions were taken during completion of the deeper monitoring wells to prevent cross-contamination between the shallow and deep groundwater systems. At deep well locations in the lowland, steel casing was advanced through the shallow fill layer and set 3 to 6 feet into the underlying silt layer. The casing was blown clear and then backfilled with bentonite. A hollow stem auger was used to drill through the bentonite and advance the boring through the silt layer. After constructing the well and sand pack in the deeper alluvial aquifer, the well annulus was then backfilled with bentonite and the steel casing removed.

The monitoring wells were developed by pumping or bailing. Field parameters were monitored during well development. Wells were generally purged until turbidity cleared and field parameters stabilized. Development water from the first set of wells (EV-1, EV-3, EV-4A/B, EV-5, MW-1) was containerized and disposed off-site by Burlington Environmental. Development water from subsequent newly installed wells was containerized and submitted for rapid-turnaround analysis of arsenic, cadmium, and lead. Depending on these results, development water was either disposed of in the evaporation facility at the former Asarco Tacoma smelter or discarded on the site. Development water from the following wells was transported to the Tacoma smelter for evaporation: WP-1, MW-4B, EV-4A, EV-6A, EV-7A/7B, EV-8A/8B, and EV-9A/9B.

2.4.2 Permeability Testing

2.4.2.1 Field Testing

Slug tests were conducted in March 1993 to determine hydraulic conductivity estimates for the representative hydrostratigraphic units on site. Slug tests rather than pumping test were the primary method used to characterize the hydraulic conductivity of the hydrostratigraphic units in the study area. Pumping tests were not conducted because they would require containment and disposal of large volumes of water. Slug testing of wells can be an accurate means of determining the transmissivity of the aquifer material immediately surrounding a well. However, due to the relatively small stress placed on the aquifer, slug testing has a limited area of influence. When applying slug test results to the characterization of a hydrostratigraphic unit, it is important to consider the extent to which soil conditions at the test site are representative of the unit as a whole.

During slug testing, water level fluctuations were digitally recorded using an In-Situ datalogger and pressure transducer. The transducer was suspended above the bottom of the well and the datalogger was started prior to slug testing. The water level recovery was recorded during testing by the datalogger at logarithmic time intervals. Both slug-in and slug-out tests were conducted at each well. The transducer, slug and rope were washed thoroughly between sites.

Alternative means were necessary to evaluate the permeability of the till at depth since it was unsaturated at all of the deeper boring locations. A representative soil sample was taken from boring EV-2B at a depth of 16 to 17.5 feet during the second round of drilling and submitted for laboratory testing. The till sample was selected from EV-2B because the vertical potential for leaching in this area is of particular interest due to high concentrations of arsenic in shallow soils. The results of the permeability testing are presented in Appendix G.

2.4.2.2 Data Analysis

The analytical approach used to evaluate the slug test data varied depending on whether the groundwater system at a given well location was confined or unconfined. Test results from unconfined systems (shallow fill and advance outwash groundwater systems) were analyzed according to slug test methodology developed by Bouwer and

Rice (1976). Slug tests from confined or partially confined systems (till in the upland and alluvium in the lowland) were analyzed using both Bouwer and Rice (1976) and Cooper et al. (1967) methods. The aquifer test data were analyzed using AQTESOLV, a computer program developed by Geraghty and Miller, which allows the user to analyze time-drawdown graphically based on curve matching techniques.

The Bouwer and Rice method was developed for slug tests on partially or completely penetrating wells in unconfined aquifers, but may also be used on wells in confined aquifers (Bouwer and Rice, 1976). The flexibity of the solution method allows it to be applied in a range of site conditions without explicit correction for aquifer type or well geometries. In contrast, there are a number of assumptions implicit in the Cooper et al. (1967) method that should be considered in its application.

The major assumptions of the method are that the aquifer is confined and that the well is fully penetrating. As noted previously, results determined from Cooper et al. analyses were only used in characterizing confined units. The assumption regarding full penetration, however, was not met at all the well sites, particularly in the lowland where wells are assumed to penetrate only the uppermost portion of the aquifer. The actual influence on hydraulic conductivity estimates is believed to be minimal. The equations developed by Cooper et al. (1967) assume that flow to the well is horizontal. Partial penetration can result in a vertical component of flow, particularly in a pumped well. Cooper et al. , however, note that partial penetration effects may be minimal under typical test conditions since flow is likely to be essentially two-dimensional during the short period of induced stress. To account for partial penetration, the hydraulic conductivity at partially penetrating wells was estimated based on the screened interval of the well rather than the full thickness of the aquifer, as recommended by Cooper et al. in their paper.

2.4.3 Tidal Investigation

A tidal investigation was conducted on May 18 and May 19, 1993, to characterize the effect of tides on both shallow and deep groundwater systems. A total of six monitoring wells (EV-4B, EV-5, MW-4A, MW-4B, MW-5 and WP-1) was instrumented with In-Situ datalogger/pressure transducer systems. Monitoring wells were selected to provide a north-south transect through existing wells screened in advanced outwash, lowland fill and lowland alluvium. A datalogger was also installed at the Snohomish River to document tidal fluctuations (Sheet 2-1). Water level measurements were recorded at one minute intervals for the duration of the test. Two rounds of manual water level measurements were taken at all monitoring well sites during the test as a cross-check to data logger readings and to provide reference measurements in wells without recorders for purposes of correlation. The monitoring wells and tidal measuring point on the Snohomish River were surveyed to a common datum (Mean Sea Level) to provide a basis for comparing water level elevations. The tidal monitoring results are presented and discussed in Section 3.1.2. Hydrometrics has proposed to collect additional tidal data to further evaluate the effects of tidally induced groundwater fluctuations on groundwater flow in the study area.

2.4.4 Monitoring of Seasonal Water Level Changes

Water levels were measured at all monitoring wells on a monthly basis to evaluate seasonal changes in groundwater levels. The measurements were taken to the nearest 100th of a foot using a Solinist electronic water level indicator. With a few exceptions, water levels measurements were collected during low tide periods to provide a consistent basis for comparison. Water level data are presented and discussed in Section 3.1.2.

2.4.5 Sample Collection

Prior to sampling, the monitoring wells were purged by removing a minimum of three bore volumes of groundwater. Purge water from the first sampling of the first set of wells (EV-1, EV-3, EV-4A/B, EV-5, MW-1) was containerized and disposed off-site by Burlington Environmental. Purge water from subsequent sampling rounds was containerized and submitted for rapid-turnaround analysis of arsenic, cadmium, and lead. Depending on these results, purge water was either disposed of in the evaporation facility at the former Asarco Tacoma smelter or discarded on the site. Purge water from the following wells was transported to the Tacoma smelter for evaporation: WP-1, MW-4B, EV-4A, EV-6A, EV-7A/7B, EV-8A/8B, and EV-9A/9B.

Samples were collected using a dedicated pump or a 3/4" peristaltic tubing pump. Sampling took place in accordance with standard operation procedures outlined in the Workplan (Hydrometrics, 1992a).

For an initial evaluation of groundwater quality, groundwater samples were collected from EV-1, EV-3 (west of East Marine View Drive), and EV-4A/B, EV-5, and MW-1 (east of East Marine View Drive) immediately following development of each well. These samples were submitted for analysis by Sound Analytical Services in Fife, WA, and analyzed for total arsenic, cadmium, and lead. In addition to providing initial data on groundwater quality, these samples were also intended to provide information relevant to investigative waste profiling.

Following this preliminary sampling, groundwater samples were collected during six sampling rounds in February, April, June, September, and December 1993, and in August 1994. On February 17, 1993, newly installed monitoring wells EV-1, EV-3, EV-4B, EV-5, MW-1, and existing monitoring well WP-1 were sampled. On April 21 and 22, and June 16, 1993, wells EV-1, EV-3, EV-4A/B, EV-5, MW-1 through MW-5, and WP-1 were sampled. The September 15, 16, and 17, 1993, sampling round included wells EV-1, EV-3, EV-4B, EV-5, EV-6A/B, EV-7A/B, EV-8A/B, EV-9A/B, MW-1 through MW-5, and WP-1. On December 28 and 29, 1993, wells EV-3, EV-4A/B, EV-5, EV-6A/B, EV-7A/B, EV-8A/B, EV-9A/B, MW-3, MW-4A, MW-5, and WP-1 were sampled. On August 23 and 24, 1994, lowland wells EV-5, EV-7A/B, EV-8A/B, EV-9A/B, MW-1 through MW-5, and WP-1 were sampled concurrent with an EMCON groundwater sampling effort of Weyerhaeuser's former Mill E wood treatment facility. During most sampling rounds, well EV-4A, a shallow well, was either dry or did not contain sufficient water to obtain representative groundwater samples.

During sampling, temperature, pH, Dissolved Oxygen (DO), and Specific Conductivity (SC) were measured in the field. The samples were submitted to Asarco's TSC laboratory for analysis of inorganic parameters. Organic parameters were analyzed by Analytical Resources Inc. in Seattle, WA. All samples were packed on ice and sent overnight delivery to the respective laboratories. Sample handling and shipping was in accordance with standard operation procedures outlined in the Workplan (Hydrometrics, 1992a). Table 2-3 shows the analytical parameters for groundwater. However, certain parameters were omitted from this list during later sampling rounds as it became apparent that their concentrations remained constant with time. In addition, analysis of arsenic speciation was discontinued in the case of consistent non-detects for arsenic. Analytical results are in Appendix A.

TABLE 2-3 ANALYTICAL PARAMETERS GROUNDWATER

Total/Dissolved Metals	Common Ions	Miscellaneous Parameters	Field Parameters	Organic Parameters**
Arsenic (As)	Bicarbonate	Alkalinity	Temperature	Semivolatiles
Cadmium (Cd)	Calcium	Conductivity	Conductivity	Volatiles
Copper (Cu)	Carbonate	pH	pH	
Lead (Pb)	Chloride		Dissolved Oxygen	
Zinc (Zn)	Magnesium			
	Potassium			
As Speciation *	Sodium			
	Sulfate			

* Dissolved only

** Wells EV-3 and EV-5, second round only

2.5 HOUSEHOLD DUST INVESTIGATION

Because household dust is a potential route for exposure through inhalation or ingestion, dust samples were collected from six residences (HD-1 through HD-6) within the study area (Sheet 2-1). The six residences (approximately 10% of the total number of residences on the former smelter site) were selected such that nearby soil metal results were available for comparison. Sampling locations and dates are listed in Table 2-4.

TABLE 2-4 HOUSEHOLD DUST SAMPLING LOCATIONS

Residential Location	Sample	Date
520 East Marine View Drive	HD-1	8/23/93
538 East Marine View Drive	HD-2	8/23/93
566 East Marine View Drive	HD-3	8/23/93
450 Pilchuck Path	HD-4	8/23/93
520 Pilchuck Path	HD-5	8/23/93
415 Pilchuck Path	HD-6	9/01/93

Sampling took place in August and September, 1993, during an extended period of dry weather to increase the chance of dust entrainment. The samples were collected using a Quiet-Flow Area Sampler. The sampling flow was maintained at a constant 10L/minute. Collection of samples took place by "vacuuming" 10 linear feet of surfaces such as windowsills and tops of appliances (e.g. refrigerators, washer/dryer). The dust was collected in a 0.08 micron external filter cassette. Filters were analyzed for arsenic and lead by Asarco's TSC laboratory. Analytical results are in Appendix A.

In addition to collection of household dust by "vacuuming", dust quality was investigated by wipe sampling. Wipe sampling took place by wiping an area of 100 cm^2 with a moist, 45 micron filter. The area selected for sampling was immediately adjacent to the area used for "vacuuming". The filters were submitted for analysis of arsenic and lead by Asarco's TSC laboratory.

2.6 QUALITY ASSURANCE, QUALITY CONTROL, AND DATA VALIDATION

During sampling activities, quality assurance (QA) was achieved through use of Standard Operating Procedures, sample chain-of-custody documentation, and submission of field quality control (QC) samples, including blanks, standards, and replicates. Quality assurance in laboratory analyses was achieved through use of Standard Laboratory Procedures and analysis of laboratory QC samples, including laboratory control samples (standards), preparation blanks, duplicates, sample spikes, and calibration verification standards and blanks. A detailed description of QA/QC procedures can be found in the Workplan (Hydrometrics, 1992a) prepared for and approved by Ecology as per WAC 173-340-820.

Samples were sent to three different laboratories. As a rule, all soil, groundwater, surface water, and household dust samples were submitted to Asarco's Technical Services Laboratory (TSC) in Salt Lake City, UT, for analysis of inorganic constituents. In Appendix A, this lab is denoted as ASARCO-SLC. Analyses of organic compounds in groundwater were performed by Analytical Resources Inc. in Seattle, WA, denoted as ARI in Appendix A. When rapid turn around was required, samples were submitted to Sound Analytical Services in Fife, WA (SAS in Appendix A). Lastly, Appendix A contains references to the lab HYDRO for a few groundwater samples. This generally indicates that a well was either dry, or a sample could not be collected by Hydrometrics personnel due to lack of water.

The analytical methods used by TSC are listed in the Workplan (Hydrometrics, 1992a). In soil, arsenic, cadmium, and lead were analyzed by ICP (EPA SW 6010), FAA (cadmium: EPA SW 7130; lead: EPA SW 7420), or GFAA (arsenic: EPA 206.2). The detection limits for arsenic, cadmium, and lead in soil generally were 5, 1, and 5 ppm, respectively. However, detection limits used for the soil samples collected as part of the Public Use sampling effort were 5 ppm for all three elements. Consequently, for these samples, the detection limit for cadmium exceeded the cleanup standard. Detection limits used in previous studies varied. In water, arsenic was analyzed by ICP (EPA 200.7) or GFAA (arsenic: EPA 206.2; cadmium: EPA 213.2; lead: EPA 239.2). Detection limits for arsenic, cadmium, and lead in water generally were 5 ppb.

Hydrometrics performed data validation to identify any unreliable or questionable data. Data validation procedures followed Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (USEPA, 1988a), and Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (USEPA, 1988b). Where applicable, validation also included statistical treatment of data to determine precision and accuracy of analytical results.

The results of the data validation effort for the Everett Smelter Site RI are presented in a validation report (Appendix I). Based on the QA/QC review, a small number of groundwater, surface water and soil samples were qualified (J4) due to exceedances related to duplicates and blanks. However, none of these exceedances required rejection of the sampling results for the purpose of data evaluation.

3.0 INVESTIGATIVE RESULTS

3.1 SITE GEOLOGY AND HYDROGEOLOGY

3.1.1 Geology

3.1.1.1 Upland Residential Area

The former smelter facilities were located on the upland portion of the plant site (Sheet 1-2). Both shallow and deep soil borings were conducted in this area to provide detailed descriptions of the subsurface geology. Monitoring wells were installed at selected locations to provide information on groundwater levels and water quality. The geologic conditions at soil boring locations are described in boring/monitoring well logs in Appendices C, D, and E. The locations of shallow soil borings are shown on Sheet 2-1. Deep soil borings and monitoring wells are shown on Sheet 2-1 and Sheet 3-1 and geologic data for these sites are presented in well logs in Appendix F. Well completion data are shown on monitoring well logs in Appendix F and are summarized in Table 3-1.

Generalized geologic cross sections of the site, A-A' and B-B' (Sheet 3-2), were constructed from geologic data at the deep soil boring and monitoring well locations. The subsurface geology shown in these sections is generally consistent with that previously described by the USGS (Minard, 1985a,b) for upland areas in northern Everett. Detailed cross sections at an expanded vertical scale, including additional east-west sections and soil arsenic data, are shown on cross-sections C-C'. D-D', E-E', F-F' and G-G' (Sheets 3-4 through 3-6) and are discussed in detail in Section 3.3.

As illustrated on the generalized cross sections in Sheet 3-2, the upland portion of the site is underlain by a thick layer of glacial till followed by a deeper sequence of advance outwash deposits. The till is covered at the surface by a layer of fill comprised of silt, sand and gravel, intermixed locally with brick, slag, and smelter demolition debris.

Sieve analyses were conducted on soil samples to determine the grainsize distribution of representative geologic units. The sieve results (Appendix G), show a very similar grainsize distribution in the glacial till and surface fill. Although the actual source of the fill is unknown, it can be assumed that it is related to regrading of the area for

TABLE 3-1 SUMMARY OF WELL COMPLETION DATA

Well	Date Completed	Site Location	Target Formation	Well Installed	MP Elev. (ft. MSL)	Boring Depth (ft)	Well Depth (ft)	Screened Interval Depth	SWL Depth** (ft)	SWL Elev. (ft MSL)
EV-1	01/19/93	Upland	Till	Y	112.38	19	15	5 - 15	4.6	107.8
EV-2	02/01/93	Upland	Till	N	NA	20	NA	NA	dry	NA
EV-2B	08/17/93	Upland	Till	N	NA	21.5	NA	NA	dry	NA
EV-3	01/22/93	Upland	Outwash	Y	56.64	55	55	50 - 55	47.9	8.7
EV-4A	01/21/93	Upland†	Fill	Y	57.56	12.5	11	6 - 11	10.6	47.0
EV-4B	01/21/93	Upland†	Outwash	Y	57.10	60	60	55 - 60	52.0	5.1
EV-5	02/02/93	Lowland	Alluvium	Y	10.30	30	30	25 - 30	7.4	2.9
EV-6A	08/17/93	Upland†	Fill	Y	57.13	55.5	54.5	44.5 - 54.5	47.9	9.2
EV-6B	08/24/93	Upland†	Alluvium	Y	57.11	68.5	67.5	62.5-67.5	52.0	5.1
EV-7A	08/16/93	Lowland	Fill (slag)	Y	11.41	15.5	10	5 - 10	2.2	9.3
EV-7B	08/20/93	Lowland	Alluvium	Y	11.3	29	29	22 - 29	7.4	3.9
EV-8A	08/16/93	Lowland	Fill (slag)	Y	11.78	11.5	11	6 - 11	2.5	9.3
EV-8B	08/18/93	Lowland	Alluvium	Y	11.07	26.5	26	20.8-25.8	8.1	3.0
EV-9A	08/16/93	Lowland	Fill (slag)	Y	12.69	17.5	16	6 - 16	3.2	9.5
EV-9B	08/23/93	Lowland	Alluvium	Y	12.52	29.5	28.5	23.5-28.5	8.1	4.4
MW-1	02/03/93	Lowland	Alluvium	Y	15.03	21	21	16 - 21	10.8	4.2
MW-2	04/13/93	Lowland	Fill	Y	10.32	11.5	9	2.5 - 9	3.8	6.5
MW-3	04/12/93	Lowland	Fill	Y	8.13	11.5	9	2.5 - 9	1.4	6.8
MW-4A	04/12/93	Lowland	Fill	Y	8.34	7	7	2.5 - 7	1.7	6.6
MW-4B	04/13/93	Lowland	Alluvium	Y	8.79	26	26	21 - 26	6.0	2.8
MW-5	04/13/93	Lowland	Fill	Y	7.67	10	9	2.5 - 9	1.2	6.5
WP-1	5/90*	Lowland	Fill (Slag)	Y	14.43	13	10	5 - 10	5.2	9.2

Notes: NA = Not Applicable
* Installed by Hart Crowser
** Approximate Static Water Level Depth
† Well located in upland area east of East Marine View Drive

residential development which began in the 1920s, and was essentially a redistribution of materials already present including debris from the former plant site. Subsequent construction of East Marine View Drive, the Weyerhaeuser Kraft Mill access Ramp and State Route 529, contributed to relocation of large amounts of fill. A review of DOT and City of Everett documents relative to the interchange construction do not provide specific information on fill redistribution. However, based on data from soil borings and topographic changes shown in the site cross sections (Sheet 3-2), it appears the fill was completely removed in the vicinity of the State Route 529 interchange during its construction. This material appears to have been used in part for construction of the access ramp to the Weyerhaeuser Kraft Mill resulting in a fill thickness greater than 60 feet east of East Marine View Drive in the access ramp area. Although no soil data are available, fill material removed from the interchange may also have been used in construction of portions of State Route 529 other than the interchange itself. The thickness of the fill in the residential portion of the site generally varies from 5 to 10 feet. The fill may be thicker locally (for example, along East Marine View Drive; see cross section B-B', Sheet 3-2). The fill thickness shown in these sections is inferred from soil borings and original ground surface elevations depicted in historical maps of the plant site (Cutter and Tegtmeier, 1913).

The till generally consists of light brown to gray, fine sand and silt with some fine gravel. Standard penetration tests conducted in the till indicate medium to very high densities. Medium densities were encountered in the weathered upper horizons of the till (20 to 50 blows per 6-inchs). High blow counts (greater than 50 blows per 6 inches) were generally encountered 3 to 6 feet into the till. Based on surficial geologic mapping by the USGS (Minard, 1985a,b), the till unit is relatively flat lying and is exposed in outcrops up to 60 feet thick. In geologic cross sections of the site (Sheet 3-2), the till is inferred to be up to 60 feet thick at the upper (western) end of the site. However, soil borings only penetrate the till to 20 feet in this area and so the exact thickness of the till at the western end of the site is unknown. The till ranges from 7 to 14 feet near the eastern limit of the upland area at EV-4A and EV-3, respectively

Groundwater was encountered in the shallow till at well EV-1, which lies just over the crest of the hill to the west of the smelter site (see detailed cross-section F-F', Sheet 3-5). The hydrologic relationship between EV-1 and the smelter site is unclear since this well appears to lie just beyond the topographic divide from the Smelter site. Evidence of shallow groundwater was found at a few other locations in the upland residential area during the course of the field investigation. In most of these cases, however, the vertical extent of soil moisture appeared to be very limited. Table 3-2 provides a summary of sites were shallow water was encountered. The location and extent of water encountered in soil borings is shown on the detailed cross sections (Sheets 3-4, 3-5 and 3-6).

No shallow groundwater was encountered at any of the deep soil borings or monitoring well locations in the residential portion of the site, west of Marine View Drive (EV-2A, EV-2B, EV-3, B-1 and B-2). Unsaturated conditions appeared to be present in the shallow till at all of these locations at the time of drilling. At those sites where shallow groundwater was encountered, the till was found to be dry at depths greater than 15 feet.

Available data suggest very limited occurrences of groundwater in the fill and till in the Smelter Site area. Shallow water is clearly present at EV-1 to the west of the Smelter site, however, this well may lie in a separate hydrologic system. Additional wells may be necessary to confirm the presence and extent of groundwater in the residential area.

Advance outwash deposits were encountered beneath the till at wells EV-3 and EV-4B. The outwash deposits at these locations consist of light brown, fine to medium sand, with occasional fine gravel and infrequent lenses of coarse sand to silt. The outwash is unsaturated immediately below the till contact at both well locations. Groundwater was not encountered until 20 to 25 feet into the advance outwash deposits, indicating unconfined groundwater conditions in the outwash at these locations.

The Snohomish River has eroded through the upland glacial sequence at the bluff on the eastern side of the site, juxtaposing alluvial/estuarine deposits against the bluff in the lowland area. The lowland deposits are stratigraphically adjacent to the advance outwash deposits (Sheet 3-2) The water table in the advance outwash is at an elevation consistent with water levels encountered in the deeper alluvial deposits in the lowland.

TABLE 3-2 SUMMARY OF SITES WHERE SHALLOW WATER WAS ENCOUNTERED IN UPLAND AREA AND ESTIMATED GROUNDWATER FLUX

Well/Boring	Total Depth ft	Depth to Water ft	Wet (?) Interval ft	Estimated Transmissivity ft2/day*	Well Log Description
S-8	15.5	2.5	3.5	1.05	Hit water at 2.5'. Gray, Silt, Clayey, Oxidation spots
S-39	16.5	1	4	1.2	Very wet brown silt above 4.0', moist light gray silt with gravel 4-5.5', dry @ 6'
S-46	16.7	4	2	0.6	Very wet, loose, brown silt from 4' -5', moist from 6' to 10', dry below 10'
S-47	11.2	4.5	2	0.6	Till from 4.5 - 6.5' very moist, moldable. Mud rings coming off augers
S-95	4	1	2	0.6	Red brown fine sand/silt, medium gravel, moist (dry at 3-4 ')
S-96	4	3	1	0.3	Light grey fine sand/silt red streaks small gravels wet (dry at 4')
S-97	4	3	1	0.3	Light grey fine sand/silt small gravels wet
S-102	4	2	2	0.6	Brown silt, sandy, pea gravels - 10%, water encountered
EV-1	19	10	10	3	Light brown/grey fine sand and silt trace fine gravel (wet)
EV-4A	11	9	3	0.9	Grey fine sand and silt, some clay, little gravel (wet)

* *Transmissivity estimate based on assumed hydraulic conductivity of 0.3 ft/day as determined from slug test results for shallow till at EV-1*

28 Total Soil Borings >48", 4 encountered moist to wet conditions
44 Total Soil Borings 48" or less, 4 encountered moist to wet conditions
6 Upland Monitoring Wells/Deep Borings, 2 encountered wet conditions (EV-1, west of Smelter Site and EV-4A, east of E. Marine View Dr.)

Estimated Groundwater Flux in Shallow Upland Till/Fill Unit:

Flux (q) = Transmissivity (T) x Hydraulic Gradient (i)

T	0.92 ft2/day	Average transmissivity of shallow soils (inferred from well log data as shown above)
i	0.125	Assumed hydraulic gradient (based on surface topography in smelter site area)
q	0.114 ft3/day	Groundwater Flux per unit width
	0.0006 gpm	Groundwater Flux per unit width
Estimated Groundwater Discharge = Q	0.6 gpm	Discharge per 1000 ft width

Lowland Area

The lowland geology consists of alluvium and estuarine deposits composed of sequences of sand, silt, and clay, with considerable amounts of organic matter. The thickness of the alluvium and estuarine deposits probably exceeds 90 feet (Minard, 1985a,b).

Hydrogeologic investigations conducted at various Weyerhaeuser facilities in the lowlands describe 3 to 9 feet of fill composed predominantly of fine to coarse sand dredged from the Snohomish River (see Section 1.5 for a description of previous investigations). This fill layer is underlain by an estuarine/wetland silt layer containing abundant organic matter. The silt layer is typically 6 to 12 feet thick, but may be thinner or absent locally. The silt is underlain by alluvial sand and gravel.

The general stratigraphic sequence encountered in the lowland portion of the site is very similar to that described at Weyerhaeuser sites. However, the fill materials associated with the lowland portion of the smelter site exhibit much more variable composition. The fill at wells EV-6A/6B, EV-7A/7B, EV-8A/8B, and EV-9A/B is composed predominantly of slag material. The slag varies from 9 to 26 feet thick at these locations. The fill at MW-1 and EV-5 consists of silt, sand, and gravel, and is much more poorly sorted than fill encountered at the Weyerhaeuser sites east of the Burlington Northern railroad tracks. The fill encountered at wells east of the tracks (MW-3, MW-4A/4B and MW-5) is similar to descriptions of the dredge fill from Weyerhaeuser Mill E and Mill B sites further to the east, and is composed of fine to coarse sand. An exception to this trend is well MW-2, which had a substantial amount of wood and metal debris in the fill.

Silt is present beneath the fill layer at all lowland well locations. Wells EV-5, EV-7B, EV-8B, EV-9B, MW-1, and MW-4B fully penetrate the silt layer and are completed in the underlying alluvium. The thickness and continuity of the silt layer potentially controls groundwater flow between the shallow fill and deeper alluvial groundwater systems. The thickness of the silt layer at lowland monitoring well sites ranges from approximately 7 to 18 feet. The silt layer may be eroded or breached locally by former meander channels of the Snohomish River. Geologic cross sections of the site indicate that a silty sand layer is present at the base of the bluff and may represent in-filling of an earlier channel of the Snohomish River (Sheet 3-5). Historical maps from the period of smelter operation also show a slough in the vicinity of the Burlington Northern tracks that appears to be a remnant of an earlier stream channel (Sheet 3-1). Where these erosional features have incised the silt, they may influence the vertical migration of groundwater. Additional lowland borings have been proposed to further investigate the continuity of the silt layer in the vicinity of the former smelter site.

Alluvial sand and gravel were encountered beneath the silt layer in all deeper lowland borings (MW-1, MW-4B, EV-5, EV-7B, EV-8B, and EV-9B) at depths of 18 to 25 feet. The lower extent of the alluvial sand and gravel has not been established, but the USGS reports that this alluvial unit may extend to depths of 90 feet (Minard, 1985a,b). The lowland alluvium would appear to lie stratigraphically adjacent to the upland advance outwash.

3.1.2 Site Hydrogeology

3.1.2.1 Hydrostratigraphic Units

Upland Residential Area

The site stratigraphy in the upland area can be divided into three distinct hydrostratigraphic units based on the hydrologic properties of the subsurface materials. These are 1) fill/shallow till, 2) deeper unweathered till, and 3) advance outwash.

The fill material and the upper weathered horizon of the till form a low permeability unit in which there are local occurrences of groundwater. As described in Section 3.1.1, moist to wet soil conditions were encountered at a number of soil borings in the upper 3 to 10 feet of the fill/weathered till unit. The presence of abundant smelter debris could enhance the permeability of this unit locally, however, high permeability debris intervals were not encountered during site borings.

The unweathered till appears to be very dense and was consistently dry at depths greater than 15 feet at all of the soil boring and well locations indicating a very low vertical permeability. The boundary between the weathered till and the denser unweathered till is gradational.

The advance outwash deposits are shown on USGS maps underlying the till throughout the northern end of Everett and are believed to be in excess of 300 feet thick (Minard, 1998a,b). They thus appear to form a thick and laterally extensive aquifer system in the northern Everett area. The advanced outwash is unconfined at EV-3 and EV-4B on the eastern edge of the upland area.

Lowland Area

The fill material, silt layer, and underlying alluvium form the three main hydrostratigraphic units in the lowland. The fill and alluvium are the principal lowland aquifers while the intervening silt layer forms a confining layer, limiting flow between the two aquifers. The shallow fill aquifer is unconfined, while the deeper alluvial aquifer is confined by the overlying silt. All three lowland units appear to lie at the same stratigraphic interval as the upland advance outwash and potentially abut the advance outwash unit along the bluff separating the upland and lowland areas.

3.1.2.2 Hydraulic Conductivity

Slug test and permeameter results for on-site wells are summarized in Table 3-3 and indicate a hydraulic conductivity range of approximately 6×10^{-3} cm/sec to 6×10^{-8} cm/sec for upland hydrostratigraphic units. Time-drawdown graphs from slug tests including curve matching analytical results are in Appendix G.

No slug tests were conducted in the upland fill, since the fill was not found to be saturated at any of the upland wells sites. However, a slug test was conducted in the shallow till at monitoring well EV-1. Slug tests at EV-1 indicate a hydraulic conductivity for the shallow till of approximately 1×10^{-4} cm/sec. Density and grainsize distribution for the fill are similar to the shallow till and so the hydraulic conductivity of the shallow till at EV-1 is likely representative of the permeability of the fill except in areas where substantial smelter debris may be present. If large amounts of smelter debris are present in the fill, it could result in localized areas of higher permeability.

Split spoon samples from the deeper unsaturated till at EV-1, and EV-2A were submitted to Pacific Testing Laboratories in Bothell, Washington, for permeameter testing to determine the hydraulic conductivity of the deeper till. Samples were submitted from EV-1 at 17.5 to 19.5 feet, and EV-2A at 10.5 to 12 feet. The tests were run using a flexible wall permeameter according to ASTM Method D-5084. The results are shown in Table 3-3 and indicate a hydraulic conductivity range for the deeper till of approximately 2×10^{-7} to 6×10^{-8} cm/sec. Laboratory results are in

TABLE 3-3 SUMMARY OF HYDRAULIC CONDUCTIVITY RESULTS

Well #	Unit	Aquifer Type	Test Method	Analytical Method	Hydraulic Conductivity (ft/day)	(cm/sec)
EV-1	Shallow Till	Unconfined	Slug Test	Bouwer & Rice	0.30	1.04 E-04
EV-1	Deep Till	Unsaturated	Permeameter	ASTM D-5084	5.7 E-04	2.0 E-07
EV-2A	Deep Till	Unsaturated	Permeameter	ASTM D-5084	1.7 E-04	5.9 E-08
EV-3	Adv. Outwash	Unconfined	Slug Test	Bouwer & Rice	16.55	5.84 E-03
EV-4B	Adv. Outwash	Unconfined	Slug Test	Bouwer & Rice	0.83	2.93 E-04
EV-5	Alluvium	Confined	Slug Test	Bouwer & Rice	36.72	1.30 E-02
EV-5	Alluvium	Confined	Slug Test	Cooper et al.	26.21	9.25 E-03
MW-1	Alluvium	Confined	Slug Test	Bouwer & Rice	3.37	1.19 E-03
MW-1	Alluvium	Confined	Slug Test	Cooper et al.	3.37	1.19 E-03
MW-2	Fill	Unconfined	Slug Test	Bouwer & Rice	58.82	2.08 E-02
MW-3	Fill	Unconfined	Slug Test	Bouwer & Rice	71.37	2.52 E-02
MW-4A	Fill	Unconfined	Slug Test	Bouwer & Rice	87.19	3.08 E-02
MW-4B	Alluvium	Confined	Slug Test	Bouwer & Rice	34.70	1.22 E-02
MW-4B	Alluvium	Confined	Slug Test	Cooper et al.	31.45	1.11 E-02
MW-5	Fill	Unconfined	Slug Test	Bouwer & Rice	30.38	1.07 E-02
WP-1	Fill	Unconfined	Slug Test	Bouwer & Rice	14.44	5.10 E-03

Appendix G. The hydraulic conductivity results for the deeper till are 3 to 4 orders of magnitude lower than the shallow till which is indicative of the permeability contrast between the weathered and unweathered till.

Slug tests at wells EV-3 and EV-4B completed in the advance outwash indicate hydraulic conductivities ranging from approximately 6×10^{-3} to 3×10^{-4} cm/sec, respectively. The higher results at EV-3 may be a more accurate indication of the permeability of the advance outwash deposits since problems encountered with running sands at EV-4B may have influenced permeability results at that site. When setting the well at EV-4B, fine sands were forced into the borehole by the hydraulic pressure in the formation and may have reduced the efficiency of the sandpack and well screen. This is suggested by a relatively high turbidity at this well compared to other wells, which persisted after well development.

Hydraulic conductivity values for the lowland hydrostratigraphic units are also shown in Table 3-3. The investigation of the lowland hydrogeology is ongoing. However, a preliminary discussion of the permeability test results for the lowland is included below.

Slug tests in the lowland area indicate hydraulic conductivities in the fill ranging from approximately 5×10^{-3} to 3×10^{-2} cm/sec. Fill permeabilities may vary over a wider range locally based on the composition of the fill material. Areas of slag may have higher permeabilities, while the finer grained fill materials at EV-5 and MW-1 are likely much lower in permeability. EV-5 and MW-1 were not completed in the fill since there was no evidence during drilling of free water within the fill interval at these locations.

The underlying silt unit has no wells completed in it, however, laboratory testing of silt samples by Weyerhaeuser indicates a hydraulic conductivity range for the silt of 2×10^{-8} to 3×10^{-7} cm/sec (Hart Crowser, 1991). Slug test results in the underlying alluvial aquifer indicate a hydraulic conductivity range of approximately 9×10^{-3} to 1×10^{-2} cm/sec.

3.1.2.3 Groundwater Flow Direction

Monthly water level measurements and water elevations for upland and lowland monitoring wells are in Table 3-4 and Table 3-5 respectively. Potentiometric maps showing seasonal groundwater flow trends were compiled in areas where there was sufficient information available for contouring (Sheet 3-3). Groundwater contours could not be developed for the upland fill or the shallow weathered till due to the scattered occurrence of groundwater in this unit. Vertical infiltration is likely limited by the high density and low permeability of the underlying till. All of the borings in the till were dry below depths of 5 to 15 feet. Because of the low vertical permeability of the till, horizontal flow would be the preferred pathway for groundwater flow. Flow directions would likely be consistent with site topography, flowing east towards the lowland area. Phreatic vegetation potentially plays a significant role in groundwater uptake in areas of till due low groundwater flux. Shallow groundwater in the bluff area probably infiltrates vertically through fill and colluvium (erosional material) at the bluff face, or is taken up by vegetation. Seepage was not observed on the face of the bluff during field activities, however, there are

TABLE 3-4. MONTHLY WATER LEVELS

	EV-1	EV-3	EV-4A	EV-4B	EV-5	EV-6A	EV-6B	EV-7A	EV-7B	EV-8A	EV-8B	EV-9A	EV-9B	MW-1	MW-2	MW-3	MW-4A	MW-4B	MW-5	WP-1
	Till	Outwash	Fill	Outwash	Alluvium	Fill	Alluvium	Fill (slag)	Alluvium	Fill (slag)	Alluvium	Fill (slag)	Alluvium	Alluvium	Fill	Fill	Fill	Alluvium	Fill	Fill
DATE:																				
2/17/93	2.29	47.78	9.45	51.68	6.35	NA	NA	NA	NA	NA	NA	NA	NA	9.96	NA	NA	NA	NA	NA	5.17
3/12/93	3.85	47.73	9.93	51.61	7.39	NA	NA	NA	NA	NA	NA	NA	NA	10.13	NA	NA	NA	NA	NA	5.04
4/26/93	3.20	47.68	8.87	51.68	7.96	NA	NA	NA	NA	NA	NA	NA	NA	9.03	2.73	0.32	0.56	6.25	0.99	4.99
5/19/93	1.02	47.78	8.49	51.59	8.33	NA	NA	NA	NA	NA	NA	NA	NA	9.00	2.89	0.43	0.68	7.08	1.26	4.96
5/20/93	0.98	47.44	8.53	51.53	7.68	NA	NA	NA	NA	NA	NA	NA	NA	9.06	2.91	0.46	0.73	7.12	1.29	4.94
6/23/93	1.78	47.69	9.25	51.78	8.51	NA	NA	NA	NA	NA	NA	NA	NA	9.59	3.07	0.68	0.93	7.30	1.40	4.80
7/22/93	2.06	47.44	9.51	51.65	6.84	NA	NA	NA	NA	NA	NA	NA	NA	9.66	3.09	0.62	0.95	5.86	0.88	4.70
8/23/93	4.07	47.77	10.22	51.46	8.72	47.97	NA	2.18	6.50	2.56	7.38	3.54	7.52	10.52	3.67	1.02	1.46	5.75	0.63	5.30
9/23/93	4.59	47.91	10.56	51.96	7.38	47.91	52.03	2.15	7.40	2.50	8.10	3.17	8.08	10.81	3.81	1.35	1.70	6.04	1.17	5.21
10/29/93	5.10	48.03	DRY	51.95	7.02	47.91	51.96	2.11	6.95	2.48	7.56	3.14	7.66	10.81	3.83	1.22	1.65	5.99	1.49	5.18
11/29/93	5.53	48.61	DRY	51.81	6.19	47.80	51.88	2.03	6.32	2.40	6.80	3.06	7.22	10.78	3.79	1.13	1.47	4.81	1.81	5.13
12/28/93	2.31	48.00	9.80	51.80	6.40	47.13	51.71	1.40	6.38	1.78	6.92	2.66	7.09	9.97	2.88	0.43	0.55	*	1.39	4.50
1/27/94	0.95	47.87	9.46	51.57	6.58	47.74	51.64	1.95	6.53	2.33	7.12	2.98	7.21	9.54	2.69	0.10	0.35	**	0.80	4.97
2/28/94	0.12	47.77	9.08	51.58	7.56	47.69	51.61	1.91	6.38	2.38	7.09	2.95	7.16	8.58	2.64	0.11	0.35	**	7.56	4.89
3/16/94	0.02	47.54	9.12	51.53	5.86	47.53	51.48	1.75	6.05	2.13	6.64	2.79	6.81	8.68	3.03	0.29	0.48	**	1.57	4.78
4/20/94	0.14	47.43	0.43	51.67	6.90	47.48	51.69	1.69	6.60	2.07	7.38	2.39	7.29	8.78	3.16	0.23	0.43	**	1.62	4.66
8/22/94	BURIED	48.02	DRY	51.93	6.69	48.74	51.42	2.91	6.64	3.28	7.18	4.21	7.44	10.97	5.18	3.24	3.18	**	3.32	6.01
9/12/94	BURIED	48.14	DRY	51.74	7.62	48.98	52.97	3.06	7.77	3.44	8.49	4.28	8.42	11.26	5.46	3.45	3.34	**	4.24	6.12
10/19/94	BURIED	48.34	DRY	52.21	7.06	48.62	52.59	3.14	7.07	3.54	7.64	4.38	7.82	11.38	7.74	3.46	3.48	**	3.11	6.26
11/17/94	3.17	47.93	9.06	51.84	6.72	47.41	51.87	1.56	6.71	1.94	7.26	2.81	7.48	10.11	3.14	0.33	0.98	**	0.68	4.62
12/15/94	1.37	47.93	9.74	51.57	5.94	47.18	51.48	1.36	6.08	1.76	6.57	2.43	6.92	9.91	2.80	0.47	0.76	**	0.74	4.44
1/11/95	0.04	47.02	8.86	51.24	5.21	47.62	51.35	1.63	5.53	1.98	7.90	2.77	8.31	8.54	2.44	0.13	0.37	**	0.55	4.62
2/7/95	0.01	47.32	9.68	51.42	7.73	47.59	51.35	2.01	7.78	2.41	6.43	2.99	6.64	8.56	3.28	0.44	0.65	**	1.28	4.58
3/9/95	0.01	47.08	9.03	51.04	5.18	46.97	51.17	1.89	6.33	2.23	7.85	2.63	6.27	8.57	3.04	0.53	0.58	**	1.02	4.89
4/26/95	FLOW	47.12	8.95	51.52	7.24	47.47	51.58	1.67	6.75	2.05	7.61	2.72	7.32	8.83	2.97	0.44	0.67	**	1.63	4.66

NOTE: * = Monitoring well damaged
** = Monitoring well abandoned
NA = Monirtoring well not installed at time of measurement

TABLE 3-5. MONTHLY GROUNDWATER ELEVATIONS

	EV-1	EV-3	EV-4A	EV-4B	EV-5	EV-6A	EV-6B	EV-7A	EV-7B	EV-8A	EV-8B	EV-9A	EV-9B	MW-1	MW-2	MW-3	MW-4A	MW-4B	MW-5	WP-1
	Till	Outwash	Fill	Outwash	Alluvium	Fill	Alluvium	Fill (slag)	Alluvium	Fill (slag)	Alluvium	Fill (slag)	Alluvium	Alluvium	Fill	Fill	Fill	Alluvium	Fill	Fill
Date																				
2/17/93	110.09	8.86	48.11	5.42	3.95	NA	NA	NA	NA	NA	NA	NA	NA	5.07	NA	NA	NA	NA	NA	9.26
3/12/93	108.53	8.91	47.63	5.49	2.91	NA	NA	NA	NA	NA	NA	NA	NA	4.90	NA	NA	NA	NA	NA	9.39
4/26/93	109.18	8.96	48.69	5.42	2.34	NA	NA	NA	NA	NA	NA	NA	NA	6.00	7.59	7.81	7.78	2.54	6.68	9.44
5/19/93	111.36	8.86	49.07	5.51	1.97	NA	NA	NA	NA	NA	NA	NA	NA	6.03	7.43	7.70	7.66	1.71	6.41	9.47
5/20/93	111.40	9.20	49.03	5.57	2.62	NA	NA	NA	NA	NA	NA	NA	NA	5.97	7.41	7.67	7.61	1.67	6.38	9.49
6/23/93	110.60	8.95	48.31	5.32	1.79	NA	NA	NA	NA	NA	NA	NA	NA	5.44	7.25	7.45	7.41	1.49	6.27	9.63
7/22/93	110.32	9.20	48.05	5.45	3.46	NA	NA	NA	NA	NA	NA	NA	NA	5.37	7.23	7.51	7.39	2.93	6.79	9.73
8/23/93	108.31	8.87	47.34	5.64	1.58	9.16	NA	9.23	4.80	9.22	3.69	9.15	5.00	4.51	6.65	7.11	6.88	3.04	7.04	9.13
9/23/93	107.79	8.73	47.00	5.14	2.92	9.22	5.08	9.26	3.90	9.28	2.97	9.52	4.44	4.22	6.51	6.78	6.64	2.75	6.50	9.22
10/29/93	107.28	8.61	DRY	5.15	3.28	9.22	5.15	9.30	4.35	9.30	3.51	9.55	4.86	4.22	6.49	6.91	6.69	2.80	6.18	9.25
11/29/93	106.85	8.03	DRY	5.29	4.11	9.33	5.23	9.38	4.98	9.38	4.27	9.63	5.30	4.25	6.53	7.00	6.87	3.98	5.86	9.30
12/28/93	110.07	8.64	47.76	5.30	3.90	10.00	5.40	10.01	4.92	10.00	4.15	10.03	5.43	5.06	7.44	7.70	7.79	*	6.28	9.93
1/27/94	111.43	8.77	48.10	5.53	3.72	9.39	5.47	9.46	4.77	9.45	3.95	9.71	5.31	5.49	7.63	8.03	7.99	**	6.87	9.46
2/28/94	112.26	8.87	48.48	5.52	2.74	9.44	5.50	9.50	4.92	9.40	3.98	9.74	5.36	6.45	7.68	8.02	7.99	**	0.11	9.54
3/16/94	112.36	9.10	48.44	5.57	4.44	9.60	5.63	9.66	5.25	9.65	4.43	9.90	5.71	6.35	7.29	7.84	7.86	**	6.10	9.65
4/20/94	112.24	9.21	57.13	5.43	3.40	9.65	5.42	9.72	4.70	9.71	3.69	10.30	5.23	6.25	7.16	7.90	7.91	**	6.05	9.77
8/22/94	BURIED	8.62	DRY	5.17	3.61	8.39	5.69	8.50	4.66	8.50	3.89	8.48	5.08	4.06	5.14	4.89	5.16	**	4.35	8.42
9/12/94	BURIED	8.50	DRY	5.36	2.68	8.15	4.14	8.35	3.53	8.34	2.58	8.41	4.10	3.77	4.86	4.68	5.00	**	3.43	8.31
10/19/94	BURIED	8.30	DRY	4.89	3.24	8.51	4.52	8.27	4.23	8.24	3.43	8.31	4.70	3.65	2.58	4.67	4.86	**	4.56	8.17
11/17/94	109.21	8.71	48.50	5.26	3.58	9.72	5.24	9.85	4.59	9.84	3.81	9.88	5.04	4.92	7.18	7.80	7.36	**	6.99	9.81
12/15/94	111.01	8.71	47.82	5.53	4.36	9.95	5.63	10.05	5.22	10.02	4.50	10.26	5.60	5.12	7.52	7.66	7.58	**	6.93	9.99
1/11/95	112.34	9.62	48.70	5.86	5.09	9.51	5.76	9.78	5.77	9.80	3.17	9.92	4.21	6.49	7.88	8.00	7.97	**	7.12	9.81
2/7/95	112.37	9.32	47.88	5.68	2.57	9.54	5.76	9.40	3.52	9.37	4.64	9.70	5.88	6.47	7.04	7.69	7.69	**	6.39	9.85
3/9/95	112.37	9.56	48.53	6.06	5.12	10.16	5.94	9.52	4.97	9.55	3.22	10.06	6.25	6.46	7.28	7.60	7.76	**	6.65	9.54
4/26/95	FLOW	9.52	48.61	5.58	3.06	9.66	5.53	9.74	4.55	9.73	3.46	9.97	5.20	6.20	7.35	7.69	7.67	**	6.04	9.77

NOTE: * = Monitoring well damaged

** = Monitoring well abandoned

NA = Monirtoring well not installed at time of measurement anecdotal accounts that seepage on the bluff face and wet soils have been observed during wet seasons below the slag outcrop on the bluff.

The amount of groundwater flux through the shallow fill/till unit in the upland area would be quite low based on the hydrologic characteristics of the material. Flux calculations shown in Table 3-2 suggest that average flow rates through the fill/till unit are less than 1 gpm per thousand feet. Higher flow rates may be present locally due to local variations in permeability, particularly if there are areas where buried smelter debris increases the permeability of the shallow fill. Higher short-term flow rates could occur in these areas during high rainfall events.

Both potentiometric data (Sheet 3-3) and stratigraphic relationships (Sheet 3-2) suggest that the advance outwash system discharges to the alluvial aquifer in the adjacent lowlands. A northeast groundwater flow direction is inferred between the advance outwash and lowland alluvium in the vicinity of the bluff based on seasonal potentiometric maps. Groundwater flow directions remain relatively consistent between spring and fall (Sheet 3-3). Groundwater levels in the advance outwash fluctuated approximately one foot seasonally, with the lowest water levels occurring in late fall and recovering in spring. Minor water level fluctuations on the order of several hundreds of a foot were observed in the advance outwash at wells EV-3 and EV-4B during the tidal investigation. Tidal data are summarized in Table 3-6.

The range of tidal fluctuation was much higher in the adjacent lowland alluvial deposits and may reflect in part the change from a confined groundwater system in the lowlands to an unconfined system in the uplands.

The potentiometric data from lowland wells indicate an easterly flow direction in the shallow fill and a northeast groundwater flow direction in the deeper alluvial aquifer (Sheet 3-3). Water levels in shallow lowland monitoring wells between the Bluff and the Burlington Northern tracks show some variability that may indicate local variations in groundwater flow directions. In general, groundwater flow directions in the lowland remain relatively constant between spring and fall, although fall potentiometric data show a steep hydraulic gradient developing in the shallow groundwater system at the Burlington Northern tracks immediately east of the site. This change in hydraulic gradient at the tracks suggests that the permeability of the

TABLE 3-6 SUMARY OF TIDAL STUDY DATA

		5/18/93 Manual Measurements		5/19/93 Manual Measurements		'5/18/93-5/19/93 Transducer Data - Statistical Summary*			
Well	**M.P. Elev.**	**SWL Depth**	**SWL Elev.**	**SWL Depth**	**SWL Elev.**	**Low**	**Mean**	**High**	**Difference**
EV-1	112.38	1.02	111.36	0.98	111.40	ND	ND	ND	ND
EV-3	56.64	47.48	9.16	47.44	9.20	9.11	9.14	9.16	0.05
EV-4A	57.56	8.49	49.07	8.53	49.03	ND	ND	ND	ND
EV-4B	57.10	51.59	5.51	51.53	5.57	5.47	5.53	5.59	0.12
EV-5	10.30	8.33	1.97	7.68	2.62	1.96	3.26	5.00	3.04
MW-1	15.03	9.00	6.03	9.06	5.97	ND	ND	ND	ND
MW-2	10.32	2.89	7.43	2.91	7.41	ND	ND	ND	ND
MW-3	8.13	0.43	7.70	0.46	7.67	ND	ND	ND	ND
MW-4A	8.34	0.68	7.66	0.73	7.61	7.49	7.50	7.56	0.07
MW-4B	8.79	7.08	1.71	7.12	1.67	1.80	3.19	4.31	2.51
MW-5	7.67	1.26	6.41	1.29	6.38	6.31	6.35	6.39	0.08
WP-1	14.43	4.96	9.47	4.94	9.49	9.47	9.49	9.52	0.05
Tidal Gage	13.60	10.22	3.38	8.44	5.16	-5.08	0.25	5.58	10.66

Notes:

ND - No Data

**Transducer data were collected at 1 minute intervals over the duration of testing* shallow fill beneath the tracks is lower, possibly due to consolidation of the fill in the track area.

Groundwater levels in the lowland shallow groundwater system are approximately 4 feet higher than in the deeper alluvium, creating a steep downward hydraulic gradient. While this suggests potential for downward flow from shallow to deep groundwater systems, the actual amount of vertical flow is limited by the low permeability of the intervening silt layer. Additional field work will be conducted to evaluate if there are other potential avenues for groundwater interaction between the shallow and deep aquifers. These include breaches in the silt layer, as well as flow around the silt layer at the contact with the advance outwash along the bluff face.

Water level fluctuations exceeded 2 feet in the lowland alluvial aquifer during the tidal investigation. In contrast, tidally induced groundwater fluctuations in the lowland shallow fill were limited to several tenths of a foot. A time lag of approximately 2 hours and twenty minutes occurred between high tide and peak groundwater levels in both the shallow and deep groundwater systems. There was no evidence of flow reversals in either system due to tidal fluctuations and a downgradient was maintained between the shallow and deep systems. The tidal data is summarized in Table 3-6. Additional tidal investigations have been proposed for the lowland area to further evaluate the effects of tidally induced groundwater fluctuations on groundwater flow in the study area.

3.1.2.4 Hydrochemical Facies

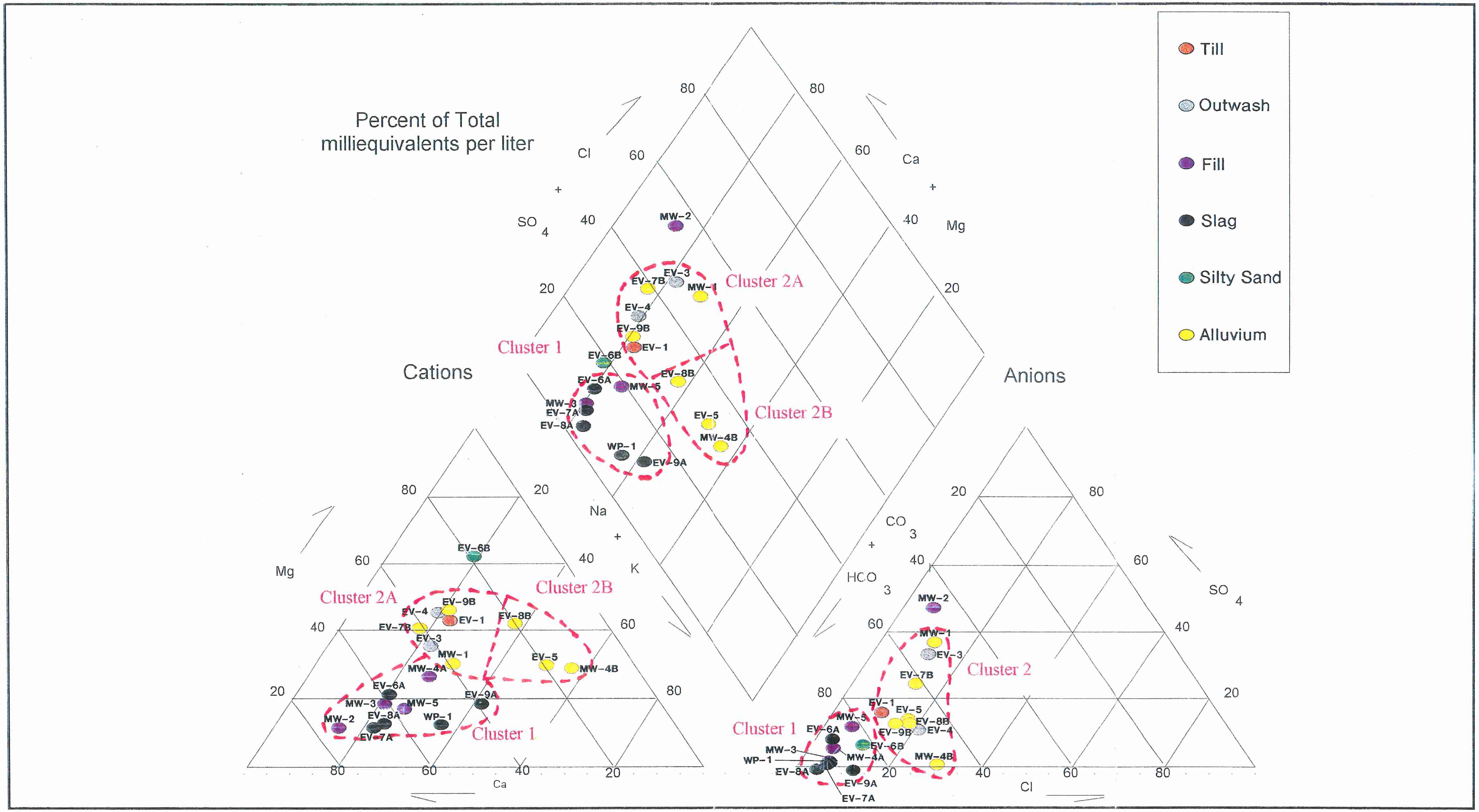
In addition to identification of hydrostratigraphic units through lithological descriptions and evaluation of potentiometric surfaces, the common ion (Mg, Ca, Na, K, Cl, SO_4, CO_3, and HCO_3) signature of groundwater can be used to further characterize the groundwater regime. Due to the different characteristics of individual aquifers (e.g., mineralogical composition, permeability/porosity, degree of atmospheric interaction) the common ion composition of groundwater may vary considerably and provide insight as to the groundwater flowpaths, time of travel, and possible mixing. However, it must be kept in mind that a similar common ion composition does not necessarily imply that waters have the same origin or are otherwise related. Instead, these waters may have independently undergone similar processes, resulting in comparable chemical characteristics.

To be able to refer to water compositions by identifiable categories, the concept of "hydrochemical facies" has been developed (Freeze and Cherry, 1979). Hydrochemical facies are distinct zones that have cation and anion concentrations that can be expressed in terms of defined compositional categories. Compositional categories can be identified by using a variety of graphical representations, the most common of which is the trilinear Piper diagram. In this diagram, the common ion concentrations are shown as percentages expressed in milliequivalents per liter.

The common ion compositions of residential and lowland groundwater are shown in Figure 3-1. To avoid unnecessary clutter, the data from individual sampling rounds are averaged and represented by a single point on the plot rather than plotted individually. Table 3-7 shows sampling rounds represented in the plot for each well location. The five different groundwater sampling rounds are denoted by the suffix -1, -2, -3, -4, or -5. In Figure 3-1, the hydrostratigraphic unit associated with an individual data point is denoted by color as indicated in the legend.

As shown in Figure 3-1, shallow lowland water samples from the slag (shown in black) and fill (shown in purple) cluster together (this group of wells is delineated on Figure 3-1 as Cluster #1). Groundwater from these shallow lowland wells is characterized by a high HCO_3 to SO_4 and HCO_3 to Cl ratio, with calcium being the dominant cation. Although not shown on the figure for the sake of clarity, the common ion cluster for surface water collected in the lowland is identical to that of the shallow groundwater. This indicates that the main source of recharge for the fill groundwater is through infiltration of surface water (i.e. precipitation, in which HCO_3 is the dominant anion).

Therefore, the common ion signature of the shallow fill unit is a reflection of the limited interaction that has taken place between soil material and groundwater. Consequently, these waters are considered immature, having spent relatively little time in the subsurface. Water level measurements in the shallow wells also indicate that the fill groundwater system and the surface water system are interconnected as water levels are close to or at the ground surface during periods of intense precipitation.



Proj. No: ASEV01
Dwg. No: 03095H01
Drawn By: 0035
Last Update: 5/4/95
Ref. Dwg: GWPIP2.WB1
Rev. Date:

Hydrometrics, Inc.

Figure 3-1

Piper Diagram for Groundwater

Asarco Everett Smelter Site Remedial Investigation
Everett, Washington

FIGURE 3-1 PIPER DIAGRAM FOR GROUNDWATER

TABLE 3-7 WATER QUALITY SITES INCORPORATED IN PIPER DIAGRAM ANALYSIS

Well/Sampling Round	Well/Sampling Round	Well/Sampling Round
EV-1 / 1	EV-7A / 5	MW-3 / 2
EV-1 / 2	EV-7B / 4	MW-3 / 3
EV-1 / 3	EV-7B / 5	MW-3 / 4
EV-1 / 4	EV-8A / 4	MW-3 / 5
EV-3 / 1	EV-8A / 5	MW-4A / 2
EV-3 / 2	EV-8B / 4	MW-4A / 3
EV-3 / 3	EV-8B / 5	MW-4A / 4
EV-3 / 4	EV-9A / 4	MW-4A / 5
EV-4B / 1	EV-9A / 5	MW-4B / 2
EV-4B / 2	EV-9B / 4	MW-4B / 3
EV-4B / 3	EV-9B / 5	MW-4B / 4
EV-4B / 4	MW-1 / 1	MW-5 / 2
EV-5 / 1	MW-1 / 2	MW-5 / 3
EV-5 / 2	MW-1 / 3	MW-5-4
EV-5 / 3	MW-1 / 4	MW-5 / 5
EV-5 / 4	MW-1 / 5	WP-1 / 1
EV-5 / 5	MW-2 / 2	WP-1 / 2
EV-6A / 4	MW-2 / 3	WP-1 / 3
EV-6B / 4	MW-2 / 4	WP-1 / 4
EV-7A / 4	MW-2 / 5	WP-1 / 5

MW-2 is an exception to the general lowland water quality trend shown in Figure 3-1. Groundwater from this well is characterized by a much lower HCO_3 to SO_4 ratio and the lowest Na+K to Ca ratio observed on the site. The low value for the latter ratio indicates that the sulfate is not likely to have originated from marine sources. Instead, it is believed that the high sulfate in groundwater from well MW-2 is likely caused by oxidation of sulfidic material in the dark brown organic silt and black wood encountered at this location during drilling. A hydrocarbon odor, as well as brick, glass and metal fragments were also encountered at this location to the total depth of

11.5 feet, suggesting the area adjacent to MW-2 has been used for disposal of a variety of materials. The water quality trend shown by individual sampling rounds at this site shows some migration toward the general composition of the other lowland wells. Release of sulfate from wood and silt layers at this site may have been enhanced due to drilling disturbances, followed by a slow re-equilibration of groundwater. However, it appears unlikely that the common ion composition in MW-2 will ever fall within the cluster formed by lowland wells. Therefore, MW-2 maintains its unique position in terms of its common ion pattern.

The cation signature of the upland till well EV-1 is similar to samples from the upland outwash unit and the alluvium in the lowland area. The anion signature is intermediate between the outwash/alluvium and the lowland shallow wells. Due to its location upgradient from the former smelter site, the common ion composition at EV-1 can be considered representative of undisturbed native till or "background" conditions.

The two upland outwash wells EV-3 and EV-4B (gray) fall within the cluster of lowland alluvial wells (yellow). This cluster of outwash and alluvial wells is delineated on Figure 3-1 as "Cluster 2". As mentioned in previous sections, the outwash deposit is at the same stratigraphic depth as the lowland alluvium, and interaction between these two units can be inferred from available potentiometric information. A division is apparent within this general cluster, with the wells falling into two distinct groups: Wells EV-3, EV-4B, MW-1, EV-7B, and EV-9B lie in one area (Cluster 2A) and EV-5, EV-8B, and MW-4B lie in a second areas (Cluster 2B). It is not clear what causes this division other than that the wells in Cluster 2A are upgradient from those in Cluster 2B. The change from 2A to 2B, as well as the gradual change evident within Cluster 2B (EV-8B→EV-5→MW-4B) may be a function of increased residence time or indicative of a change in aquifer composition. For instance, an increased presence of clayey material may result in compositional changes in groundwater through processes such as cation exchange It is interesting to note that cluster 4B is closest to the area in which the slough may have been located (see Sheet 3-1). Although the impact of the slough on the groundwater movement and quality is unknown, it is possible that the slough affects groundwater quality. For instance, the slough may act as a preferred groundwater pathway, as a barrier, or allow for more atmospheric interaction due to a higher permeability. Also, a different mineralogical composition of the slough sediments could result in different common ion characteristics. The composition of the slough sediments and their effect of groundwater quality and flow is the subject of additional investigation proposed for the lowlands area.

Finally, a sample from well EV-6B indicates a composition different from the upland outwash or lowland alluvial wells, with a Mg to Na+K ratio which is the highest encountered in the groundwater investigation. In the anion and diamond diagrams, EV-6B plots in the vicinity of cluster 3, the fill wells. Although based on one measurement only, the stratigraphic location of EV-6B in combination with the common ion signature suggests that EV-6B is influenced by the lowland fill aquifer.

In summary, analysis of the common ion composition of groundwater in the study area reveals that three water types can be distinguished in the fill, outwash/alluvium, and till. The alluvium can be further divided into two groundwater types, but additional investigation is required to provide a satisfactory explanation. Groundwater in the outwash unit appears to interact with groundwater in the alluvial system. Wells MW-2 and EV-6B occupy a unique position in terms of their common ion signature, with well EV-6B possibly showing interaction with the lowland fill aquifer. No clear mixing relationships are observed.

3.2 OCCURRENCE AND DISTRIBUTION OF SLAG

Slag is a by-product of the lead-smelting process, and generally resembles a dark, fractured rock much like basalt. Its color ranges from gray to black, with occasional rusty surfaces due to oxidation of iron-bearing constituents. Slag is a hard material with a rough surface, and tends to break into sharp fragments when crushed. Its appearance can vary from massive to vesicular, the latter variety having been caused by entrapment of gas during the cooling process. The texture of slag can range from predominantly crystalline, which is the result of gradual cooling, to amorphous (i.e. vitrified or glassy) caused by rapid cooling. Due to its toughness, slag is generally considered to be highly resistant to chemical and physical weathering.

Slag occurrences in the residential area and lowland were investigated using field observations of surface material and soil samples collected at depth. Also, historic and anecdotal information available was used to make an assessment of the nature and extent of the slag distribution in the lowland area.

In the residential area, scattered slag was found in soils from EV-2A between 1 and 3 feet. In shallow residential borings, slag was found in S-113 up to a depth of 2 feet. Near residential boring S-27, large slag fragments were used as decorative rock. In boring S-27 itself, no slag was encountered.

Evidence of the disposal of slag in the lowland area is largely anecdotal. Photographs of the Puget Sound Reduction Company plant in the late 1800s (Woodhouse, 1979; Daily Independent, 1900) suggest that the molten slag was discarded over the hillside east of the plant. Investigations by SAIC (1991a) and Hydrometrics (present study), have demonstrated the presence of slag on the hillside - the slag outcrop (Sheet 3-1) - and in the lowland below East Marine View Drive currently owned by the Weyerhaeuser Company. Also, the City of Everett had the right to remove up to 4,000 yd^3 of slag per year based on an agreement with Asarco signed in 1933.

Slag on the slag outcrop contains flow patterns typical of molten slag that has been poured off a hillside. A 1913 topographic map of the smelter tract (Cutter and Tegtmeier, 1913) shows two outlines of a slag dump prior to and after partial excavation of the slag (Sheet 1-3). Since the smelter discontinued operations in 1912, it can be assumed that the slag deposit did not increase in size after 1913.

The present outline of the slag deposit as determined by visual observation and borings is markedly different from the outline on the 1913 topographic map. Slag was evidently removed after the smelting operation ceased. In addition to excavation of slag for such purposes as road repair, it is believed that the Cascade Insulation Company (CIC) may have used slag in its rockwool manufacturing process based on various sources listed in Section 1.2. Although records of the actual process have not been located, contemporary information on insulation manufacturing is available (e.g. Close, 1946; Wilson, 1959). It is believed that solidified slag was excavated and remelted in a furnace, after which it flowed to a port in the furnace. As the molten slag left the port, it was shredded by a blast of steam or air, which carried the beads or shot and streamers of wool into annealing chambers. The beads and streamers had the appearance of a comet and its tail, and both have been identified on the site. The rockwool fibers were formed as they passed through the air from the steam blast into the annealing chamber. CIC operated sometime between 1944 and 1955. A 1956 aerial photograph shows the CIC plant and the recently completed interchange between State Route 529 and East Marine View Drive. On this photograph, there is no clear evidence of the presence of the slag deposit, and the topography along the Kraft Mill access road is identical to the current one.

The approximate extent of the slag deposit has been delineated using information from soil borings and monitoring wells. Cross sections A-A' (Sheet 3-2), E-E' (Sheet 3-4), F-F' (Sheet 3-5), and G-G' (Sheet 3-6) show vertical transects through the slag deposit. In slag borings SL-1, SL-3, and SL-4, the slag deposit was encountered at approximately 27, 48, and 27.5 feet below ground surface, respectively. In GeoEngineers' (1990) borings B-1 and B-2 (see Appendix F for logs), it appears that the slag deposit was encountered at approximately 35 and 5 feet below ground surface. However, in most cases, slag chips were present in overlying material, and the actual boundary of the slag deposit may be somewhat imprecise. During the present investigation of the upland area east of East Marine View Drive, slag was observed in EV-6A from 30 to approximately 48 feet, in EV-6B from 30 to approximately 56 feet, and in EV-4B from 15 to 17 feet.

In the lowland area, slag has been found at various locations other than the slag deposit itself. The Weyerhaeuser property between the embankment and the Burlington Northern railroad tracks contains surficial slag. There is no clear pattern to the distribution of this surficial slag. Dredgings from several drainage channels bisecting the lowland and along the railroad tracks indicate the presence of slag as well. These channels have a maximum depth of approximately 3 feet. In GeoEngineers' (1990) boring B-2 in the lowland, scattered slag was found to a depth of 5 feet below ground surface, overlying the slag deposit which extended to a depth of approximately 22 feet. Test Pit 1 also contained slag at a depth between 6 and 7 feet. Fill material in five soil borings (AB-3 through AB-7) advanced by Hart Crowser (1990) contained slag as well. The log for monitoring well WP-1 indicates the presence of slag from 4 to 10 feet below ground surface. In the present study, slag was encountered in EV-7A from 2 to approximately 14 feet, in EV-8A from 2 to approximately 11 feet, and in EV-9A from 6 to 16 feet. In EV-7A, EV-8A, and EV-9A, some slag had a granular, bead-like appearance, most likely resulting from the rockwool manufacturing process described above. Other evidence for rockwool manufacturing having taken place includes the presence of fibrous slag fragments on the surface of the lowland. This material has a pumice-like appearance and floats on water. In EV-5, MW-1, MW-2, MW-3, MW-4A/B, and MW-5, no slag was found.

In addition to the slag in the lowland, surficial slag was observed on the hillside sloping into the Weyerhaeuser Everett Pulp Mill demolition landfill and along the Snohomish River shoreline on Weyerhaeuser Mill B property. No slag was encountered near or in monitoring wells installed on Burlington Northern property.

Due to the presence of a substantial existing data base on the physical and chemical characteristics of slag, no extended effort was made to collect slag for analytical purposes. However, Table 3-8 shows typical analyses of slag as produced by the former Everett lead smelter. The three slag samples were collected from slag borings SL-1, SL-3, and SL-4 near the Weyerhaeuser access road (Sheet 2-1). The samples were submitted for analysis of total metals, TCLP metals, and EPA Method 1312 metals. Method 1312 is also known as the Synthetic Precipitation Leaching Procedure (SPLP). This method is similar to the TCLP procedure, but employs a different leaching medium. The TCLP uses an acetic acid solution at a pH of approximately 2 or 5, depending on the nature of the material being tested. The acetic acid leach is designed to simulate the leachate generated in a landfill containing municipal waste. The SPLP, in contrast, uses a sulfuric/nitric acid mixture at a pH of approximately 4.2 or 5.0 for areas east and west of the Mississippi River, respectively. This extraction medium is designed to simulate the effects of natural precipitation. In general, SPLP is considered a less aggressive leaching method, in particular for lead. Lead is especially sensitive to the presence of organic acids, with which it readily complexes, resulting in elevated lead concentrations in TCLP leachates. However, under most natural conditions in the absence of significant amounts of organic acids, lead is highly immobile and is rarely detected in groundwater.

The results show that the slag composition is quite variable. In order of average decreasing concentration, metals rank as follows: zinc, lead, barium, copper, arsenic, and chromium. Cadmium, mercury, selenium, and silver do not occur in concentrations exceeding 100 ppm. In general, the results are in good agreement with the range of metal values for slag analyses presented in Section 1.5.2 (Table 1-5 from Hart Crowser (1990)). The slag analyses indicate that slag exceeds the MTCA soil cleanup standards for arsenic and lead. WAC 173-340-740(2)(a). Slag sample SL-3 does not fail the cadmium cleanup standard; slag samples SL-1 and SL-4 do.

TABLE 3-8 ANALYTICAL RESULTS SLAG SAMPLES

Parameter (ppm)	SL-1	SL-3	SL-4
Total Metals			
Arsenic	432	410	787
Barium	1,645	8,340	412
Cadmium	3.0	1.0	7.0
Chromium	145	99	44
Copper	1,011	1,701	1,767
Lead	14,790	8,501	18,800
Mercury	0.2	0.2	0.5
Selenium	32	25	19
Silver	87	94	50
Zinc	31,870	67,410	78,380
TCLP Metals			
Arsenic	0.2	0.2	0.4
Barium	2.3	13	0.5
Cadmium	< 0.1	< 0.1	< 0.1
Chromium	< 0.1	< 0.1	< 0.1
Copper	< 0.1	< 0.1	< 0.1
Lead	31	7.8	19
Mercury	< 0.001	< 0.001	< 0.001
Selenium	< 0.1	< 0.1	< 0.1
Silver	< 0.1	< 0.1	< 0.1
Zinc	30	47	110
SPLP Metals			
Arsenic	< 0.1	< 0.1	1.3
Barium	< 0.1	0.2	< 0.1
Cadmium	< 0.1	< 0.1	< 0.1
Chromium	< 0.1	< 0.1	< 0.1
Copper	< 0.1	< 0.1	< 0.1
Lead	< 0.1	< 0.1	< 0.1
Mercury	< 0.001	< 0.001	< 0.001
Selenium	< 0.1	< 0.1	< 0.1
Silver	< 0.1	< 0.1	< 0.1
Zinc	< 0.1	< 0.1	< 0.1

The TCLP results indicate that dangerous waste criteria for arsenic (5 ppm), barium (100 ppm), cadmium (1 ppm), chromium (5 ppm), mercury (0.2 ppm), selenium (1 ppm), and silver (5 ppm) are not exceeded. WAC-173-303-090(8)(c). The lead criterion of 5 ppm is exceeded in all three samples. These results are very similar to those obtained by Hart Crowser (1990, Table 1-5). TCLP criteria for copper and zinc do not exist. SPLP criteria have not been promulgated either. However, if TCLP criteria are applied to the SPLP results, no exceedances are observed. A comparison of the TCLP and SPLP results shows that, as mentioned previously, the TCLP method is a more aggressive leaching test. In particular, the differences in lead and zinc concentrations are rather dramatic.

The SPLP results suggest that slag is not an important source of arsenic, cadmium, and lead to groundwater and surface water on the site. The elevated dissolved arsenic concentrations detected in lowland surface water and groundwater are not likely to have been caused by leaching of the slag, which contains relatively small amounts of arsenic, especially when compared to some residential soils within the former smelter boundary. In addition, if leaching of slag occurred to any significant extent, dissolved lead concentrations in surface water and groundwater in the lowland should be elevated due to the substantial lead content of slag itself. However, this is not the case. In groundwater, dissolved lead is detected in only a few wells, and in surface water dissolved lead concentrations are low as well. Although slag may act as a source to lowland surface water and groundwater, slag alone is probably not responsible for the highly elevated arsenic concentrations in surface water and deep groundwater, nor does it appear responsible for the arsenic distribution pattern observed in the deep groundwater.

3.3 SOIL QUALITY

3.3.1 Residential Area

To further determine the quality of residential soil, following SAIC's 1991 soil investigation (SAIC, 1991b), approximately 550 samples were collected and analyzed by Hydrometrics. The investigative methods used by Hydrometrics are described in Section 2.2, and Sheet 2-1 shows Hydrometrics' sampling locations. Statistical parameters are summarized in Table 3-9. Appendix A lists Hydrometrics' as well as SAIC's analytical results. Section 3.3.1.1 describes the methods used to evaluate soil quality, and Section 3.3.1.2 discusses the analytical results.

3.3.1.1 Methods of Soil Quality Evaluation

Methods used to evaluate soil quality include 1) statistical analysis, 2) construction of cross sections and concentration profiles for individual borings showing vertical metals distributions, 3) construction of maps showing maximum metals concentrations, and 4) construction of contour maps to determine the nature and extent of contamination. The statistical analysis, maximum concentration maps, and cross sections are included in this RI document. The contour maps are part of a separate volume entitled "Arsenic, Cadmium, and Lead Contour Maps for the Everett Smelter Site Study Area", available at Ecology.

Statistical Analysis

The objective of the statistical analysis is to provide summary parameters with which the distributions of the elements of concern can be characterized and interpreted. Statistical parameters commonly used for this purpose include the mean, standard deviation, correlation coefficient, and a variety of other parameters which may serve particular functions. In addition, scattergrams and a correlation matrix are presented which provide further insight in the distribution and interrelationships of arsenic, cadmium, and lead.

The statistical analysis of the soil data in this report is limited to a presentation of a small number of statistical parameters. The reason for this is twofold. First, as shown on Sheet 1-3, the site has been investigated by a large number of parties, which has resulted in a considerable amount of information regarding soil quality. To ascertain that the statistical evaluation is as comprehensive as possible, all available data have been incorporated where appropriate. However, this results in a data set which consists of a variety of sample types (e.g., grab vs. composite), collected for a variety of purposes. For example, some samples were collected to identify smelter structures (Hydrometrics, present study), for geotechnical reasons (GeoEngineers, 1990), and in preparation of construction activities (Dames and Moore, 1993). This may introduce a bias in certain components of the data set, which invalidates an overly rigorous statistical analysis. Second, as will be demonstrated in later sections, soil quality, in particular in the footprint of the former smelter, is highly variable, with metal concentrations ranging from undetected to tens of percents. Due to this variability, a detailed statistical analysis provides relatively little information regarding the actual metal distribution in soil, especially in the smelter area. Therefore, the statistical evaluation in Section 3.3.2.1 is limited to a presentation of the geometric mean, the geometric mean ± 1 standard deviation, scattergrams, and a correlation matrix.

Due to the distinctly different nature of the two arsenic and metal sources on the site, the statistical evaluation is performed for two separate sample groups. Elevated arsenic and metals concentrations in soils are thought to have been primarily caused by two different processes: 1) settling of fugitive emissions and emissions from the smokestacks, and 2) burial and redistribution of smelter demolition debris and waste products. As will be demonstrated in following sections, the former process has affected a large area exhibiting a widespread distribution pattern. The presence of demolition debris on the other hand, is largely restricted to the former plant property, and the associated arsenic and metals patterns can be very irregular. Due to these different distribution characteristics for soil samples collected on the former smelter site and soil samples collected adjacent to this former property, statistical parameters have been calculated for two separate sample groups: the "smelter" samples and the "peripheral" samples. It is assumed that any effects caused by aerial emissions within the former plant site are negligible compared to the effects caused by the presence of the demolition debris.

Both sample groups used for statistical analysis contain samples collected by SAIC (1991a,b) and Hydrometrics (present study). The first group consists of samples located on and in the direct vicinity of the former smelter site ("smelter" samples). As shown on Sheet 2-1, this area is the approximate equivalent of the area bounded by East Marine View Drive, Hawthorne Street, Medora Drive, and the southern boundary of the former smelter property. The second group consists of samples located adjacent to this area, i.e. north of Medora Drive, west of Hawthorne Street, and south of the southern boundary of the former smelter property ("peripheral" samples). Metals other than arsenic, cadmium, and lead are not evaluated using statistical techniques because of the small number of analyses. Section 3.3.2.4 describes analytical results for these parameters. In case of non-detects, half the detection limit was used for statistical analysis. Although detection limits varied somewhat between the individual studies, for the purpose of the statistical evaluation it was assumed that they were 5 ppm for arsenic and lead, and 1 ppm for cadmium.

The statistical evaluation was performed using data from SAIC's study (SAIC, 1991b) at the six locations (IA-1 through IA-6) where soil was removed and replaced as part of the interim remedial actions (Hydrometrics, 1992b). It was decided to use these historic data rather than those of the replacement soil utilized in the 1992 Interim Actions to obtain a better understanding of the metals distribution related to former smelter activities. Consequently, the statistical analysis does not entirely reflect the current metals distribution, although the small number of samples affected is not likely to have a significant impact.

Also, as mentioned previously, during the present study samples were collected at a number of Pre-RI locations previously sampled by SAIC (SAIC, 1991b). Use of both data sets simultaneously would be inappropriate, and so the statistical evaluation used results from the present study where Hydrometrics' sampling locations coincided with those from SAIC (1991b). These locations are S-4, S-8, S-13, S-15, S-22, S-27, S-28, S-34, S-36, S-37, S-39, S-46, S-47, S-50, S-72, S-74, and S-83. Before using one or the other of the data sets, a test was conducted to ensure that there would be no adverse impact resulting from the selection. To determine whether results obtained in the present study agreed with results obtained by SAIC, the two subsets were compared using a correlated t-test. This test identifies a statistically significant difference between the means of two groups using paired samples. Parameters tested were arsenic, cadmium, and lead.

Application of the t-test to the geometric parameters shows that SAIC's and Hydrometrics' arsenic and lead results are identical from a statistical point of view. In other words, any difference between the two subgroup means is not significant and due to chance. For cadmium, the t-test results indicate that the two subgroups are statistically different. Based on the t-test results, use of Hydrometrics' data rather than SAIC's data for statistical evaluation should not result in a different outcome for arsenic and lead. Use of Hydrometrics' cadmium data may lead to results that are slightly different from those based on SAIC's data alone. However, due to the relatively small number of locations sampled twice, overall observations regarding cadmium should not be affected.

Cross Sections and Concentration Profiles

To evaluate the vertical distribution of arsenic, five cross sections were prepared showing detailed geology and arsenic concentrations with depth (Sheets 3-4 through 3-6). Locations of the five cross sections were selected such that they covered the most important areas of interest both in the upland and lowland areas. To present sufficient vertical detail, a vertical exaggeration of 8:1 was used. Rather than using the cross sections as vertical contour maps, arsenic concentrations were color-coded to provide general information on the vertical distribution of arsenic. Use of a contouring approach was felt to be inappropriate due to the scarcity of analytical results relative to the length of the transect covered by the individual cross sections. Therefore, the cross sections should not be used to predict metals concentrations on a yard-by-yard scale.

Cross sections showing vertical cadmium and lead concentrations were not constructed, because, as demonstrated in the statistical evaluation, lead and cadmium generally follow trends that are similar to those for arsenic. However, Appendix B presents concentration profiles for arsenic, cadmium, and lead for individual borings, most of which are included in the cross sections as well (Figures B-1 through B-24).

Maximum Concentration Maps

At Ecology's request, the spatial distribution of arsenic, cadmium, and lead in study area soils is presented in the form of three contour maps (Sheets 3-7 through 3-9) that show the maximum concentration found at a particular sampling location independent of depth. The contour maps were constructed using the contouring software Softdesk DCA, Version 7. Following completion of these mathematically correct contour patterns, they were evaluated and revised if necessary based on best professional judgment. This included an evaluation of former smelter building locations, use of boundary conditions where contour lines were ill-defined due to lack of data, and use of man-made structures where appropriate. The following are some examples of how this site-specific contouring was applied. For instance, it became apparent that underground flues to a large extent were collapsed in place. Therefore, contours surrounding the very high metals values associated with these structures should follow the approximate outlines of the flues. Terminal contour lines were hatched when no peripheral information was available. Due to the distinctly different soil characteristics between the residential area west of East Marine View Drive and the lowland area east of East Marine View Drive, this roadway was on occasion used to define the extent of the residential contour pattern. In addition, the road cut created during construction of SR 529 was used as a contouring boundary. The lowland area itself was not contoured due to the limited number of soil samples available. Although detection limits varied somewhat between the individual studies, detection limits used were 5 ppm for arsenic and lead, and 1 ppm for cadmium. At locations were SAIC (1991b) and Hydrometrics RI samples coincided, the highest concentration was used regardless of origin. Interim Action samples (IA-samples, Hydrometrics, 1992b) were not included in the contouring.

The three contour maps provide general information on the distribution of arsenic, cadmium, and lead on a site-wide scale and are for illustrative purposes only. Ideally, concentrations in an area defined by two contour lines will fall within the range identified by the these two boundaries. However, in particular in the former smelter area, this may not always be the case due to the large variability potentially associated with the distribution of smelter debris. Also, these maps show a depth-integrated pattern as opposed to a horizontal section through the site at a given depth. Therefore, they should not be used to make inferences with regard to arsenic and metals concentrations at particular depths, nor should they be used to predict the spatial distribution of arsenic and metals. Consequently, these three maps cannot be used to determine soil arsenic and metal concentrations on a yard-by-yard scale. In addition, it is inappropriate to evaluate compliance with MTCA criteria such as cleanup levels based on these maps.

Contour maps showing arsenic and metal distributions for individual depths are part of a separate volume entitled "Arsenic, Cadmium, and Lead Contour Maps for the Everett Smelter Site Study Area". This volume is available to interested parties at a limited number of repositories. Use of the maps contained in this volume is constrained by the same limitations as described above. These maps should therefore also not be used for predictive or compliance purposes.

3.3.1.2 Results and Interpretation

Statistical Analysis

Table 3-9 and Figure 3-2 present selected descriptive statistical parameters for the arsenic, cadmium, and lead concentrations at the various depths sampled. Table 3-10 shows a correlation matrix for the elements of concern, and Figures 3-3 through 3-8 are scattergrams providing a graphical representation of the correlation coefficients.

The statistical analysis presented in Table 3-9, as well as its graphical representation in Figure 3-2 are meant for illustrative purposes only. Cleanup decisions, compliance monitoring, and performance monitoring will be based on a more detailed sampling effort, after which the results will be evaluated using appropriate statistical techniques as provided in Ecology (1992). Therefore, neither Table 3-9 nor Figure 3-2 should be interpreted in terms of MTCA requirements. Also, due to the variability associated with the contaminant distribution, concentration profiles for individual borings may differ from the two average borings shown in Figure 3-2. In particular in the smelter area, small-scale variations can lead to concentration trends that are highly irregular and unpredictable. Consequently, the profiles shown in Figure 3-2, as well as the data presented in accompanying Table 3-9 should not be used for predictive purposes.

An important feature of Ecology's statistical guidance is the default assumption that environmental data are distributed lognormally (Ecology, 1992). According to Ecology (1992), rejection or acceptance of a lognormal or normal distribution can be made visually. This was accomplished by constructing histograms for the various data sets investigated. Other parameters taken into account for an assessment of normality included the coefficient of variation, the kurtosis, and the skewness. The coefficient of variation test is a relatively straightforward method by which to identify whether a population follows a normal distribution. The coefficient of variation is defined in Section 2.1.3 of Ecology (1992) as the standard deviation divided by the mean. If this ratio exceeds 1.00, there is evidence of gross nonnormality (EPA, 1989c).

Although the approach described above for testing of normality is not as rigorous as use of methods such as the probability plot or the W test, it is sufficient for the purposes of the RI, which is to describe the contaminant distribution in general terms. Application of the coefficient of variation test indicates that very few of the individual arsenic, cadmium, and lead distributions are normal. Therefore, logarithmically transformed data were used for calculation of descriptive statistics. Table 3-9 presents geometric parameters (the antilogs of logarithmically transformed variables) for a variety of data sets. Under the first heading "All Samples", all 726 analytical results available are combined regardless of sampling depth and sampling location. The next step consists of a separation of "smelter" samples and "peripheral" samples as defined in Section 3.3.1.1. Under the second heading "All Samples", statistical parameters are calculated for all 407 "smelter" samples and 319 "peripheral" samples regardless of depth. Following this general approach, the statistical parameters are determined by individual depth while maintaining the separation between "smelter" and "peripheral" samples. As can be seen, as depth increases, the number of samples decreases substantially, resulting in statistical parameters that become less representative of site-wide conditions. All values are in ppm.

The data shown in Table 3-9 indicate that arsenic and lead, and to a lesser extent, cadmium concentrations differ considerably between the "smelter" and "peripheral" sample groups. Also, they vary with depth. Without exception, for each individual depth, geometric means are lower for the "peripheral" samples than for the "smelter" samples, usually by one or two orders of magnitude.

Figure 3-2 shows the information presented in Table 3-9 in graphical form. In this figure, the geometric means for arsenic, cadmium, and lead in soils from the "smelter" and "peripheral" sample groups are plotted as a function of depth. Concentration trends with depth are very similar for the three analytes. In "smelter" soils, geometric mean arsenic concentrations show a maximum at 1 foot. Geometric mean cadmium concentrations reach a local maximum at 0.5 foot, whereas lead shows a gradually declining trend over the entire depth profile. In "peripheral" soils, arsenic has a slight maximum at 0.5 foot, after which arsenic concentrations decrease with depth. Cadmium concentrations are relatively constant, and lead shows a continuous decrease with depth. At a depth of 7 feet, both cadmium and lead concentrations from "smelter" soils reach concentrations that resemble "peripheral" values. "Smelter" arsenic concentrations resemble shallow "peripheral" values below a depth of 13 feet.

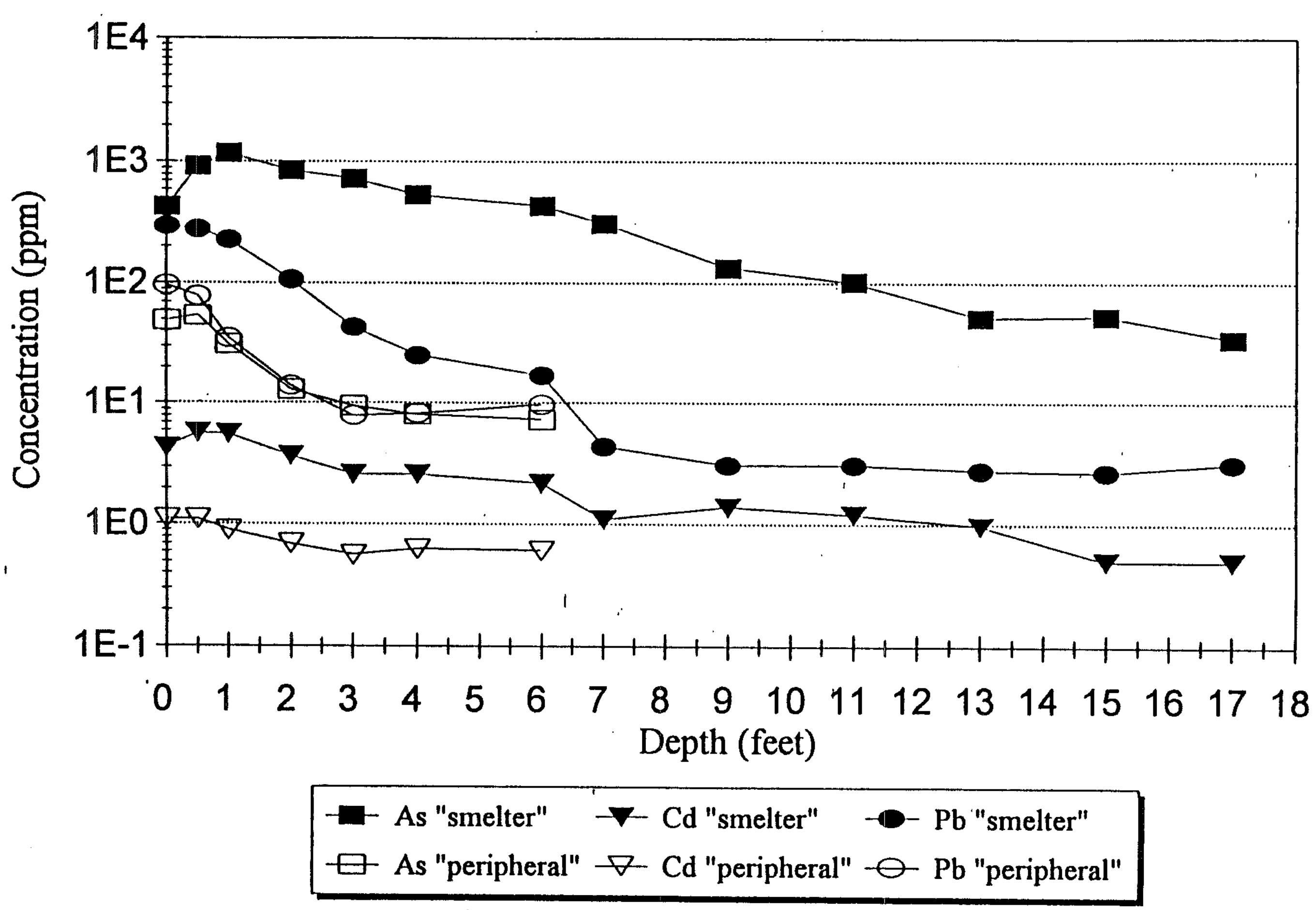
Two features in Figure 3-2 are especially noteworthy. First, arsenic and cadmium show local concentration maxima in both "smelter" and "peripheral" soils at approximately 0.5 foot below ground surface, whereas lead has no such maximum.

Second, at a depth between approximately 6 and 7 feet, cadmium and lead, and to a lesser extent arsenic, undergo a concentration transition in "smelter" soils. These two features can also be seen on most concentration profiles for individual borings (Figures B-1 through B-24 in Appendix B), and are discussed in the section describing the cross sections and concentration profiles.

TABLE 3-9 DESCRIPTIVE STATISTICS FOR ARSENIC, CADMIUM, AND LEAD IN SOILS

	Mean	Mean ± 1 St. Dev.	Mean	Mean ± 1 St. Dev.
All Samples	n=726			
Arsenic	119	9.7-1,460		
Cadmium	1.7	0.44-6.3		
Lead	42	5.6-315		
	"Smelter"		**"Peripheral"**	
All Samples	n=407		n=319	
Arsenic	463	43-4,931	23	4.9-112
Cadmium	2.9	0.70-12	0.83	0.40-1.7
Lead	59	6.2-569	29	6.0-136
Surface	n=79		n=78	
Arsenic	429	87-2,116	49	15-160
Cadmium	4.3	1.4-13	1.1	0.48-2.3
Lead	295	101-860	96	39-238
0.5 Foot	n=49		n=51	
Arsenic	923	151-5,648	54	18-165
Cadmium	5.7	1.8-18	1.1	0.48-2.6
Lead	276	78-980	78	29-211
1 Foot	n=50		n=50	
Arsenic	1,166	160-8,503	31	5.7-170
Cadmium	5.6	1.7-18	0.89	0.38-2.1
Lead	226	49-1,052	35	9.5-131
2 Feet	n=53		n=55	
Arsenic	846	70-10,243	13	2.4-68
Cadmium	3.7	0.85-16	0.69	0.41-1.2
Lead	107	14-844	14	3.9-49
3 Feet	n=49		n=40	
Arsenic	721	45-11,595	9.6	2.6-36
Cadmium	2.6	0.61-11	0.56	0.43-0.74
Lead	43	4.8-391	7.9	2.4-26
4 Feet	n=22		n=30	
Arsenic	532	25-11,201	8.1	1.9-34
Cadmium	2.6	0.46-15	0.63	0.38-1.0
Lead	25	3.1-204	8.3	2.1-33
6 Feet	n=18		n=3	
Arsenic	430	38-4,845	7.4	3.2-17
Cadmium	2.2	0.51-10	0.61	0.43-0.85
Lead	17	3.5-83	9.8	1.8-54
7 Feet	n=17			
Arsenic	308	38-2,474		
Cadmium	1.1	0.33-3.8		
Lead	4.4	1.8-11		
9 Feet	n=15			
Arsenic	132	11-1,616		
Cadmium	1.4	0.26-7.2		
Lead	3.1	1.8-5.3		
11 Feet	n=13			
Arsenic	101	14-706		
Cadmium	1.2	0.22-6.3		
Lead	3.1	2.2-4.4		
13 Feet	n=10			
Arsenic	51	9.3-276		
Cadmium	0.97	0.29-3.2		
Lead	2.8	2.0-3.9		
15 Feet	n=8			
Arsenic	53	7.1-398		
Cadmium	0.5	0.5		
Lead	2.7	2.2-3.1		
17 Feet	n=3			
Arsenic	34	3.4-344		
Cadmium	0.5	0.5		
Lead	3.2	2.1-4.9		

n - Number of Samples



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Geometric Mean
Soil Metal Concentrations
Figure 3–2

Table 3-10 is a correlation matrix showing correlation coefficients (R) that are statistically significant at a 95% confidence limit. The correlation analysis was performed on the logarithmically transformed data for the "smelter" and "peripheral" groups individually. As expected based on Figure 3-2, positive correlation is found between arsenic, cadmium, and lead in the two sample groups. This is in contrast with observations made by Hart Crowser (1990) that "...there is no statistical correlation between arsenic and lead concentrations in Slag Fill area samples, based on linear regression analysis ($r^2 = 0.084$)...", which results in a correlation coefficient of 0.29. The values presented in Table 3-10 are evidence that such a correlation does exist.

TABLE 3-10 CORRELATION MATRIX FOR ARSENIC, CADMIUM, AND LEAD IN SOILS

	Arsenic	Cadmium	Lead	**"Peripheral"**
Arsenic	1.00	0.72	0.78	Arsenic
Cadmium	0.44	1.00	0.65	Cadmium
Lead	0.51	0.68	1.00	Lead
"Smelter"	Arsenic	Cadmium	Lead	

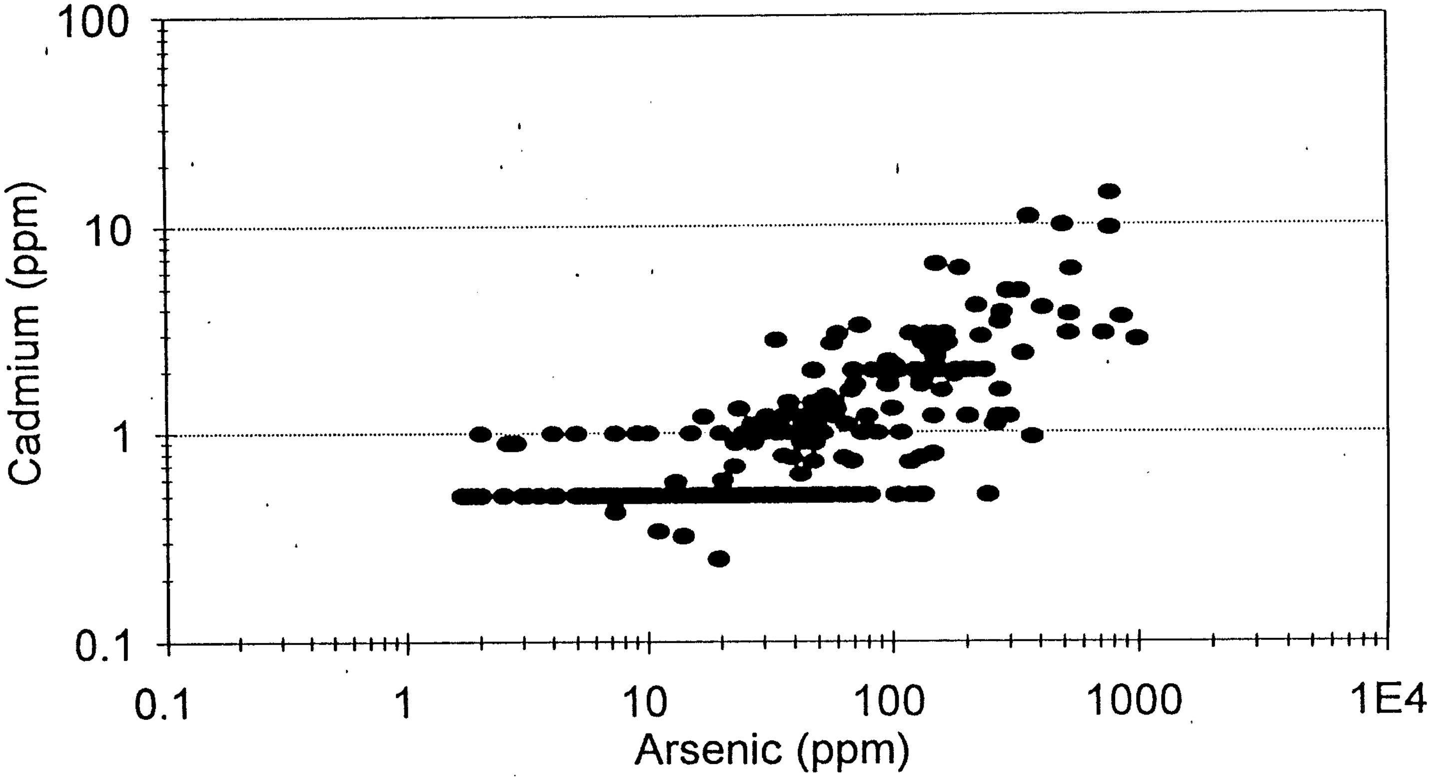
The values in Table 3-10 show that, in general, correlation is better for "peripheral" samples than for "smelter" samples. This may be caused by the fact that the arsenic, cadmium, and lead distribution in "peripheral" samples is thought to have been primarily caused by stack and fugitive emissions, resulting in a somewhat regular pattern. In the smelter area, the metals distribution is more spotty and random, with the presence of individual arsenic, lead, and possibly cadmium, sources. Also, the different leaching and transport behavior of arsenic as opposed to cadmium and lead (see above), will lead to lower correlation coefficients.

The results obtained from the correlation analysis are displayed in a graphical format in six scattergrams (Figures 3-3 through 3-8). For "peripheral" soils, the positive correlation between arsenic, cadmium, and lead is obvious in all three graphs. The best correlation is found between arsenic and lead, which cluster along a straight line with a slope of approximately 1 (Figure 3-4). In other words, an increase in arsenic concentration in "peripheral" soil is associated with an approximately equal increase in lead concentration. In "smelter" soils, as indicated by the lower values for R, the patterns show significant amounts of scatter. In particular the arsenic versus cadmium graph (Figure 3-6) displays a lack of distinctly positive correlation. In the lead versus cadmium graph (Figure 3-8), the anomalously high cadmium values associated with lead concentrations < 5 ppm are found in soils from location S-22.

Cross Sections and Concentration Profiles

The vertical distribution of arsenic is shown on Sheets 3-4 through 3-6, which present five cross sections located in the residential and lowland area of the site. Cross section C-C' (Sheet 3-4) is a north-south transect across the entire former plant area along its western boundary; cross section D-D' (Sheet 3-4) is a north-south transect in the central part of the former plant site; cross section E-E' (Sheet 3-4) is a north-south transect in the lowland area and is discussed in Section 3.3.2.2; cross section F-F' (Sheet 3-5) is a west-east transect across the central part of the former plant site and extending into the lowland, and cross section G-G' (Sheet 3-6) is a west-east transect across the southern part of the former plant site also extending into the lowland. Lowland portions of cross sections F-F' and G-G' (i.e. east of East Marine View Drive) are evaluated in Section 3.3.2.2.

Cross section C-C' shows that arsenic concentrations generally decrease with distance from the former plant site and with depth. The fill/till interface can be identified clearly based on a sudden decrease in arsenic concentrations at, for instance, locations S-22, S-34, and S-28. However, at location S-28 this decrease is not as pronounced, and elevated arsenic concentrations extend into the native till. S-28 coincides with the former flues leading to the two main stacks (see Sheet 1-2). It appears, therefore, that these flues may have been demolished in place, and that substantial amounts of debris are still present. Fill material is present along the entire transect with the exception of the road cut associated with construction of SR 529 and its cloverleaf interchange with East Marine View Drive.



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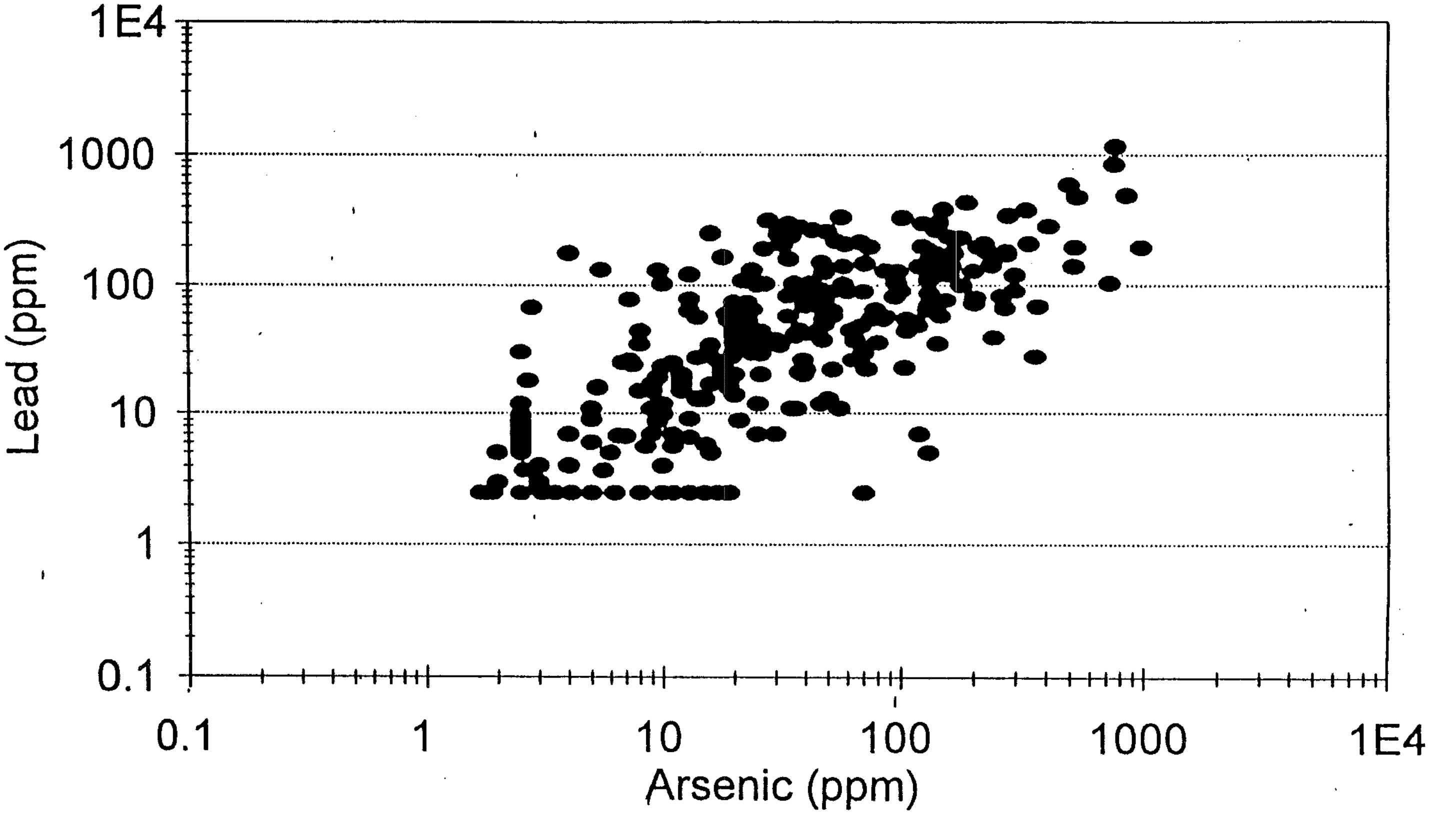
Scattergram for Arsenic vs. Cadmium
in Peripheral Soils
Figure 3–3



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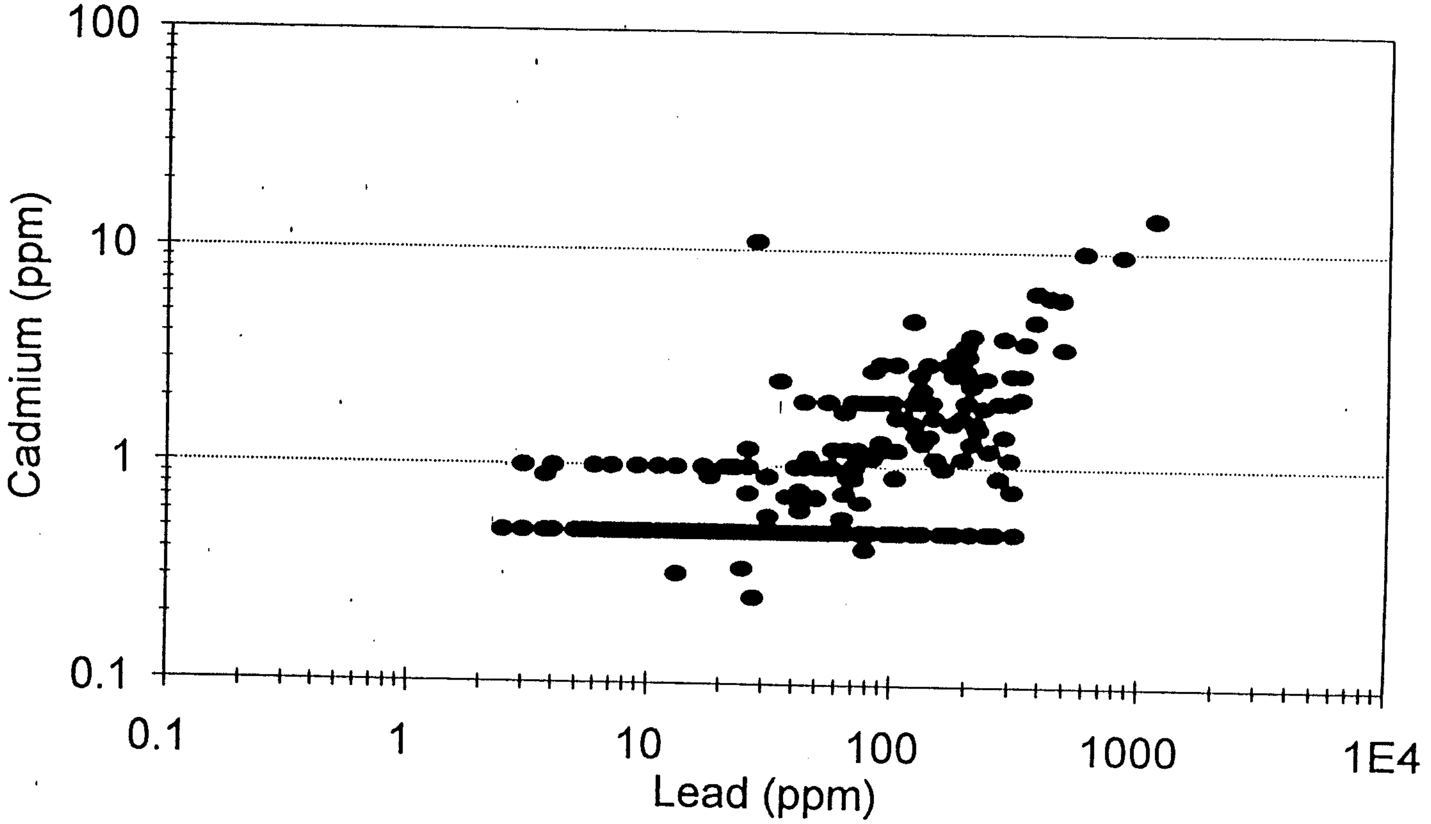
Scattergram for Arsenic vs. Lead
in Peripheral Soils
Figure 3–4



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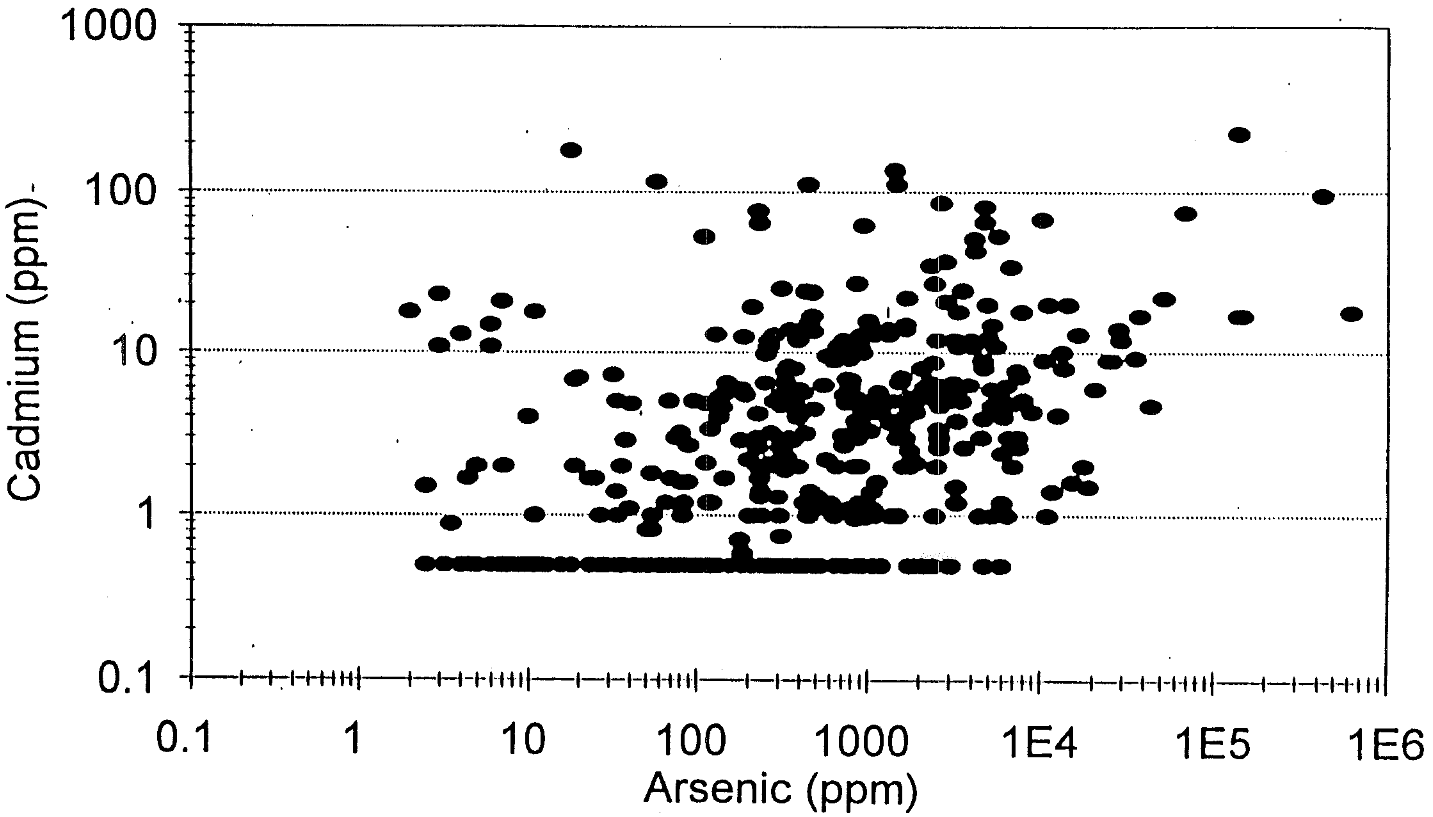
Scattergram for Lead vs. Cadmium
in Peripheral Soils
Figure 3-5



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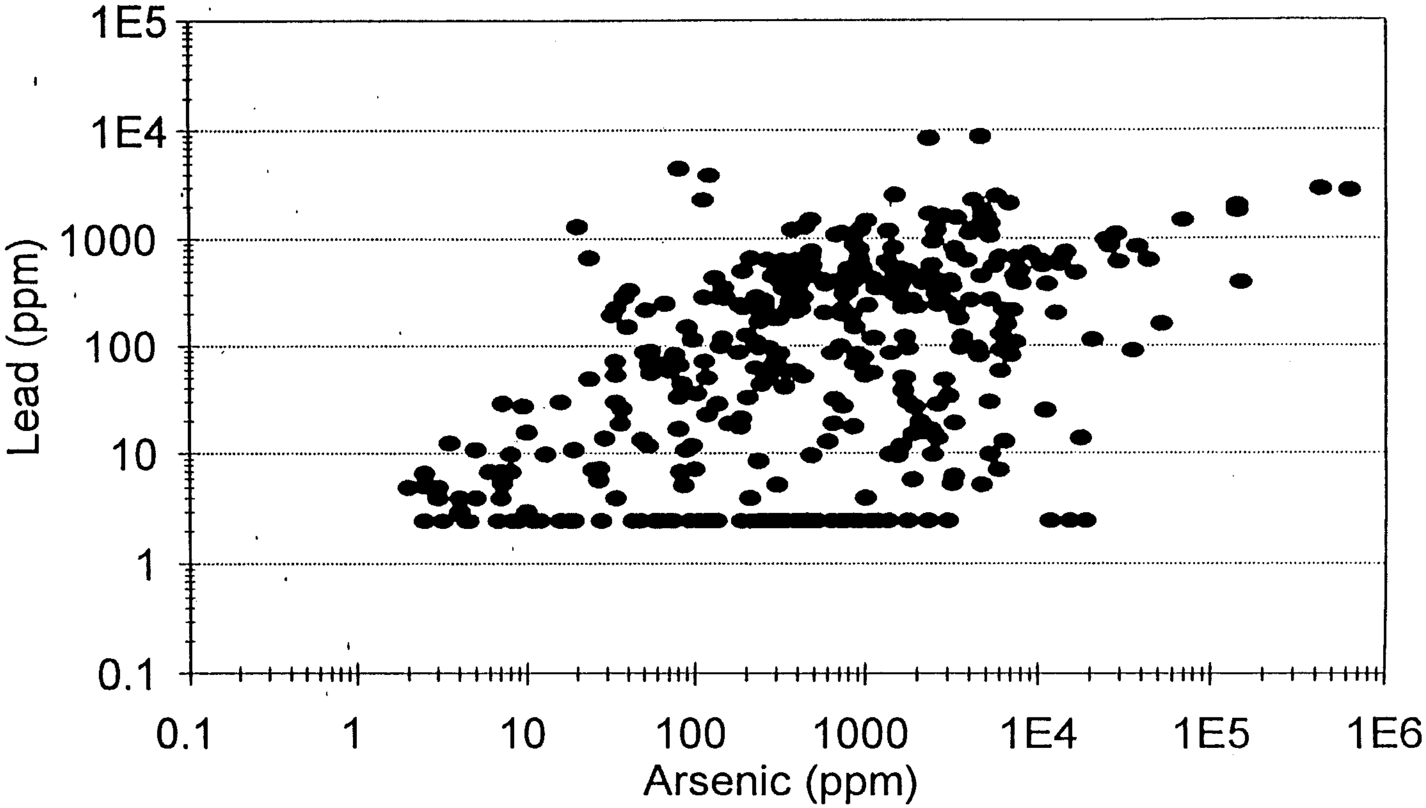
Scattergram for Arsenic vs. Cadmium
in Smelter Soils
Figure 3-6



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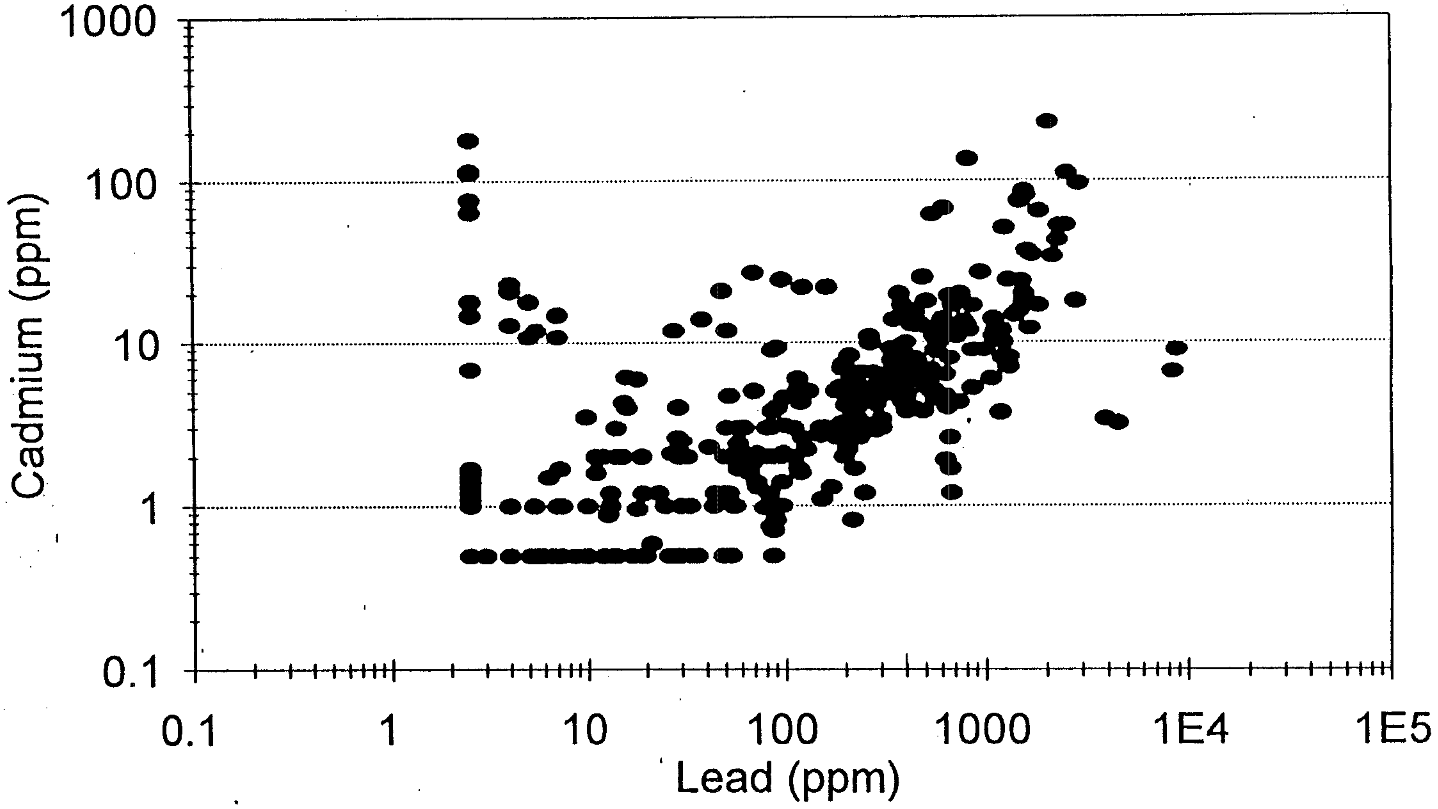
Scattergram for Arsenic vs. Lead
in Smelter Soils
Figure 3-7



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Scattergram for Lead vs. Cadmium
in Smelter Soils
Figure 3–8

Cross section D-D' shows the same features as cross section C-C'. With distance from the former smelter site, arsenic concentrations generally decrease. The fill/till interface appears to act as a barrier to downward migration of arsenic as evidenced by the decrease in concentrations across this contact. However, in some instances (S13, S-113, and S-92), elevated arsenic levels extend into the till despite a distinct change in concentration. These locations coincide with the former arsenic recovery plant, parts of which may have been left in place following demolition. Fill material is present along the entire transect with the exception of the road cut associated with the on-ramp for SR 529.

Along the upland portion of cross section F-F', fill material is absent with the exception of the area south of SR 529 adjacent to location S-22 Consequently, arsenic concentrations generally are substantially lower than in cross sections C-C' and D-D'. Fill is present for the entire length of cross section G-G', located south of F-F'. The arsenic trends observed are similar to those discussed earlier. The fill/till interface to a variable degree proves a barrier for downward migration of arsenic, with elevated arsenic concentrations extending into the native till at some locations. Despite the presence of extremely elevated arsenic levels in upgradient soils from S-111 (not shown), soils in EV-3 do not appear to have been unduly affected.

The vertical distribution of arsenic, cadmium, and lead at individual residential soil boring locations is presented in Appendix B in Figures B-1 through B-18 (residential soil borings), Figures B-19 and B-20 (monitoring wells EV-1 and EV-3), and Figures B-21 through B-24 (deep soil borings B-1, B-2, EV-2A, and EV-2B). The residential soil borings shown are "smelter" borings which exceeded depths of 6 feet. Concentration trends for shallow (< 6 feet) "peripheral" borings were not constructed because they are adequately represented by Figure 3-2, in which an average "peripheral" boring is shown.

As mentioned previously, due to the variability associated with the contaminant distribution, concentration profiles for individual borings may differ from the two borings shown in Figure 3-2. In particular in the smelter area, small-scale variations can lead to concentration trends that are highly irregular and unpredictable. Consequently, the profiles shown in Figure 3-2, as well as the data presented in Table 3-9 should not be used for predictive purposes, nor should they be interpreted in terms of MTCA criteria.

Despite the variability associated with the contaminant distribution, certain generalities can be found for residential borings within the former smelter area. As mentioned previously, concentration trends generally are similar for residential borings within the former smelter area. All borings show arsenic, cadmium, and lead maxima below the surface at depths between 0.5 and 4 feet. In general, the fill/till interface is encountered at depths between 5 and 7 feet, after which cadmium and lead concentrations decrease markedly, whereas arsenic shows a more gradual decline. The concentration profile for monitoring well EV-1 indicates that arsenic, cadmium, and lead levels are well within the background ranges discussed in Section 3.3.1.3. At monitoring well EV-3, downgradient from some of the most affected soils, cadmium and lead levels are within background at all depths. Arsenic concentrations, however, reach background levels at a depth between 25 and 35 feet. In borings EV-2A and EV-2B, located near former flues, maximum concentrations are found between 2 and 3.5 feet. Samples below a depth of 6 feet show arsenic, cadmium, and lead concentrations close to or within background ranges. Borings B-1 and B-2, located in the SR 529 cloverleaf, show two different concentration patterns. In B-1, arsenic and lead levels are within background ranges over the entire depth profile. However, cadmium shows a rapid increase between 0 and 4.5 feet from < 1 ppm to a value of 21 ppm. Below 4.5 feet, cadmium concentrations remain steady at levels exceeding 10 ppm. Although the location of B-1 coincides with the former ore building, it is not clear what causes these anomalously high and persistent cadmium levels. It is anticipated that several borings will be completed in the vicinity of B-1 to further investigate the elevated cadmium levels. Boring B-2 shows a pattern associated with the absence of anthropogenic fill material. All arsenic and lead levels are essentially within background ranges over the entire depth profile. Cadmium is not detected. B-2 does not appear to be located on any of the former smelter structures.

The arsenic, cadmium, and lead concentration trends in smelter and peripheral soils can be further explained by a more detailed consideration of the stratigraphic information contained in the boring logs (Appendices C and D). These logs generally indicate the presence of organic-rich topsoil in the upper six inches of the soil profile, followed by fill material. Since the topsoil contains material other than fill (e.g. roots, compost, peat moss), arsenic, cadmium, and lead concentrations in topsoil are expected to be lower than those in fill alone. Arsenic and cadmium show this surficial pattern; lead, however, shows highest geometric mean concentrations at the surface within the topsoil. The difference in behavior between arsenic and cadmium, and lead may be caused by the presence of a continuous lead source in the form of exhaust lead resulting from vehicular activity. For arsenic and cadmium, there is no such ongoing source, and the arsenic and cadmium trends found at the surface are essentially static patterns reflecting disturbance of the soil profile by gardening activities. Another factor, albeit probably of less importance, is the fact that lead in the environment is a highly immobile element (see Section 4.2.3). Whereas arsenic and cadmium may be leached from the soil by precipitation, resulting in a depleted surface layer, lead remains in place, bound in insoluble compounds. A study of arsenic concentrations with depth in Ruston soil also found that of the 27 different possible permutations of arsenic trends in samples collected at four depths, the most common pattern was that of a continuous decrease in concentration with depth (26.5% of the 1080 cases), followed by a pattern which showed an arsenic maximum at 1 to 6 inches immediately below the topsoil (20.1% of the cases) (Envirometrics, 1995). The third-most common trend was that of a concentration maximum at 6 to 12 inches (13.5% of the cases). It appears, therefore, that the shallow concentration trend found in the peripheral area may be a common phenomenon for sites on which aerial deposition was the main cause of contamination.

Within the fill material, smelter debris, when encountered, is usually found between approximately two to four feet. In some cases (e.g., location S-13), smelter debris is more pervasive and extends from the surface to a depth of six feet. The transition from anthropogenic fill to native glacial till usually occurs between 6 and 7 feet. As Figure 3-2 shows, it is at this depth interval that lead and cadmium, and to a lesser extent arsenic concentrations, decrease significantly in "smelter" soils. The glacial till is a dense, homogeneous deposit consisting of gray silts with a very low permeability. During collection of soil samples, it was observed that the glacial till was dry, despite the presence of abundant precipitation. Consequently, it appears to act as a barrier to downward infiltration of precipitation and transport of metals. Lead and cadmium clearly show this pattern; arsenic appears to penetrate somewhat within the glacial till. Figures B-1 through B-24 (Appendix B) for the individual soil borings show similar patterns.

Despite the dense, impermeable nature of the glacial till, fractures provide a partial avenue for infiltration of precipitation. In several instances, rust-colored fractures were observed, indicative of oxidation of iron-bearing compounds by atmospheric interaction. These fractures can act as routes for downward migration. The extent of migration is element-specific. Lead-bearing compounds are very insoluble at neutral to alkaline pH, resulting in very low dissolved lead concentrations in groundwater and surface water. In addition, lead is attenuated easily in the environment by adsorption onto clays and iron (hydr)oxides. The average decrease from 17 ppm at 6 feet to 4.4 ppm at 7 feet (a reduction of approximately 75 percent) indicates that leaching of lead from soils by precipitation and subsequent transport of lead is not very effective. Cadmium is more mobile, resulting in an average decrease from 2.2 ppm at 6 feet to 1.1 ppm at 7 feet (a reduction of 50%). However, at the low cadmium concentrations found in the soils depths of 2 to 6 feet, leaching of cadmium from soils does not result in significantly elevated cadmium concentrations in infiltrating precipitation. In addition, whatever cadmium is carried downward, is scavenged effectively by the clay and oxide surfaces. The concentration profiles show that arsenic is most mobile and travels to greatest depths. Between 6 and 7 feet, the average decrease from 430 to 308 ppm only represents a 30% reduction. It is thought that a significant portion of the arsenic in fill material is contained in flue dust, which is a highly leachable material, resulting in substantially elevated dissolved arsenic concentrations, as evidenced by surface water data (Section 3.4). Also, due to the circumneutral to slightly alkaline pH of infiltrating precipitation (approximately 7.0 to 7.5 following contact with soil), adsorption of pentavalent arsenic (As(V)) is limited (see Section 4.2.1 on the geochemistry of arsenic). This combination of highly leachable material and a lack of retardation results in arsenic being transported to depths of 17 feet and more.

Maximum Concentration Maps

Sheets 3-7 through 3-9 are contour maps showing maximum arsenic, cadmium, and lead concentrations at any given location regardless of sampling depth. As expected based on the positive correlation found between the three elements of concern, the three maps show patterns that are very similar. Highest concentrations are found within the former smelter area. Concentrations generally decrease with increasing distance from the smelter. The following sections summarize the most prominent features of the three individual contour maps for arsenic, cadmium, and lead. However, the following evaluation is a generalization only. It must be kept in mind that, due to the large variability of contaminant concentrations, particularly in the former smelter area, exceptions to the general pattern are a regular occurrence. In most cases it is not clear what causes these localized areas of anomalously high values, and no attempt is made to provide detailed analyses of these individual anomalies. However, as a result of the limited density of sampling locations particularly in the peripheral area, it is possible that other such anomalies exist in the study area. Also, due to the decreasing number of sampling points with distance from the former smelter, contour lines on the periphery of the study area are less constrained and should be viewed as approximations.

For arsenic (Sheet 3-7), highest concentrations (in excess of 10,000 ppm) coincide with the location of the former arsenic ovens, arsenic kitchens, and arsenic dust chambers (Sheet 1-2). Soils collected in this area contain arsenic up to 727,000 ppm. From this central area containing the highest concentrations, soils with elevated concentrations extend in a northwesterly and southern direction, most likely caused by aerial deposition by prevailing winds. Although the windrose in Section 1.4 indicates that prevailing winds are from the southeast and the northwest, the local topography probably has a channeling effect resulting in winds that closely follow the contours of the upland. As arsenic levels decrease, the contour pattern becomes more regular, with each consecutive contour line enveloping a gradually increasing area. Based on the location of the contour lines, it would appear that aerial deposition leads to arsenic concentrations of approximately 1,000 ppm and less. The 7 ppm line cannot be drawn adequately due to a lack of locations at which the maximum arsenic concentration encountered was 7 ppm or less. Due to the fact that the contour line corresponding to the MTCA cleanup level of 7 ppm cannot be constructed, the nature and extent of the arsenic contamination has not been defined with respect to the arsenic cleanup level.

At four locations, arsenic concentrations equal to or exceeding 500 ppm are found well within an area generally characterized by much lower arsenic levels. These locations are HA-6 (Dames & Moore, 1993), S-109, S-201, and S-302. It is not clear what causes these anomalously high concentrations. In both HA-6 and S-109, the soils in question are relatively shallow (1-3 foot and surficial, respectively) and both are locations that are surrounded by soils with significantly lower arsenic concentrations. In addition, the boring log for S-109 does not suggest the presence of any unusual material other than "average" fill. Borings S-201 and S-302 are both located on the Memorial Legion Golf Course. Historically, pest and weed control on golf courses has involved use of arsenic-based herbicides and pesticides (Duble et al., 1978). Based on an average application rate provided by the authors of 88 kg calcium arsenate ($Ca_3(AsO_4)_2$) per hectare, it was determined that approximately 6 ppm arsenic could be retained in the soil per application. It would seem, therefore, that prolonged use of an arsenic-based herbicide or pesticide could result in elevated arsenic concentrations. An alternative explanation for the anomalously high arsenic levels is redistribution of soils from the former smelter property during construction of the golf course. The possible existence of plume "touchdown" areas is discussed following the evaluation of the lead pattern.

For cadmium (Sheet 3-8), highest concentrations (in excess of 100 ppm) are found at four locations, only two of which coincide with buildings on the former smelter property. Boring S-112 is located near the former arsenic kitchens, and SAIC (1991b) location T-7 is in close proximity to a former flue. However, TP-3 (Dames & Moore, 1993) and S-22/S-78 (SAIC, 1991b) do not appear to be located in areas that can be directly associated with a smelter activity. Due to the unusually high cadmium concentrations found at the latter two locations, it appears that a local presence of demolition debris rather than aerial deposition may be the cause. This is because the site-wide cadmium pattern suggests that aerial deposition of cadmium is not a process that can easily lead to cadmium levels over 100 ppm. Soils with cadmium levels between 5 and 100 ppm are almost exclusively confined to the former smelter area with the exception of location TP-3. It would appear, therefore, that aerial distribution leads to cadmium concentrations of approximately 5 ppm and less. For cadmium, the MTCA cleanup level contour line of 2 ppm can be constructed adequately. As such, the area enclosed by this contour line is an approximate representation of the area affected by the smelter.

At four locations, cadmium concentrations equal to or exceeding 2 ppm are found well within an area generally characterized by much lower cadmium levels. Location TP-3 has been discussed above; the other three locations are S-109, S-201, and S-302, which are also characterized by unusually high arsenic levels. According to ATSDR (1991), phosphate fertilizers are considered a major source of cadmium input to agricultural soils. It would stand to reason that application of phosphate fertilizer on a golf course might be a common occurrence, which in turn might lead to enhanced cadmium levels in the golf course soil. An alternative explanation for the anomalously high cadmium levels is redistribution of soils from the former smelter property during construction of the golf course. The possible existence of plume "touchdown" areas is discussed following the evaluation of the lead pattern.

For lead (Sheet 3-9), highest concentrations (in excess of 10,000 ppm) are found at one location; S-111. This location coincides with the former arsenic ovens. With the exception of two areas, soils with lead concentrations over 500 ppm are almost entirely confined to the former smelter property. The aerial deposition trends found for arsenic and cadmium are not immediately obvious. It appears, therefore, that elevated lead concentrations are primarily associated with demolition debris from the smelter site and further redistribution of this material as the results of construction or other activities. The MTCA lead cleanup level contour line of 250 ppm can be constructed adequately. As such, the area enclosed by this contour line is an approximate representation of the area affected by the smelter. The 24 ppm contour line (i.e. Washington State natural background (Ecology, 1994b)) cannot be constructed satisfactorily. Therefore, the area has not been defined in terms of the natural background for lead.

At three locations, lead concentrations exceeding 500 ppm are found in an area generally characterized by much lower lead levels. The three locations are HA-5/HA-6 (Dames & Moore, 1993), S-201, and S-302. These areas have been discussed previously because of anomalously high arsenic and cadmium levels as well. Enhanced lead concentrations in golf course soils may be the result of application of lead arsenate, historically a common pesticide for turf and ornamentals (NAS, 1977). An alternative explanation for the anomalously high lead levels is redistribution of soils from the former smelter property during construction of the golf course. The possible existence of plume "touchdown" areas is discussed below.

Airborne emissions and releases from the former smelter took two forms: low-level fugitive emissions and tall stack releases. The metals concentrations resulting from fugitive emissions likely decreased with distance from the smelter within a relatively short range. However, metals concentrations resulting from smokestack emissions likely did not decrease with distance within this short range. In addition, the possibility of "touchdown" areas caused by downward looping of the plume may have resulted in areas of elevated concentrations at a significant distance from the former smelter. Although the evidence for the existence of "touchdown areas" on similar sites (e.g., the Ruston site) has not been compelling (Bechtel, 1992), it is possible that such "touchdown" areas may exist within the study area.

An evaluation of the potential presence of a "touchdown" area has to include a consideration of factors that control atmospheric dispersion and deposition of particulate matter, such as stack height, wind speed and direction, atmospheric stability, particulate density and aerodynamic diameter, terrain effects, plume rise, and precipitation events. While the influence of these factors may vary considerably from site to site, wind speed and direction, particulate density/aerodynamic diameter, precipitation, and terrain effects probably were the major influences on deposition patterns surrounding the smelter considering the limited height of the stacks (≤ 120 feet). A qualitative assessment of these factors suggests that fallout of particulate matter may have taken place in an area at some distance from the smelter itself. In light of the prevailing wind direction being from the southeast, it is therefore possible that the elevated arsenic, cadmium, and lead levels found in soil samples collected on the Memorial Legion Golf Course indicate the presence of a "touchdown" area.

3.3.1.3 Determination of Background Concentrations of Arsenic, Cadmium, and Lead

An important aspect related to the characterization of the distribution of any element of concern is a determination of its background concentration. Without this determination, it is not possible to evaluate whether certain concentrations exceed background levels. Background concentrations of elements such as arsenic, cadmium, and lead vary in response to both natural geochemical processes and manmade, or anthropogenic, effects. Area background concentrations for urban areas can be considerably higher than natural background concentrations in rural areas due to the presence of a variety of non-localized, anthropogenic sources. Everett has been a major industrial center since the 1890s. Industrial activities included logging, milling, boatbuilding, commercial fishing, various forms of manufacturing (e.g., paper, bricks, shingles), and, of course, smelting.

During the RI investigation, no concerted effort was made to determine area or natural background concentrations for arsenic, cadmium, and lead. However, various sources are available which provide information with respect to background levels.

The following information on several background studies is presented to provide a frame of reference only.

Lindsay (1979) presents background ranges for arsenic, cadmium, and lead in soil on a worldwide basis. Arsenic background concentrations range from 1 to 50 ppm, cadmium background concentrations range from 0.01 to 0.70 ppm, and lead background concentrations range from 2 to 200 ppm.

The EPA Urban Soils Monitoring Program consisted of collecting soil samples in a large number of urban locations nationwide. Carey et al. (1980) published data from five randomly selected Standard Metropolitan Statistical Areas (SMSAs) included in EPA's sampling program. For arsenic, average urban background concentrations ranged from 1.6 to 16.4 ppm. Urban background for lead ranged from 7.3 to 219 ppm, whereas urban cadmium ranged from 0.06 to 1.41 ppm.

As part of the Endangerment Assessment for the Ruston/North Tacoma study area, an evaluation of urban background levels for arsenic, cadmium, and lead was performed (Black and Veatch, 1988). The Ruston/North Tacoma study area is a site in which soils have been affected by historic stack emissions from a copper smelter. As such, this site is very similar to the Everett study area, in particular the "peripheral" part. As a result of the evaluation, urban background concentrations for arsenic, cadmium, and lead of 20 ppm, 1 ppm, and 250 ppm were selected. These values are comparable to the ones presented in Carey et al. (1980) and Lindsay (1979).

A recent study by Ecology and the U.S. Geological Survey (Ecology, 1994b) has determined that natural background concentrations in Washington State are 7 ppm, 1 ppm, and 24 ppm for arsenic, cadmium, and lead, respectively. The study asserts that these values are representative of “the major urban, industrial, and highly developed core areas in Washington”. However, although exact sampling locations cannot be identified from the report, it appears that most if not all samples were collected in rural areas. Also, the low background values found strongly suggest that urban and industrial areas were not represented to any significant extent in the background study. It is conceivable, therefore, that the area background for arsenic on the site is higher than 7 ppm.

3.3.1.4 Total Metals and TCLP Results

Four samples from locations S-111, S-112, S-113, and S-27 were analyzed for total and TCLP metals. The samples were collected at depths of 3', 0.5', 2', and 2', respectively, and were selected for complete analysis because they appeared directly associated with former smelter activities. As such, they are thought to represent worst case samples. The sample from S-111 consisted of a mixture of brick and weathered flue dust. The samples from S-112 and S-27 contained brick fragments as well, whereas slag was found in the sample from S-113. To more accurately determine the composition of fluedust, a fifth, composite, sample was collected at location S-111, which consisted exclusively of this material.

Table 3-11 shows the analytical results for the five samples. Results are in ppm. Also shown are the TCLP criteria for the various analytes from WAC 173-303-090(8).

TABLE 3-11 ANALYTICAL RESULTS TOTAL AND TCLP METALS IN SOILS

Sample	S-27	S-111	S-112	S-113	S-112	
Depth (feet)	2	3	0.5	2	Composite	
Total Metals						
Antimony	n/a	n/a	n/a	n/a	3,100	
Arsenic	5,306	622,500	143,600	25,540	727,000	
Barium	150	1,704	113	147	< 5	
Cadmium	6	18	230	9	< 5	
Chromium	37	8.2	34	54	< 5	
Copper	95	167	99	112	< 5	
Lead	1,063	2,804	2,061	983	26	
Mercury	100	135	1,250	225	0.5	
Selenium	11	34	208	38	< 5	
Silver	6.8	21	7.4	6.1	< 5	
Zinc	140	87	75	89	< 5	
TCLP Metals						TCLP Criterion
Arsenic	12.0	4,048.0	111.0	51.0	8,519.0	5
Barium	0.5	0.5	< 0.1	0.2	< 0.1	100
Cadmium	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	1
Chromium	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	5
Copper	< 0.1	< 0.1	< 0.1	< 0.1	0.11	NA
Lead	0.2	< 0.1	< 0.1	< 0.1	0.12	5
Mercury	< 0.001	< 0.001	6.6	0.0015	< 0.5	0.2
Selenium	< 0.1	< 0.1	< 0.1	< 0.1	0.12	1
Silver	< 0.1	< 0.1	< 0.1	< 0.1	< 0.05	5
Zinc	0.5	0.2	< 0.1	0.3	0.065	NA

n/a - not analyzed
NA- Not Applicable

The analytical results indicate that the five samples contain disproportionately large amounts of arsenic. With the exception of the sample from location S-27, all arsenic concentrations are close to or equal to the highest concentrations found for the respective depth intervals. Furthermore, the 0.5 foot sample from S-112 is noteworthy in that it contains the highest cadmium concentration found on the site during Hydrometrics' investigation, as well as unusually large amounts of mercury and selenium. The sample from S-111 consists of approximately 62% arsenic, which is the second highest arsenic concentration observed on the site. In this sample, barium, copper, lead, and silver are elevated as well relative to the other high-arsenic samples. One of the more common arsenic-bearing compounds is arsenic pentoxide (As_2O_5), which contains 65% arsenic. From the analytical results, it appears that this sample is primarily composed of this mineral phase, which is a natural oxidation product of arsenic trioxide (As_2O_3). Arsenic trioxide, or arsenolite, was manufactured by the Everett smelter for use as an insecticide and industrial agent, and would be the main component of fluedust. This is confirmed by the composite sample collected at location S-112. It consists of 73% arsenic and 0.3% antimony, with only minor concentrations of the remaining metals. Pure arsenic trioxide contains 76% arsenic, and it appears, therefore, that this sample is almost exclusively composed of fluedust. Assuming that no elements other than arsenic, antimony, and oxygen occur in this sample in significant quantities, a hypothetical mineral formula can be written as follows: $As^{5+}_{0.414}As^{3+}_{1.306}Sb^{3+}_{0.004}O_3$ or $As^{5+}_{0.481}As^{3+}_{1.519}Sb^{3+}_{0.0047}O_{3.488}$. This composition is indicative of partially weathered fluedust.

The TCLP results show that all five samples exceed the TCLP criterion for arsenic. In addition, the sample from S-112 exceeds the mercury criterion as well. A comparison between total arsenic content and TCLP arsenic shows that the sample from S-111 is the most leachable under TCLP conditions, with a relative leachability of 3 to 7 times the three other samples. Despite the fact that the TCLP method is not representative of leaching under ambient groundwater conditions, it appears that flue dust may be highly leachable under the less aggressive, natural conditions. It is unclear what causes the elevated total and TCLP mercury concentrations in the sample from S-112. There does not seem to be any direct correlation between the high mercury concentration and historic activities at this location.

When compared with the slag samples (see Section 3.2), it follows that the five residential soil samples have a relative leachability which is at least an order of magnitude higher than slag. In other words, a soil sample containing the same amount of arsenic as a slag sample leaches a minimum of ten times more arsenic than the slag. These results are in good agreement with relative leaching characteristics determined for slag and soil from the Asarco Tacoma smelter (Hydrometrics, 1993a).

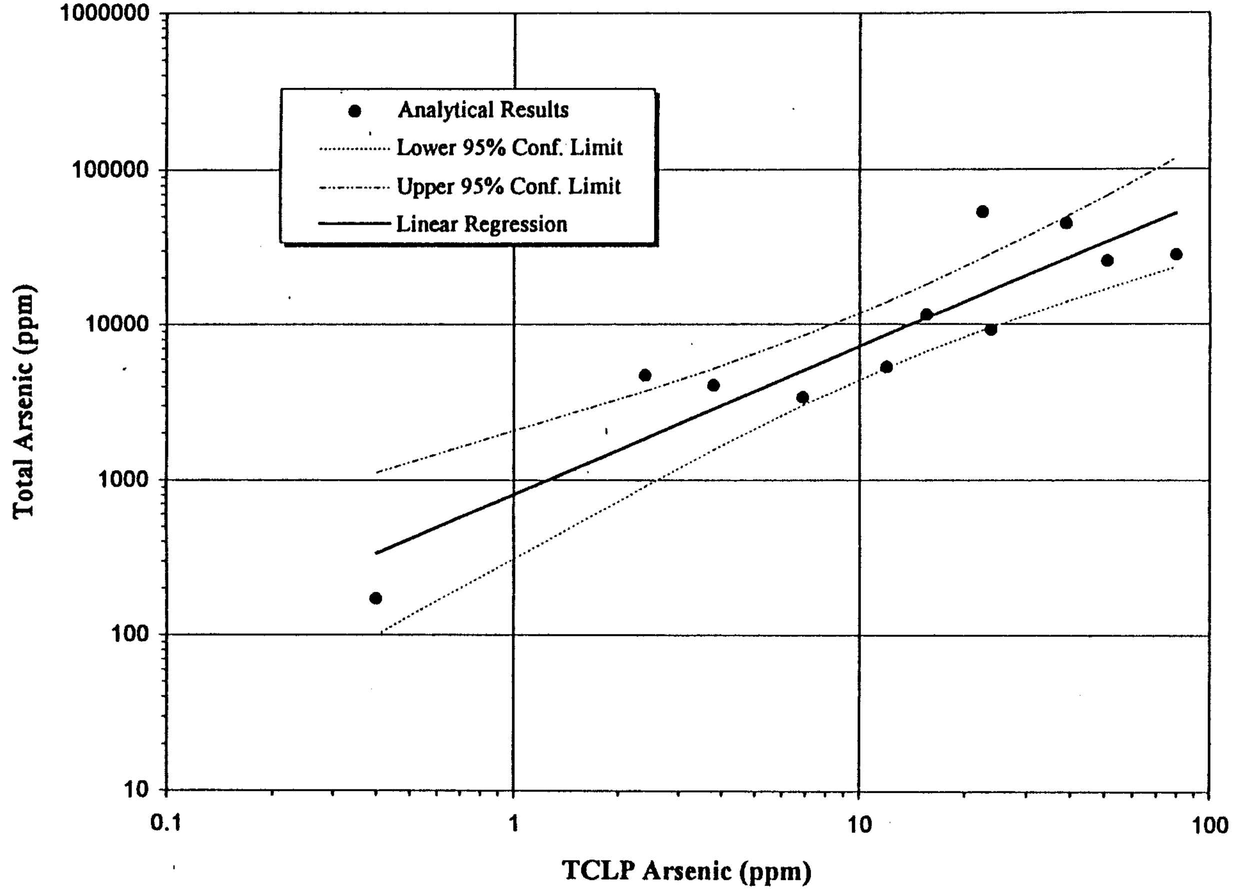
Figure 3-9 is a graph of TCLP arsenic results versus total arsenic concentrations of eleven soil samples collected in the residential area. The samples used for construction of the figure include two of the five samples discussed in the previous paragraphs, the three samples collected during the interim remedial activities from locations IA-2, IA-4, and IA-5 (see Table 1-13), and the six samples collected by SAIC in 1991 (see Table 1-12). Due to the fact that the range of interest centers around the 5 ppm TCLP level, results from samples S-111 and S-112 (2 samples) were not included because of the highly elevated TCLP arsenic concentrations. Inclusion of these values would skew any statistical analysis through the disproportionate effect these samples would have on calculation of statistical parameters. All samples consist of shallow (≤ 3 feet) fill material. Figure 3-9 shows that, when using a logarithmic scale, total arsenic and TCLP arsenic plot along an approximately straight line. This is indicative of a causal relationship between total and TCLP arsenic. The correlation coefficient of 0.91 also indicates that total and TCLP arsenic are strongly associated. The trend can be approximated by applying linear regression, which results in the following relationship:

$$\log(\text{total As}) = 0.95 * \log(\text{TCLP As}) + 2.90$$

or

$$\text{total As} = 10^{(0.95 * \log(\text{TCLP As}) + 2.90)}$$

with arsenic concentrations in ppm. Based on these results, the TCLP arsenic criterion of 5 ppm is likely to be exceeded by soils containing more than approximately 3,700 ppm arsenic. This value is in good agreement with studies of the leachability of soils containing fugitive arsenic and lead in the Ruston/North Tacoma residential area (Bechtel, 1992). Soils in Ruston/North Tacoma are very



5/5/95

TCLP Arsenic
vs. Total Arsenic in Soils
Figure 3–9

similar to those in the Everett Smelter site study area. In both cases, the soils are of a combined anthropogenic/glacial origin, and in both cases aerial deposition of arsenic-containing emissions has resulted in elevated soil arsenic concentrations. TCLP analysis of Ruston/North Tacoma soils containing up to approximately 3,000 ppm arsenic has demonstrated that the TCLP criterion of 5 ppm is not exceeded (Bechtel, 1992).

Figure 3-9 also shows lower and upper 95% confidence limits of the regression trend as calculated using equations from Remington and Schork (1970). The 95% confidence band defines the range in which there is a 95% probability that the regression line will be positioned as new data become available. The lower 95% confidence limit for a TCLP arsenic value of 5 ppm corresponds to a total arsenic concentration of approximately 2,100 ppm; the upper 95% confidence limit for a TCLP arsenic value of 5 ppm corresponds to a total arsenic concentration of approximately 6,500 ppm.

The existence of this trend has important ramifications as to the origin of the arsenic. It suggests that the chemical and physical characteristics of arsenic-bearing soil are relatively constant, resulting in leaching behavior that follows a predictable pattern. This in turn implies that the distribution of arsenic on the former smelter site is related to the distribution of one type of material by one particular process. The most likely process is the disposal of fluedust-containing smelter debris following demolition of the smelter.

The leachability of soils collected adjacent to the former smelter site has not been determined. However, as mentioned previously, studies of the leachability of soils containing fugitive arsenic and lead in the Ruston/North Tacoma residential area have demonstrated that TCLP criteria are not exceeded in soils containing up to approximately 3,000 ppm arsenic (Bechtel, 1992). The significantly lower arsenic and metals concentrations in peripheral soils, combined with the absence of highly leachable fluedust, suggest that TCLP exceedances are not likely to be observed outside the former plant boundary.

The above evaluation of the relationship between total arsenic and TCLP arsenic is meant as an illustration only. It should not be used for rigorous predictive purposes, nor should it be interpreted in terms of MTCA criteria as promulgated in WAC 173-

303-090(8). Further study may be required to quantify the relationship between the actual total and TCLP arsenic at the Everett Smelter Site using appropriate statistical techniques.

3.3.2 Lowland Area

To determine the quality of soil in the lowland area, 139 samples were collected during completion of monitoring wells and slag borings, 84 of which were analyzed. The investigative methods are described in Section 2.2, and Sheet 2-1 shows the sampling locations. Appendix A lists the complete analytical results. Section 3.3.2.1 describes the methods used to evaluate soil quality, and Section 3.3.2.2 briefly discusses the analytical results. The investigation of soil quality in the lowland area is ongoing.

3.3.2.1 Methods of Soil Quality Evaluation

As mentioned previously, all soil samples collected in the lowland area originate from monitoring wells or slag borings. As a result, the number of soil samples collected at a given depth is too small for any type of statistical analysis. Also, the soils were collected from different hydrostratigraphic units and consist of a variety of distinctly different materials (slag, alluvium, glacial deposits), which renders any statistical evaluation inappropriate. Contour maps for the lowland were not constructed because the density of the spatial distribution of soil samples is not sufficient. Therefore, soil quality was evaluated in a qualitative way through construction of cross sections showing vertical metals distributions as well as concentration profiles for individual borings.

The vertical distribution of arsenic in the lowland is shown on Sheets 3-4 through 3-6, which present five cross sections located in the residential and lowland area of the site. Three cross sections are of relevance to the lowland: cross section E-E' (Sheet 3-4), which is a north-south transect in the lowland area; cross section F-F' (Sheet 3-5), which is a west-east transect across the central part of the former plant site and extending into the lowland, and cross section G-G' (Sheet 3-6), which is a west-east transect across the southern part of the former plant site also extending into the lowland.

3.3.2.2 Results and Interpretation

Cross section E-E' shows that highest arsenic concentrations are found in the slag. The values are quite variable and do not correspond well with the slag analyses presented in Table 3-8 (Section 3.2). This may be due to the presence of other materials mixed in with the slag, resulting in either lower or higher arsenic concentrations depending on their composition. In particular, in well WP-1 the anomalously high value of 7,940 ppm arsenic is associated with a thin layer of yellowish brown silt. The high arsenic concentration as well as the yellowish color suggest that this silt may contain fluedust as a component. Overlying fill material also contains elevated arsenic levels, in part due to the presence of scattered slag. The few samples collected in the underlying silt unit suggest that the silt may be acting as a barrier to downward arsenic transport resulting in higher arsenic concentrations than overlying soils (e.g., EV-5, EV-7B). Soils in the alluvium do not appear to have been adversely affected to any significant degree. This despite the fact that groundwater from EV-7B and EV-9B contains several parts per million of dissolved arsenic.

In the lowland portion of cross section F-F', the arsenic distribution is similar. Highest arsenic concentrations generally are found in the slag and the overlying fill material. Samples collected in the two silt units again suggest that some arsenic may be accumulating in the silt as the result of downward migration of arsenic (e.g., EV-4B, EV-7B, MW-4B). Arsenic concentrations in the advance outwash, silty sand, and alluvium indicate that these soils have not been adversely affected to any significant degree by the elevated dissolved arsenic concentrations in the alluvial groundwater system. This is especially noteworthy for alluvial material from well EV-8B, which contains groundwater with dissolved arsenic values in excess of 10 ppm.

Arsenic concentrations in the lowland portion of cross section G-G' are limited to samples from well pairs EV-9 and MW-4, which have been discussed previously as part of transects E-E' and F-F'. Therefore, the lowland portion of this cross section will not be evaluated separately.

The vertical distribution of arsenic, cadmium, and lead at individual lowland monitoring well locations is presented in Appendix B in Figures B-25 through B-35. In the case of paired wells, the figures have been constructed by combining the analytical results available from both the shallow and deep well.

In general, metal concentrations decrease with depth, unless slag is encountered. The presence of slag clearly manifests itself through elevated metals concentrations in wells EV-4B, EV-7A, EV-8A, and EV-9A. Metal concentrations in soils from wells east of the railroad tracks generally are lower than in soils collected west of the tracks. With the exception of some surficial samples, metal levels in soils from wells MW-1, MW-3, MW-4A/B and MW-5 are close to or within the background ranges for arsenic, cadmium, and lead presented in Section 3.3.1.3.

The vertical extent of soil containing elevated metals has been delineated adequately for most individual wells, i.e. in most wells the deepest soil sample collected contains arsenic, cadmium, and lead levels that are close to or within background ranges. Depending on the presence of slag, this depth may range from 0 to 60 feet. The most notable exception is MW-2, which show consistently high levels in soils over its entire sampling interval. This is probably due to use of this location as a disposal site resulting in the presence of, for instance, brick, glass, metal, and organic material.

Due to the relatively small number of monitoring well locations, the lateral and vertical distribution of metals has not been defined adequately for the lowland area as a whole. In addition, the stratigraphy of the lowland area is much more complex than that of the residential portion of the site, in particular adjacent to the bluff where alluvial and glacial sediments are juxtaposed. To satisfactorily characterize the nature and extent of metals in soil, it is therefore necessary that additional soil samples be collected. These soil samples will primarily be obtained in conjunction with a proposed extended groundwater investigation. This investigation will allow for collection of soil samples during hydropunching and installation of additional monitoring wells. Also, trenching or excavation of test pits may be used to collect additional soil samples.

3.4 SURFACE WATER QUALITY

3.4.1 Residential Area

To determine the quality of surface water in the residential area, samples were collected during three precipitation events. The investigative methods are described in Section 2.3, and Sheet 3-1 shows the sampling locations. Rounds 1, 2, and 3 took place on March 22 and December 10, 1993, and January 23, 1994, respectively. Field parameters, and arsenic and lead results are shown in Tables 3-12 and 3-13, respectively. Appendix A contains all analytical results. Section 3.4.1.1 describes the results of field measurements and Section 3.4.1.2 discusses the results of the inorganic parameters arsenic, cadmium, and lead. Surface water samples were not analyzed for organic components.

Sheet 3-1 shows the surface water flow pattern, drainage areas, and the combined storm and sanitary sewer system. The drainage areas were approximated based on an evaluation of the site topography. The flow pattern shows that SW-6 and SW-7 on occasion receive runoff from the same approximate area. During periods of high precipitation, runoff accumulates at the base of the off-ramp from SR 529. This runoff generally discharges to the south in SW-7, but some overflow may cross the on-ramp and discharge to SW-6. The runoff from the on-ramp as well as the cloverleaf discharges exclusively to SW-6, as indicated by the arrows. All runoff enters the combined storm and sanitary sewer and is routed to the City of Everett treatment plant on Smith Island.

3.4.1.1 Field Parameters

Parameters measured in the field included temperature, specific conductivity (SC), pH, and flow. Values are listed in Table 3-12. On average, surface water temperatures were highest during the March sampling event and lowest during the December event. The differences in temperature are related to time of sample collection and time of year. On March 22, temperatures for the 24-hour timespan ranged from 8.3 to 16.1°C, whereas on December 10, they ranged from 5.0 to 12.2°C. In December, samples were collected early in the morning, before air temperatures had been raised significantly. In March, samples were collected late in the day after a full day of warming. The January sampling event occupied an intermediate position.

Temperature does not appear to have an effect on the concentrations of total metals in surface water since transport of particulates is a process controlled by the physical aspects of surface water flow. Temperature may have an effect on dissolved metal concentrations, but this effect is expected to be small within the temperature range commonly found in Everett (approximately 0 to 30°C). As an example, consider dissolution of an unlimited reservoir of arsenolite (arsenic trioxide, As_2O_3) at pH =7. At a temperature of 0.5°C (i.e. just above freezing), the dissolved arsenic concentration in equilibrium with As_2O_3 is approximately 0.116 mole/L. At 30°C,

TABLE 3-12 FIELD PARAMETERS FOR UPLAND SURFACE WATER

Location	Sampling Time	pH	Temperature (°C)	SC (µmhos/cm)	Flow (gpm)
ROUND 1 (03/22/93)					
SW-6	15.15	7.6	13.1	n/a	2
	17.10	7.4	13.0	n/a	4
	7.30	7.9	9.6	n/a	0.1
SW-7	15.30	7.5	12.9	n/a	0.1
	17.20	7.6	12.7	n/a	0.2
SW-8	16.00	7.6	13.4	n/a	1
	17.30	7.5	12.8	n/a	1.5
SW-9	16.15	7.0	13.4	n/a	0.5
	17.40	7.0	13.0	n/a	0.5
SW-10	16.20	7.0	13.2	n/a	1
	17.50	7.0	12.7	n/a	0.7
SW-11	16.30	7.0	12.8	n/a	0.5
	18.00	7.0	12.6	n/a	< 0.1
SW-12	16.40	7.0	12.9	n/a	1
	18.10	6.9	12.7	n/a	0.5
ROUND 2 (12/10/93)					
SW-6	10.15	6.9	8.4	104	9.2
SW-7	10.00	7.1	8.1	187	2.31
SW-8	DRY	n/a	n/a	n/a	
SW-9	9.45	7.5	8.4	147	0.14
SW-10	9.30	7.1	8.8	206	2.31
SW-11	9.10	6.8	8.6	106	0.61
SW-12	8.30	6.7	8.8	15.7	0.05
ROUND 3 (01/23/94)					
SW-6	12.40	8.3	10.1	63	16.5
	16.10	7.0	9.9	54	19.8
SW-7	12.20	7.6	10.3	44	0.8
	16.00	6.9	10.6	42	1.5
SW-8	12.10	7.9	10.3	41	0.5
	15.45	7.1	10.0	36.5	4
SW-9	11.55	6.9	10.4	153	0.54
	15.35	7.1	10.2	14.7	2.3
SW-10	11.40	7.1	10.1	133	0.76
	15.20	7.0	10.3	12.6	0.4
SW-11	11.30	5.3	9.9	59	0.99
	13.45	7.2	11.3	75	0.23
SW-12	11.00	7.0	9.8	12.5	2
	13.30	7.5	10.4	62	0.15

n/a - not analyzed

this concentration is approximately 0.222 mole/L, or an increase by a factor of approximately two. Therefore within the temperature extremes commonly found in Everett, changes in dissolved arsenic concentrations are not likely to vary by more than a factor of approximately two, an insignificant effect.

Values for pH ranged from 6.9 to 7.9, 6.7 to 7.1, and 5.3 to 8.3 for the March, December, and January rounds, respectively. Since precipitation has a pH of approximately 5.6, the values for pH found are indicative of chemical interaction of surface water with the substrate (e.g., asphalt, sod, barren soil).

SC was measured during Rounds 1 and 2 only. In general, for any given location, values for SC were higher during the December than during the January sampling round. The anticipated negative correlation between SC and flow was not observed. This correlation was anticipated to be negative because increased flow generally results in a more dilute solution, i.e. dissolved metals concentrations decrease as flow increases. Since SC is a measure of dissolved metals concentrations, SC decreases with increased flow as well. However, SC and dissolved arsenic correlate positively, showing the expected relationship between dissolved components and electrical conductivity. Since dissolved lead was not detected, no relationship was observed between this parameter and SC.

Surface water flows generally were lowest during the March sampling event. With the exception of SW-7 and SW-10, highest individual flows were observed during the January event. Precipitation during Round 1 was 0.058" from 15.00 hr to 18.30 hr. During Round 2, only a trace of precipitation was recorded, whereas during Round 3, a total of 0.09" of rain fell between 10.30 hr and 17.00 hr. For the corresponding 24-hour periods, precipitation was 0.18, 1.93, and 0.30", respectively. Round 1 samples were collected at the onset of the precipitation event after a period of dry weather (total of 0.18" over three-day period), Round 2 samples were collected near the tail end of an extended, 4-day precipitation event (total of 3.09"), and Round 3 samples were collected during an average precipitation event (total of 0.45" over two-day period). As a result, flows observed during Round 1 were initial flows, flows observed during Round 2 were part of a long-term continuous surface runoff system, and flows observed during Round 3 occupied an intermediate position.

3.4.1.2 Arsenic and Metals

Table 3-13 shows total and dissolved arsenic and lead concentrations in surface water samples from seven sampling locations. Only cadmium analyses are not presented in Table 3-13 due to the fact that detection of cadmium was limited to three samples in

TABLE 3-13 ARSENIC AND LEAD RESULTS FOR UPLAND SURFACE WATER

Location	Sampling Time	Arsenic (dis) (ppm)	Arsenic (tot) (ppm)	Lead (dis) (ppm)	Lead (tot) (ppm)
			ROUND 1 (03/22/93)		
SW-6	15.15	n/a	0.034	n/a	0.146
	17.10	n/a	0.028	n/a	0.118
	7.30	n/a	1.068	n/a	0.025
SW-7	15.30	n/a	0.026	n/a	0.027
	17.20	n/a	0.022	n/a	0.023
SW-8	16.00	n/a	0.011	n/a	0.036
	17.30	n/a	0.020	n/a	0.043
SW-9	16.15	n/a	0.027	n/a	0.069
	17.40	n/a	0.054	n/a	0.116
SW-10	16.20	n/a	0.014	n/a	0.0086
	17.50	n/a	0.009	n/a	0.0078
SW-11	16.30	n/a	< 0.005	n/a	0.0071
	18.00	n/a	< 0.005	n/a	< 0.005
SW-12	16.40	n/a	< 0.005	n/a	0.025
	18.10	n/a	< 0.005	n/a	0.017
			ROUND 2 (12/10/93)		
SW-6	10.15	4.7	5.8	< 0.005	0.025
SW-7	10.00	10.0	12.0	< 0.005	0.008
SW-8	DRY	n/a	n/a	n/a	n/a
SW-9	9.45	< 0.005	0.006	< 0.005	0.009
SW-10	9.30	6.4	6.2	< 0.005	< 0.005
SW-11	9.10	< 0.005	< 0.005	< 0.005	< 0.005
SW-12	8.30	< 0.005	< 0.005	< 0.005	0.005
			ROUND 3 (01/23/94)		
SW-6	12.40	0.111	0.200	< 0.005	0.070
	16.10	0.253	0.200	< 0.005	0.150
SW-7	12.20	0.348	0.440	< 0.005	0.034
	16.00	0.100	0.094	< 0.005	0.035
SW-8	12.10	0.0053	0.010	< 0.005	0.024
	15.45	0.0073	0.015	< 0.005	0.047
SW-9	11.55	< 0.005	0.010	< 0.005	0.020
	15.35	< 0.005	0.013	< 0.005	0.076
SW-10	11.40	0.021	0.025	< 0.005	0.0099
	15.20	0.018	0.022	< 0.005	< 0.005
SW-11	11.30	< 0.005	0.0063	< 0.005	0.009
	13.45	< 0.005	0.012	< 0.005	0.010
SW-12	11.00	< 0.005	< 0.005	< 0.005	0.023
	13.30	< 0.005	< 0.005	< 0.005	0.015

n/a - not analyzed

Cadmium analyses are presented in Appendix A

Round 2. Complete results, including cadmium analyses, are listed in Appendix A. Dissolved parameters were not analyzed for Round 1 samples.

In general, dissolved arsenic concentrations are approximately equal to total arsenic concentrations. For lead, the situation is completely different. Dissolved lead was not detected in any surface water sample, despite the fact that total lead concentrations may be as high as 0.15 ppm. These results are in good agreement with observations made for surface water samples at other sites containing arsenic and lead. Arsenic generally is readily solubilized, whereas lead solubility under most natural conditions is very limited (see also Section 4.2 for a general evaluation of arsenic and lead geochemistry). This implies that lead in surface water is transported in particulate form as opposed to the dissolved nature of the arsenic. The different geochemical behavior of arsenic and lead is reflected in the absence of any positive correlation between the two parameters. Correlation between pH and arsenic or lead is also absent, suggesting that transport of these two analytes is controlled by physical parameters rather than chemical parameters, i.e. the duration and intensity of the precipitation event.

Total lead concentrations and flow volumes are positively correlated. This means that the amount of lead transported is primarily governed by the amount of surface runoff (i.e. intensity of the precipitation event and the associated physical ability of the surface runoff to transport suspended particles, including those from paved roadways containing vehicular lead). Total arsenic concentrations are not correlated with flow volumes. This suggests that arsenic concentrations may be controlled by duration of a precipitation event rather than intensity. In other words, the longer a precipitation event, the higher the potential for saturation of soil material, which in turn increases the potential for leaching. Enhanced leaching results in more elevated arsenic concentrations in surface runoff.

The available field observations support the above scenario. As mentioned in the previous section, flows during Round 1 were initial flows, flows during Round 2 were part of a long-term continuous surface runoff system, and flows during Round 3 occupied an intermediate position. Although flows during Round 2 were lower than those during Round 3, arsenic concentrations were highest during Round 2 as a result of the extended duration. Also, during the first two sampling events of Round 1, arsenic was detected at very low levels only. However, one sample collected at SW-6 near the tail end of this event after a 14-hour lag time, contained very high arsenic levels, despite the minimal flow associated with this final sample. Again, this is indicative of the fact that sufficient saturation of the ground surface had taken place during the 14-hour interval to allow for significant leaching of arsenic. Lead concentrations did not show this pattern, but were proportional to the observed flows.

Although not listed in Table 3-13, total and dissolved cadmium were detected during Round 2 at locations SW-6, SW-7, and SW-10. For these three locations, total cadmium concentrations were 0.025, 0.060, and 0.025 ppm, respectively. Dissolved concentrations approximately equaled total concentrations. The three instances in which cadmium was detected correspond to the three highest arsenic levels found during surface water sampling. Although based on a very small number of samples, it therefore appears that cadmium behavior may be analogous to that of arsenic. This would mean that cadmium is mainly transported in dissolved form, and will only be found in surface water runoff after extended periods of rain during which soil becomes saturated and leaching occurs.

A location-by-location analysis shows that, during Round 1, arsenic and lead concentrations are highest at location SW-6. For Round 2, highest concentrations are found at locations SW-6, SW-7, and SW-10, whereas Round 3 concentrations are highest at locations SW-6 and SW-7. Sheet 3-1 shows the surface water sampling locations and surface runoff patterns as determined during precipitation events. As indicated on the map, both SW-6 and SW-7 receive runoff from the same approximate area, i.e. the former smelter location south of SR 529. This is the area in which soils generally contain the highest metal levels. Runoff at SW-10 consists of a mixture of both non-smelter and smelter provenance. Runoff at the remainder of the surface water sampling locations does not originate within the former smelter boundaries, and metal concentrations are significantly lower. At background station SW-12, no elements of concern were detected during any of the three sampling rounds.

It follows that the surface water quality is directly linked to its origin. More specifically, surface water originating within the former smelter site shows elevated levels of arsenic, cadmium, and lead. As mentioned previously, all runoff is collected in the combined storm and sanitary sewer and is routed to the Smith Island wastewater treatment plant. This plant discharges its effluent to the Snohomish River through two outfalls from the secondary mechanical treatment facility and a settling lagoon. Although the treatment plant complies with applicable regulations.

Freshwater and marine criteria as promulgated under WAC 173-201A-040(3) are listed in Table 3-14 for comparison.

TABLE 3-14 WATER QUALITY CRITERIA FOR SURFACE WATER

Parameter	Freshwater Acute	Freshwater Chronic	Marine Acute	Marine Chronic
	(ppm)	(ppm)	(ppm)	(ppm)
Arsenic	0.36	0.19	0.069	0.036
Cadmium	N/A	N/A	0.0372	0.008
Lead	N/A	N/A	0.1511	0.0058

Due to accumulation of metals in sanitary sewer sediment, this material may contain detectable levels of arsenic, cadmium, and lead. Although no sediment samples have been collected from the sewer system, it is unlikely that any of this material would be classified as a dangerous waste as per WAC 173-303-090 or 103.

Based on the values listed in Table 3-13, the stations in which arsenic criteria were never exceeded, are SW-8, SW-11, and SW-12. SW-9 exceeded the marine chronic criterion once. For cadmium, marine criteria were exceeded at SW-6, SW-7, and SW-10 during the second sampling round. The marine chronic criterion for lead was exceeded at all sampling locations at least once. Exceedances of the Federal Drinking Water Standards for arsenic (0.050 ppm), cadmium (0.005 ppm), and lead (zero goal), followed a similar pattern.

3.4.2 Lowland Area

To determine the quality of surface water in the lowland area, samples were collected during three sampling rounds on March 18, May 19, and December 10, 1993. The investigative methods are described in Section 2.3, and Sheet 3-1 shows the sampling locations. Field parameters, and arsenic and lead results are shown in Tables 3-15 and 3-16, respectively. Appendix A contains all analytical results. Section 3.4.2.1 describes the results of field measurements and Section 3.4.2.2 discusses the results of the inorganic parameters arsenic, cadmium, and lead. Surface water samples were not analyzed for organic components. Due to the fact that the lowland investigation is ongoing, evaluation of the surface water data is limited. Further collection of surface water will be required for a more comprehensive assessment of lowland surface water quality and behavior.

Sheet 3-1 shows the surface water flow pattern in the lowland. In general, surface water flows northward through a system of shallow (< 3 feet) drainage ditches which discharges into the Snohomish River on Weyerhaeuser property. Flow is very minimal to non-existent; portions of the drainage system are not maintained and are obstructed by debris. As a result, periods of high precipitation can lead to ponding and overflow.

3.4.2.1 Field Parameters

Parameters measured in the field included temperature, specific conductivity (SC), pH, and flow. Values are listed in Table 3-15. The field parameters measured are a standard set of parameters used to characterize surface water. Temperature can be used as a relative measure of atmospheric conditions; pH is essential with regard to metal speciation and mobility as explained in Section 4.2 (Environmental Chemistry), and SC is a measure of the concentration of dissolved species which can, for instance, be used as an indicator of interaction with soil material.

On average, surface water temperatures were highest during the May sampling event and lowest during the December event. SC showed the same pattern; highest during the May event and lowest during the December event. This may be a reflection of dilution that would take place during wet periods (December) as opposed to drier periods (May), and would be consistent with the anticipated negative correlation between SC and flow discussed previously in Section 3.4.1.1. Values for pH ranged from acidic to alkaline. It appeared that pH could vary considerably between sampling events, with SW-3 being the most prominent example (pH measurements from 6.1 to 8.7). Values for pH were lowest during the December event, which may be indicative of the increased contribution of low-pH precipitation.

3.4.2.2 Arsenic and Metals

Table 3-16 shows total and dissolved arsenic and lead concentrations in surface water samples. Cadmium analyses are not presented in Table 3-16 due to the fact that cadmium was only detected primarily as the result of a lowering of the detection limit

TABLE 3-15 FIELD PARAMETERS FOR LOWLAND SURFACE WATER

Location	pH	Temperature (°C)	SC (µmhos/cm)	Flow (gpm)
ROUND 1 (03/18/93)				
SW-1	7.1	9.3	360	none
SW-2	7.6	8.9	400	2
SW-3	8.7	11.7	475	none
SW-4	7.3	11.6	180	none
SW-5	6.7	9.4	350	none
ROUND 2 (05/19/93)				
SW-1	7.4	16.7	450	none
SW-2	7.4	16.4	445	none
SW-3	7.7	13.8	482	none
SW-4	7.6	19.4	310	none
SW-5	6.9	15.8	440	none
SW-14	7.3	17.3	600	none
ROUND 3 (12/10/93)				
SW-1	6.3	8.9	128	none
SW-2	6.3	9.0	178	none
SW-3	6.1	8.6	96	none
SW-4	6.2	8.1	88	none
SW-5	5.5	8.9	114	none
SW-14	n/a	n/a	n/a	none

n/a - not analyzed

TABLE 3-16 ARSENIC AND LEAD RESULTS FOR LOWLAND SURFACE WATER

Location	Arsenic (dis)	Arsenic (tot)	Lead (dis)	Lead (tot)
	(ppm)	(ppm)	(ppm)	(ppm)
ROUND 1 (03/18/93)				
SW-1	0.619	0.679	0.007	0.025
SW-2	0.909	3.265	0.007	0.148
SW-3	1.444	1.663	0.016	0.057
SW-4	0.427	0.778	0.019	0.229
SW-5	0.035	0.064	0.012	0.023
ROUND 2 (05/19/93)				
SW-1	1.240	1.841	0.011	0.029
SW-2	1.133	1.652	0.0093	0.031
SW-3	1.696	1.863	0.011	0.070
SW-4	0.418	0.826	< 0.005	0.029
SW-5	0.150	0.428	0.012	0.467
SW-14	0.770	2.861	< 0.005	0.372
ROUND 3 (12/10/93)				
SW-1	0.480	0.390	0.020	0.034
SW-2	0.480	0.530	0.026	0.046
SW-3	0.140	0.470	0.024	0.048
SW-4	0.150	0.190	0.006	0.019
SW-5	0.047	0.048	0.025	0.035
SW-14	0.0006	0.720	0.035	0.031

Cadmium analyses are presented in Appendix A during Round 5. Complete results, including cadmium analyses, are listed in Appendix A.

Dissolved arsenic concentrations may or may not equal total arsenic concentrations. In the latter case, this is indicative of arsenic being transported in a particulate form that is not readily soluble, such as slag particles. Dissolved lead generally is considerably lower than total lead. This was also observed for residential surface water and corroborates that the solubility of lead compounds is very limited. Correlation between pH and arsenic or lead is absent, suggesting that transport of arsenic and lead is controlled by physical parameters rather than chemical parameters. Additional evidence is provided by the fact that arsenic and lead concentrations generally are lowest during the wet December event and highest during the dry May event. This also indicates a relatively straightforward relationship between water volume and metal concentration. Although not listed in Table 3-16, total and dissolved cadmium were detected during Round 1 at SW-4, and during Round 5 at SW-1, SW-2, SW-4, and SW-14. Detection during Round 5 was primarily a function of a lowering of the detection limit from 5 ppb to 3 ppb.

Based on the marine acute and chronic criteria listed in Table 3-14, arsenic and lead exceedances occurred at all sampling locations. Cadmium did not exceed any marine criteria. The Federal Drinking Water Standards were also exceeded by arsenic, lead, and in one instance, by cadmium.

3.5 GROUNDWATER QUALITY

3.5.1 Residential Area

To determine the quality of groundwater in the residential area, samples were collected from monitoring wells EV-1 and EV-3. Sampling rounds 1, 2, 3,4, and 5 took place in February, April, June, September, and December 1993, respectively. The investigative methods are described in Section 2.4. Sheet 3-1 shows the sampling locations. Field parameters, arsenic and lead results, arsenic speciation results, and organic analyses are presented in Tables 3-17, 3-18, 3-19, and 3-20, respectively. Appendix A contains the complete set of analytical data. Section 3.5.1.1 describes the results of field measurements, Section 3.5.1.2 discusses the results of the inorganic parameters arsenic,

TABLE 3-17 FIELD PARAMETERS FOR UPLAND GROUNDATER

Location	pH	Temperature (°C)	DO (mg/L)	SC (μmhos/cm)	Depth to Water (feet)
ROUND 1 (02/17/93)					
EV-1	6.7	8.5	5.8	200	2.29
EV-3	6.5	11.8	4.2	350	47.78
ROUND 2 (04/21/93)					
EV-1	6.5	10.5	6.2	201	0.5
EV-3	6.4	13.1	4.6	310	47.70
ROUND 3 (06/16/93)					
EV-1	6.4	12.9	6.8	190	1.26
EV-3	6.4	13.1	4.6	310	47.70
ROUND 4 (09/15/93)					
EV-1	8.0	14.6	8.2	165	5.05
EV-3	6.4	13.2	5.2	333	47.57
ROUND 5 (12/29/93)					
EV-3	6.9	12.2	4.2	392	47.94

cadmium, and lead, and Section 3.5.1.3 evaluates the presence of organic compounds. The common ion characteristics of upland groundwater are discussed in Section 3.1.2.4.

3.5.1.1 Field Parameters

Parameters measured in the field included temperature, specific conductivity (SC), dissolved oxygen (DO), and pH. Values are listed in Table 3-17. The field parameters measured are a standard set of parameters used to characterize groundwater. As mentioned previously, temperature can be used as a relative measure of atmospheric interaction; pH is essential with regard to metal speciation and mobility; DO is a semi-quantitative measure of redox potential which has the same significance as pH; and SC is a measure of the concentration of dissolved species which can, for instance, be used as an indicator of saltwater intrusion.

Water temperatures in EV-1 ranged from 8.5°C in February to 14.6°C in September, reflecting a general warming trend during the summer. Water temperatures in EV-3 ranged from 11.8°C to 13.2°C, indicating that the groundwater in EV-3 is less affected by surface conditions. Dissolved oxygen values showed a similar variation; in EV-1, DO increased from 5.8 to 8.2 mg/L, while in EV-3, DO was approximately constant at between 4.2 and 5.2 mg/L. The differences in atmospheric interaction between EV-1 and EV-3 were also reflected by fluctuating water levels in EV-1 (depth to groundwater was between 0.5 and 5.05 feet), whereas in EV-3 water levels were essentially constant (between 47.57 and 47.78 feet). Specific conductivity was relatively constant in both EV-1 and EV-3. Values for pH in EV-1 and EV-3 were very similar, ranging from 6.4 to 6.7. The September measurement for pH in EV-1 is not considered correct.

3.5.1.2 Arsenic and Metals

Table 3-18 shows total and dissolved arsenic and lead concentrations in groundwater samples from EV-1 and EV-3. Complete results are listed in Appendix A. As can be seen, arsenic and lead are either not detected or are close to the detection limit of 0.005 ppm. In EV-1 and EV-3, other constituents detected include total copper, and total and dissolved zinc. Copper and zinc levels in both wells were similar, with total copper concentrations ranging from < 0.005 to 0.066 ppm, and total zinc concentrations ranging from 0.006 to 0.13 ppm. Total and dissolved cadmium were not detected. Although Ecology has not yet determined the appropriate cleanup standard for groundwater at this site, the MTCA Method A cleanup levels for arsenic and lead of 0.005 ppm are exceeded during Round 1 (total arsenic, 0.012 ppm, EV-3), Round 2 (total lead, 0.016 ppm, EV-1), and Round 5 (total lead, 0.0054 ppm, EV-3; total arsenic, 0.0058 ppm, EV-3).

TABLE 3-18 ARSENIC AND LEAD RESULTS FOR UPLAND GROUNDWATER

Location	Arsenic (dis) (ppm)	Arsenic (tot) (ppm)	Lead (dis) (ppm)	Lead (tot) (ppm)
ROUND 1 (02/17/93)				
EV-1	< 0.002	0.0024	< 0.005	< 0.005
EV-3	0.0032	0.012	< 0.005	< 0.005
ROUND 2 (04/21/93)				
EV-1	< 0.005	0.012	< 0.005	0.016
EV-3	< 0.005	0.0052	< 0.005	< 0.005
ROUND 3 (06/16/93)				
EV-1	< 0.005	< 0.005	< 0.005	< 0.005
EV-3	< 0.005	< 0.005	< 0.005	< 0.005
ROUND 4 (09/15/93)				
EV-1	< 0.005	< 0.005	< 0.005	< 0.005
EV-3	< 0.005	< 0.005	< 0.005	< 0.005
ROUND 5 (12/29/93)				
EV-3	< 0.005	0.0058	< 0.005	0.0054

Soil quality in EV-1 does not appear to have been affected by former smelter activities. Consequently, the metal concentrations found in soil can be regarded as urban background values for Everett (see Figure B-19 in Appendix B). Since these soils are a likely source of metals to groundwater, the low metals concentrations in groundwater from EV-1 are also indicative of urban background conditions. Metal concentrations in soils from EV-3 follow a different trend (see Figure B-20 in Appendix B). The first ten feet are characterized by highly elevated arsenic levels, after which a general decline results in background concentrations at a depth of approximately 35 feet. Despite the presence of at least 35 feet of soil with arsenic concentrations exceeding background, water quality in EV-3 has not been compromised. The absence of groundwater adversely affected by soil conditions suggests that downward migration of water through soil containing elevated metals does not occur to the extent that it reaches the outwash unit underlying the native till. Due to the dense, homogeneous nature of the glacial till, vertical infiltration to depths greater than approximately 35 feet appears to have been effectively prevented. However, horizontal flow of groundwater over the till may be occurring, resulting in lateral migration of arsenic and metals in the shallow groundwater system.

Arsenic speciation results are shown in Table 3-19. Arsenic speciation provides a measure of the redox potential (Eh, pH) of the groundwater. In addition, it has important ramifications with respect to the potential mobility of arsenic in groundwater (see also Section 4.2.1). Due to the fact that parameters other than pH and Eh also affect arsenic speciation (e.g., salinity, presence of other redox pairs, presence of adsorbents), it is often not appropriate to predict arsenic speciation based on field measurements of pH and Eh alone.

TABLE 3-19 ARSENIC SPECIATION RESULTS FOR UPLAND GROUNDWATER

Location	Arsenic 3+ (ppm)	Arsenic 5+ (ppm)
EV-1	< 0.005	< 0.005
EV-3	< 0.005	< 0.005

Arsenic speciation in wells EV-1 and EV-3 was analyzed during the first round of groundwater sampling only. Since arsenic concentrations in these two wells were close to or below detection limits, the errors associated with additional arsenic speciation analyses would have rendered these results virtually meaningless. It is not possible to draw any conclusions regarding groundwater geochemistry using the available arsenic speciation data.

3.5.1.3 Organic Parameters

Per the Workplan (Hydrometrics, 1992a), one smelter site well (EV-3) was selected for analysis of organic constituents. The sample was analyzed for semivolatile and volatile organics by Analytical Resources Inc., Seattle.

Table 3-20 shows the analytical results for organic parameters that were detected. Appendix A presents the complete listing of organic analytes.

TABLE 3-20 ANALYTICAL RESULTS ORGANIC PARAMETERS IN UPLAND GROUNDWATER

Parameter (ppb)	EV-3
Semivolatiles	
Di-n-butylphtalate	1.3
Bis(2-ethylhexyl)phtalate	1.1

Di-n-butylphthalate was detected in a method blank at 1.1 ppb. Therefore, detection of this compound in EV-3 at similar levels is likely to reflect laboratory conditions. Phtalates are plasticizers, used in the manufacturing of plastics including tubings and containers. As such, they are common components of labware and the occurrence of phtalates in analytical results is generally thought to be caused by laboratory contamination. Based on the data presented in Table 3-20, it appears that organic constituents in groundwater are not an issue of concern in the residential area at the Everett Smelter Site.

3.5.2 Lowland Area

To determine the quality of groundwater in the lowland area, samples were collected from monitoring wells EV-4A/B, EV-5, EV-6A/6B, EV-7A/B, EV-8A/B, EV-9A/B, MW-1, MW-2, MW-3, MW-4A/B, MW-5, and WP-1 during six sampling rounds in February, April, June, September, December, 1993, and August, 1994. The investigative methods are described in Section 2.4, and Sheet 3-1 shows the sampling locations. Field parameters, arsenic and lead results, arsenic speciation results, and organic analyses are shown in Tables 3-21, 3-22, 3-23, and 3-24, respectively. Appendix A contains the complete set of analytical results. Section 3.5.2.1 describes the results of field measurements, Section 3.5.2.2 discusses the results of the inorganic parameters arsenic, cadmium, and lead, and Section 3.5.2.3 evaluates the presence of organic compounds. The common ion characteristics of lowland groundwater are discussed in Section 3.1.2.4. Due to the fact that the lowland investigation is ongoing, evaluation of the groundwater data is limited. Further collection of groundwater data will be required for a more comprehensive assessment of lowland groundwater quality and behavior.

3.5.2.1 Field Parameters

Parameters measured in the field included temperature, Specific Conductivity (SC), pH, and flow. Values are listed in Table 3-21. In general, water temperatures were highest during the August 1994 sampling and lowest during the February and December 1993 sampling events. Values for pH ranged from alkaline to slightly acidic, with wells EV-7A and EV-8A generally showing values for pH that were one order of magnitude higher than those for the other wells. Wells EV-9A and MW-2 stood out as a result of their elevated values for SC.

3.5.2.2 Arsenic and Metals

Table 3-22 shows total and dissolved arsenic and lead concentrations in lowland groundwater samples. Additional results, including cadmium, copper, and zinc analyses are listed in Appendix A.

Analytical results for groundwater in the lowland indicate that various marine water and freshwater criteria are exceeded. However, available groundwater data are not sufficient to adequately characterize the nature and extent of the groundwater plume.

To provide a qualitative assessment of this plume, Figures 3-10 and 3-11 show dissolved arsenic concentrations for the upper (fill) and lower (alluvial) aquifer, respectively. The data used are those from the most recent sampling event available. In the upper aquifer, all arsenic values are from Round 6, except for well EV-6A

TABLE 3-21 FIELD PARAMETERS FOR LOWLAND GROUNDWATER

Location	pH	Temperature	DO	SC	Depth to Water
		(°C)	(mg/L)	(µmhos/cm)	(feet)
			ROUND 1 (02/17/93)		
EV-4B	6.8	12.3	5.2	720	51.68
EV-5	6.8	10.7	4.4	600	6.35
WP-1	7.9	10.1	2.8	580	5.17
MW-1	6.7	10.9	4.5	212	9.96
			ROUND 2 (04/21/93)		
EV-4B	6.6	13.3	5.2	800	51.70
EV-5	6.6	10.7	4.4	600	6.35
WP-1	8.0	14.9	2.0	588	5.03
MW-1	6.8	11.2	4.8	220	8.93
MW-2	7.7	10.2	1.7	2300	2.79
MW-3	6.9	10.7	2.2	479	0.32
MW-4A	6.8	10.4	2.5	422	0.63
MW-4B	6.9	12.7	2.2	810	6.56
MW-5	7.2	15.2	1.7	336	1.00
			ROUND 3 (06/16/93)		
EV-4A	6.3	14.0	2.6	620	9.01
EV-4B	6.7	13.9	4.8	845	51.69
EV-5	6.5	13.6	2.6	552	8.14
WP-1	7.5	14.0	3.4	751	4.65
MW-1	6.5	11.0	6.8	208	9.22
MW-2	7.5	13.8	2.6	2240	2.86
MW-3	6.6	15.3	2.4	509	0.42
MW-4A	6.6	15.9	2.6	405	0.74
MW-4B	7.0	13.7	2.6	990	7.59
MW-5	6.8	15.2	2.6	426	1.13

TABLE 3-21. FIELD PARAMETERS FOR LOWLAND GROUNDWATER (Continued)

Location	pH	Temperature	DO	SC	Depth to Water
		(°C)	(mg/L)	(μmhos/cm)	(feet)
ROUND 4 (09/15/93)					
EV-4B	6.7	n/a	n/a	820	51.91
EV-5	6.5	12.3	2.5	521	8.27
EV-6A	6.8	13.2	1.3	570	48.18
EV-6B	8.5	12.2	1.9	575	51.84
EV-7A	9.0	15.8	3.2	525	2.39
EV-7B	6.6	12.8	7.8	328	6.56
EV-8A	8.5	16.1	2.4	558	2.45
EV-8B	7.0	12.7	4.2	465	5.76
EV-9A	7.4	15.9	5.4	1477	6.64
EV-9B	6.3	13.0	5.8	370	8.29
WP-1	7.7	15.8	3.5	755	5.5
MW-1	6.8	11.8	7.6	213	10.7
MW-2	7.6	15.8	1.8	2220	4.0
MW-3	6.9	17.6	1.6	502	1.75
MW-4A	6.8	17.9	2.8	422	1.99
MW-4B	7.1	13.4	2.4	1140	7.0
MW-5	7.0	15.4	2.0	394	1.46
ROUND 5 (12/28/93)					
EV-4A	7.6	13.1	8.0	543	9.85
EV-4B	6.9	11.9	5.2	864	51.79
EV-5	6.5	11.2	4.8	676	6.40
EV-6A	6.9	11.2	4.6	553	47.22
EV-6B	7.3	11.6	5.8	536	51.75
EV-7A	9.2	9.9	3.8	491	1.43
EV-7B	6.7	10.8	4.8	368	6.38
EV-8A	8.8	9.6	1.8	515	1.79

TABLE 3-21. FIELD PARAMETERS FOR LOWLAND GROUNDWATER (Continued)

Location	pH	Temperature (°C)	DO (mg/L)	SC (µmhos/cm)	Depth to Water (feet)
ROUND 5 (12/28/93)					
EV-8B	7.1	10.9	6.0	463	7.05
EV-9A	7.3	13.1	2.6	1614	2.51
EV-9B	6.4	11.6	2.8	489	7.21
WP-1	8.1	12.2	2.4	802	4.52
MW-3	6.6	8.2	2.4	473	0.41
MW-4A	6.9	8.5	2.8	449	0.58
MW-5	7.5	8.2	2.4	458	1.48
ROUND 6 (08/23/94)					
EV-5	6.6	13.9	-	495	7.87
EV-7A	8.8	16.5	-	458	2.91
EV-7B	6.6	14.1	-	338	7.58
EV-8A	8.1	17.1	-	577	3.31
EV-8B	6.7	14.3	-	537	7.49
EV-9A	6.3	14.7	-	1298	4.42
EV-9B	6.6	13.3	-	346	8.48
WP-1	7.8	16.6	-	1433	6.03
MW-1	6.5	13.0	-	198	11.01
MW-2	7.3	17.6	-	2030	5.0
MW-3	6.7	20.4	-	549	3.34
MW-4A	6.6	20.7	-	408	3.11
MW-5	6.3	20.3	-	577	3.33

n/a - not analyzed

TABLE 3-22 ARSENIC AND LEAD RESULTS FOR LOWLAND GROUNDWATER

Location	Arsenic (dis) (ppm)	Arsenic (tot) (ppm)	Lead (dis) (ppm)	Lead (tot) (ppm)
ROUND 1 (02/17/93)				
EV-4B	0.014	0.015	< 0.005	< 0.005
EV-5	0.002	< 0.002	< 0.005	< 0.005
WP-1	0.768	1.227	0.006	0.026
MW-1	< 0.002	< 0.002	< 0.005	< 0.005
ROUND 2 (04/21/93)				
EV-4B	0.045	0.047	< 0.005	< 0.005
EV-5	< 0.005	< 0.005	< 0.005	< 0.005
WP-1	0.650	0.700	0.0057	0.013
MW-1	< 0.005	< 0.005	< 0.005	< 0.005
MW-2	0.040	0.040	< 0.005	0.069
MW-3	< 0.005	< 0.005	< 0.005	< 0.005
MW-4A	< 0.005	< 0.005	0.0058	0.011
MW-4B	2.620	2.620	< 0.005	< 0.005
MW-5	< 0.005	0.0088	< 0.005	0.0079
ROUND 3 (06/16/93)				
EV-4A	n/a	0.935	n/a	0.139
EV-4B	0.106	0.110	< 0.005	< 0.005
EV-5	< 0.005	< 0.005	< 0.005	< 0.005
WP-1	0.895	0.919	< 0.005	0.012
MW-1	< 0.005	< 0.005	< 0.005	< 0.005
MW-2	0.037	0.054	< 0.005	0.157
MW-3	0.0059	0.0084	< 0.005	< 0.005
MW-4A	< 0.005	< 0.005	< 0.005	< 0.005
MW-4B	2.700	2.726	< 0.005	< 0.005
MW-5	< 0.005	< 0.005	< 0.005	< 0.005

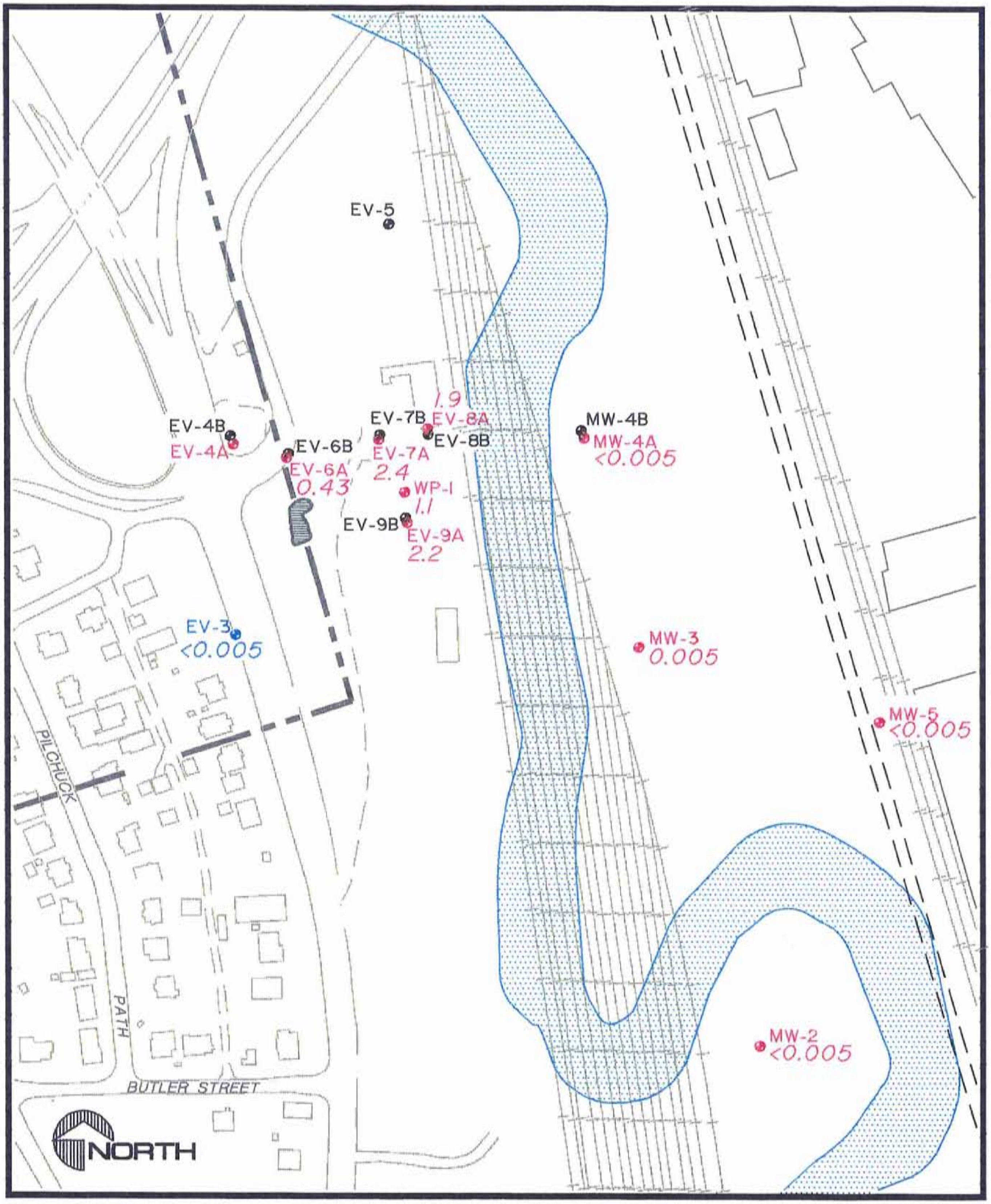
TABLE 3-22. ARSENIC AND LEAD RESULTS FOR LOWLAND GROUNDWATER (Continued)

Location	Arsenic (dis) (ppm)	Arsenic (tot) (ppm)	Lead (dis) (ppm)	Lead (tot) (ppm)
ROUND 4 (09/15/93)				
EV-4B	0.152	0.113	< 0.005	< 0.005
EV-5	< 0.005	< 0.005	< 0.005	< 0.005
EV-6A	4.973	36.097	0.028	51.100
EV-6B	< 0.005	0.120	< 0.005	0.484
EV-7A	3.329	3.093	0.022	2.092
EV-7B	3.954	3.757	< 0.005	< 0.005
EV-8A	1.862	1.693	< 0.005	0.578
EV-8B	16.020	14.637	< 0.005	< 0.005
EV-9A	2.262	2.083	< 0.005	0.103
EV-9B	0.533	0.495	< 0.005	< 0.005
WP-1	0.848	1.221	< 0.005	0.046
MW-1	< 0.005	< 0.005	< 0.005	< 0.005
MW-2	0.052	0.038	< 0.025	0.0059
MW-3	0.0091	0.0084	< 0.005	< 0.005
MW-4A	0.0058	0.014	< 0.005	0.034
MW-4B	2.713	2.775	< 0.005	0.0064
MW-5	< 0.005	< 0.005	< 0.005	< 0.005
ROUND 5 (12/28/93)				
EV-4A	n/a	0.453	n/a	0.281
EV-4B	< 0.005	0.007	< 0.005	0.012
EV-5	< 0.005	< 0.005	< 0.005	< 0.005
EV-6A	0.428	0.839	0.200	0.807
EV-6B	< 0.005	0.0098	< 0.005	0.042
EV-7A	1.793	2.043	0.062	0.513
EV-7B	4.858	5.253	< 0.005	< 0.005
EV-8A	1.375	1.875	< 0.005	2.142

TABLE 3-22. ARSENIC AND LEAD RESULTS FOR LOWLAND GROUNDWATER (Continued)

Location	Arsenic (dis) (ppm)	Arsenic (tot) (ppm)	Lead (dis) (ppm)	Lead (tot) (ppm)
ROUND 5 (12/28/93)				
EV-8B	9.448	9.850	< 0.005	< 0.005
EV-9A	1.875	5.270	< 0.005	5.310
EV-9B	0.916	1.058	< 0.005	< 0.005
WP-1	0.910	0.991	< 0.005	0.014
MW-3	< 0.005	0.013	< 0.005	< 0.005
MW-4A	< 0.005	0.0073	< 0.005	0.017
MW-5	< 0.005	< 0.005	< 0.005	< 0.005
ROUND 6 (08/23/94)				
EV-5	< 0.005	< 0.005	< 0.005	< 0.005
EV-7A	2.4	2.5	0.17	0.16
EV-7B	6.1	6.4	< 0.005	< 0.005
EV-8A	1.9	2.1	0.15	0.13
EV-8B	3.3	3.6	< 0.005	< 0.005
EV-9A	2.2	2.4	0.18	0.16
EV-9B	0.89	0.93	< 0.005	< 0.005
WP-1	1.1	1.2	< 0.005	< 0.005
MW-1	< 0.005	< 0.005	< 0.005	< 0.005
MW-2	< 0.005	0.049	< 0.005	0.026
MW-3	0.005	0.008	< 0.005	< 0.005
MW-4A	< 0.005	< 0.005	< 0.005	< 0.005
MW-5	< 0.005	0.006	< 0.005	0.005

n/a - not analyzed



1" = 200'　　TAC-03095T11　　5/24/95

LEGEND

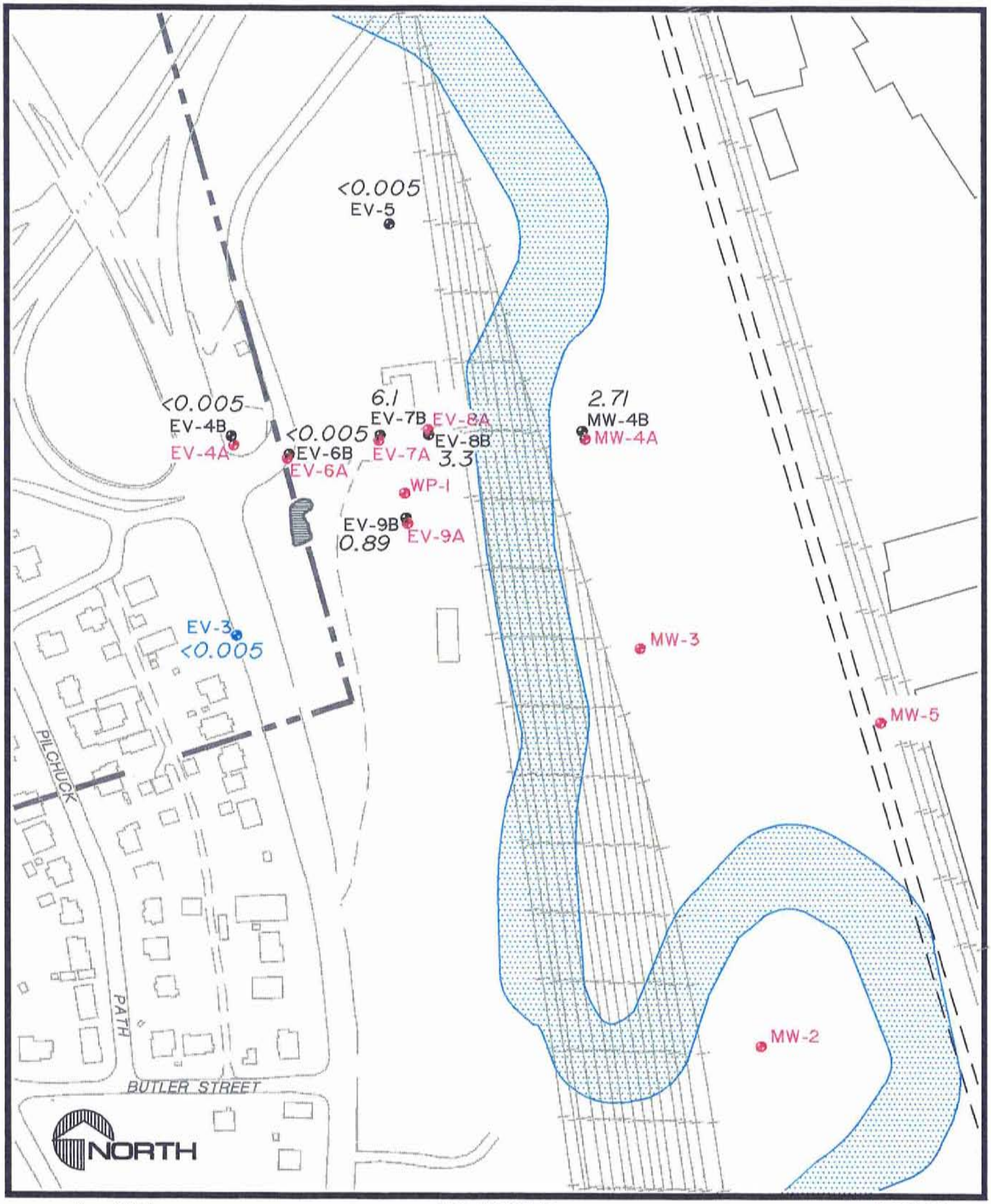
● FILL

● ALLUVIUM

● OUTWASH

1.9 DISSOLVED ARSENIC (PPM)

Figure 3–10
Dissolved Arsenic Concentrations
in the Lowland Fill Aquifer



1" = 200'

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5/24/95

LEGEND

● FILL

● ALLUVIUM

● OUTWASH

1.9 DISSOLVED ARSENIC (PPM)

Figure 3–11
Dissolved Arsenic Concentrations in the Lowland Alluvial Aquifer

which is a Round 5 sampling result. In the lower aquifer, results for wells EV-6B and MW-4B are from Rounds 5 and 4, respectively. Dissolved arsenic concentrations in well MW-4B have remained constant during Rounds 2 through 4, and it is therefore believed that the value shown on Figure 3-10 is representative of conditions as they existed during Round 6 sampling. Round 4 and 5 dissolved arsenic concentrations in well EV-6B have also remained constant. However, Round 4 and 5 dissolved and total arsenic concentrations in well EV-6A are dramatically different. It is believed that the Round 5 results are the most representative of groundwater conditions in EV-6A for several reasons. First, the difference between Round 4 total and dissolved arsenic concentrations is suspiciously large as, with some exceptions, total and dissolved arsenic concentrations tend to be very similar in lowland groundwater. Second, the Round 4 total lead concentration is anomalously high and suggests inadvertent introduction of foreign material in the groundwater sample. This is confirmed by the field log for the Round 4 sampling effort, which states that the groundwater sample was brown and silty. No such reference is made for the sample from Round 5. Third, a potential source material for the highly elevated arsenic and lead concentrations encountered is absent. Soil samples collected from wells EV-6A and EV-6B contain arsenic and lead in concentrations that are unlikely to result in the values found in groundwater found during Round 4. Based on groundwater and soil analyses from upgradient wells EV-4A and EV-4B, a potential source directly upgradient is absent as well. Dissolved arsenic was not analyzed in groundwater samples from well EV-4A due to the very small volumes of groundwater available and the difficulty associated with filtering the highly turbid samples.

Figure 3-10 shows that highest dissolved arsenic concentrations in the upper aquifer are found in wells WP-1, EV-7A, EV-8A, and EV-9A. Upgradient well EV-6A contains substantially less arsenic, as well as downgradient wells MW-4A and MW-3 in which dissolved arsenic is not detected. It appears, therefore, that, although a flowpath exists from upgradient well EV-6A to downgradient wells EV-7A and EV-8A (cross section F-F', Sheet 3-5), the upland fill material east of East Marine View Drive is not necessarily the source for arsenic in lowland shallow groundwater. Calculations have indicated that the groundwater flux through the shallow groundwater system in the upland area is very low (less than 1 gpm per thousand feet width). Consequently, this flux cannot adequately explain the concentrations and distribution of arsenic observed in the lowland groundwater system. Instead, the data suggest that the source is located in the lowland itself. Despite the presence of fill and slag containing elevated arsenic levels, it is not possible to unequivocally identify this material as the source, because highest soil arsenic concentrations do not appear to correspond to highest dissolved arsenic levels in groundwater. The substantial decrease in dissolved arsenic concentration across the railroad tracks suggests the presence of a barrier to groundwater flow. As discussed in Section 3.1.2.3, this may have been caused by compaction of the fill in the track area. Further delineation of the groundwater plume and lower aquifer characteristics, as well as identification of a source material will require more study.

Figure 3-11 shows the dissolved arsenic pattern for the lower aquifer. It is similar to the arsenic distribution in shallow groundwater in that highest arsenic concentrations are found in wells EV-7B, EV-8B, EV-9B, as well as in MW-4B. In upgradient wells EV-4B and EV-6B, dissolved arsenic was not detected. It appears, therefore, that despite a flowpath from upgradient wells EV-4B and EV-6B to downgradient wells EV-7B and EV-8B (cross section F-F', Sheet 3-5), upland soils east of East Marine View Drive are not necessarily the source for arsenic in lowland deep groundwater. Also, as mentioned previously, flux calculations indicate that the arsenic loading from the shallow upland groundwater system is not sufficient to account for the arsenic concentrations and distribution observed in the lowland groundwater. Instead, as for the shallow aquifer, the data suggest that the source is located in the lowland itself. However, the lower aquifer itself is not likely to be the source either because soils in the outwash, silty sand, and alluvial units do not contain arsenic levels that are sufficiently high to result in the dissolved arsenic concentrations found in lower aquifer groundwater. The elevated arsenic levels in MW-4B suggest that the tracks do not act as a barrier to deeper groundwater, but that arsenic is being transported eastward. Further delineation of the groundwater plume and lower aquifer characteristics, as well as identification of a source material will require more study.

Arsenic speciation results are shown in Table 3-23. Not all wells are represented in each sampling round because arsenic speciation in later sampling rounds was only analyzed in those wells which contained arsenic in significant quantities. The analyses show that in general, trivalent arsenic is the dominant species, indicating that groundwater conditions are reducing with respect to arsenic. Exceptions are wells EV-4B (outwash), and EV-7B and EV-9B (alluvium), in which pentavalent arsenic dominates. It is not clear what causes the high As(V) to As(III) ratio. As mentioned

TABLE 3-23 ARSENIC SPECIATION RESULTS FOR LOWLAND GROUNDWATER

Location	Arsenic 3+	Arsenic 5+	% Arsenic 3+
	(ppm)	(ppm)	
ROUND 1 **(02/17/93)**			
EV-4B	< 0.005	0.006	< 45
EV-5	< 0.005	< 0.005	N/A
WP-1	0.485	0.093	84
MW-1	< 0.005	< 0.005	N/A
ROUND 2 **(04/21/93)**			
WP-1	0.715	0.106	87
MW-2	0.026	0.005	84
MW-3	0.007	< 0.005	> 58
MW-4A	0.006	< 0.005	> 45
MW-4B	1.870	0.043	98
MW-5	0.005	< 0.005	> 50
ROUND 3 **(06/16/93)**			
WP-1	0.754	0.107	88
EV-4B	< 0.005	0.095	< 5
MW-2	0.029	< 0.005	> 85
MW-4B	1.039	0.045	96

TABLE 3-23. ARSENIC SPECIATION RESULTS FOR LOWLAND GROUNDWATER (Continued)

Location	Arsenic 3+	Arsenic 5+	% Arsenic 3+
	(ppm)	(ppm)	
		ROUND 4 (09/15/93)	
WP-1	0.604	0.166	78
EV-6A	3.516	0.228	94
EV-6B	< 0.005	< 0.005	N/A
EV-7A	2.666	0.446	86
EV-7B	3.058	0.984	76
EV-8A	1.540	0.143	92
EV-8B	12.455	2.368	84
EV-9A	1.750	0.264	87
MW-4B	0.913	0.036	96
		ROUND 5 (12/28/93)	
WP-1	0.730	0.142	84
EV-6A	0.132	0.220	38
EV-6B	< 0.005	< 0.005	N/A
EV-7A	1.707	0.280	86
EV-7B	< 0.005	5.190	< 0.1
EV-8A	1.332	0.130	91
EV-8B	10.010	1.279	89
EV-9A	1.532	0.272	85
EV-9B	< 0.005	0.932	< 0.5

N/A - Not Applicable

in Section 3.1.2.4, these three wells also have a unique common ion signature which distinguishes them from the remaining alluvial wells. High dissolved oxygen concentrations, indicative of atmospheric interaction, as well as high values for pH could result in a predominance of pentavalent arsenic. However, DO values in the three wells are not unusually high, and neither are values for pH. Further investigation will be required to more fully characterize arsenic speciation behavior.

3.5.2.3 Organic Parameters

Per the Workplan (Hydrometrics, 1992a), one downgradient well (EV-5) was selected for analysis of organic parameters. The sample was analyzed for semivolatile and volatile organics by Analytical Resources Inc., Seattle.

Table 3-24 shows the analytical results for organic parameters that were detected. Appendix A presents the complete listing.

TABLE 3-24 ANALYTICAL RESULTS ORGANIC PARAMETERS IN LOWLAND GROUNDWATER

Parameter (ppb)	EV-5	EV-5 (dup)
Volatiles		
Carbon Disulfide	1.1	< 1.0
Semivolatiles		
Di-n-butylphtalate	1.2	1.7
Bis(2-ethylhexyl)phtalate	8.4	2.1
Di-n-octylphtalate	1.1	< 1.0

Carbon disulfide is a common constituent of a large variety of products including solvents, fumigants, and herbicides. In addition, carbon disulfide is used in the manufacturing of such products as paper, rubber, and pharmaceuticals (Verschueren, 1983), and the occurrence of carbon disulfide in EV-5 at a concentration barely exceeding the detection limit does not appear to be related to the presence of the former smelter. Di-n-butylphthalate was detected in a method blank at 1.1 ppb. Therefore, detection of this compound in EV-5 at similar levels is likely to reflect laboratory conditions. Phtalates are plasticizers, used in the manufacturing of plastics including tubings and containers. As such, they are common components of labware and the occurrence of phtalates in analytical results is generally thought to be caused by laboratory contamination. Based on the limited amount of data presented in Table

3-24, it appears that organic constituents in groundwater are not an issue of concern in the lowland area investigated thus far.

3.6 HOUSEHOLD DUST

To determine the quality of household dust, samples were collected from six residences within the study area (HD-1 through HD-6). The investigative methods (wipe sampling and "vacuuming") are described in Section 2.5, and Sheet 2-1 shows the sampling locations. The analytical results are shown in Table 3-25 and Appendix A. Analytical detection limits for arsenic and lead were 2.5 µg. Due to differences in air volume used while collected "vacuum" samples, detection limits reported in the table vary.

TABLE 3-25 DUST SAMPLING RESULTS

Location	Wipe Sample		"Vacuum" Sample	
	Arsenic	Lead	Arsenic	Lead
	(µg/100cm^2)	(µg/100cm^2)	(µg/L)	(µg/L)
HD-1	39	4.2	10.4	1.9
HD-2	<2.5	<2.5	<0.1	<0.1
HD-3	<2.5	<2.5	<0.125	<0.125
HD-4	<2.5	2.9	<0.25	<0.25
HD-5	<2.5	<2.5	<0.25	<0.25
HD-6	<2.5	<2.5	<0.125	<0.125

The results shown in Table 3-25 indicate that, with the exception of location HD-1, arsenic and lead could not be detected in wipe and "vacuum" samples. At location HD-1 (520 East Marine View Drive), arsenic and lead were detected in both sample types. The soils at this residence contain the highest arsenic and lead levels found in the study area.

Table 1-10 in Section 1.5.2 shows the analytical results for household dust sampling by the Washington Department of Health and the Snohomish Health District in 1991. Locations HS3, HS4, and HS5, correspond to Hydrometrics' sampling locations HD-6, HD-2, and HD-5, respectively. A comparison between the two studies shows that the results differ considerably. In light of the fact that even within the 1991 study, ICP results and AA results show no correlation whatsoever, this is not surprising. The discrepancy reinforces the findings of a review of epidemiological studies conducted in the Ruston/North Tacoma residential area. This study, using a variety of sampling techniques, found that different sampling techniques produced different values for metals in household dust (SAIC, 1992). In addition, it was determined that none of the approaches used could be considered the most representative for evaluating potential human exposures.

Although the data set obtained in the present study is very small, it is tempting to invoke a causal relationship between metal levels in household dust and metal level in adjacent soil. Since all current residences were constructed after smelter demolition, direct stack emissions cannot be responsible for the metal levels in indoor dust. Also, since dust samples were collected on elevated surfaces such as refrigerator tops, direct tracking of dust is not possible. It appears, therefore, that the samples reflect resuspended airborne particulate material. The most likely mechanism contributing to these household dust loadings is physical tracking of soil particles on shoes and/or clothing, by pets, or on toys. Indoor resuspension may be caused by drafts, activities such as vacuuming and sweeping, or simply by movement of the occupants.

Due to the absence of regulatory criteria for household dust, it is not possible to address exceedances of federal and/or state standards. However, decontamination target criteria for industrial purposes are several orders of magnitude higher than the levels found in the six residences. For arsenic, cadmium, and lead, these target concentrations are 10,000, 1,000, and 10,000 μg/100cm^2, respectively. Although these numbers are not directly applicable to residential conditions, they do provide a certain frame of reference. Similarly, guidelines for hazard identification and abatement of lead-based paint in residences (HUD, 1990), contain the following standards for specific interior surfaces:

- floors: 200 μg/ft^2 (= 21.5 μg/100cm^2)
- window sills: 500 μg/ft^2 (= 53.8 μg/100cm^2)
- window wells: 800 μg/ft^2 (= 86.1 μg/100cm^2)

Using the value for window sills as the most applicable, it follows that this very conservative standard is not exceeded by either wipe samples or "vacuum" samples.

4.0 FATE AND TRANSPORT OF ARSENIC, CADMIUM, AND LEAD

This chapter describes the environmental chemistry, and fate and transport of the three primary elements of concern: arsenic, cadmium, and lead. The environmental chemistry is intended to provide a general understanding of the behavior of arsenic, cadmium, and lead under natural conditions. Wherever possible, the environmental chemistry and fate and transport will be related to conditions as they exist in the Everett Smelter Site study area. A consideration of fate and transport is important for the following three reasons:

- movement of metals in and between environmental media (groundwater, surface water, soil, air) has ramifications for possible exposure routes of migration;
- fate and transport processes may reduce or enhance metal concentrations in these media;
- fate processes may produce changes in the physical or chemical environment which affect potential human exposures even if metal concentrations remain constant.

In addition, an understanding of fate and transport is an important consideration in the selection of a cleanup action under MTCA. Ecology will not select a cleanup alternative that allows the continued uncontrolled release (transport) of a hazardous substance, since, as per WAC 173-340-360(e)(i), a cleanup action shall prevent or minimize present and future releases and migration of hazardous substances in the environment.

The following are definitions of "fate" and "transport" as they are used throughout this section:

Fate - Fate defines the process of movement and/or transportation of a substance within the environment. Possible physical and chemical fate processes in the study area include sorption (adsorption, co-precipitation), volatilization, oxidation/reduction, dilution, and biologically mediated processes. Physical fate processes do not affect the structure of the substance itself (e.g. dilution), whereas chemical fate processes result in a phase and/or speciation change (e.g. dissolution and oxidation/reduction). The physical fate of a substance is usually controlled by physical parameters such as temperature or flow regime. Environmental conditions such as pH and Eh are usually responsible for determining the chemical fate.

Transport - Transport is defined as the movement of a substance from one location to another through mechanisms associated with environmental media such as air, soil, and water. Examples of physical transport include movement of dissolved or particulate matter through groundwater. Examples of chemical transport involve mechanisms such as precipitation and volatilization. It is important to realize that, although mobility is closely related to transport, they are not identical. Mobility refers to the ease of movement of a substance within or between media. In general, it is necessary for a substance to be mobile before it is susceptible to transport.

4.1 POTENTIAL ROUTES OF MIGRATION

Transport of arsenic, cadmium, and lead in the study area has been influenced by natural causes (e.g., precipitation, wind), as well as human activity (e.g., gardening, earth moving). Following deposition of stack and fugitive emissions and disposal of demolition debris, metals in soils were potentially subject to transport by a variety of processes. These processes include, but are not limited to, surface water transport, air transport, plant uptake, vehicular tracking, soil leaching, volatilization, resuspension, human activity, etc. The following are brief evaluations of individual routes of migration and their significance.

4.1.1 Air Transport

As mentioned previously, air transport of arsenic, cadmium, and lead was the primary historic mechanism for the original distribution of these metals at the site. However, the smelter discontinued operations in 1912, and this release mechanism ceased to exist. Currently, two air transport mechanisms are considered of importance; 1) resuspension of particulates from soils and roadways via wind and vehicular activity, and 2) possible biological methylation and subsequent volatilization of arsenic from soils (see Section 4.2.1 for a discussion of methylation).

Resuspension of metal-containing dust and soil is a potential route for movement of arsenic, cadmium, and lead between soil, street dust, and household dust. Also, air exchange between indoor and outdoor air is a potential route. Particles transported into residences by tracking may settle as household dust (see Section 3.6). In the lowland area, resuspension of dust and soil material would be mainly caused by use of heavy equipment.

There are no site-specific data related to methylation of arsenic. However, a speciation study conducted by Nicola and Pierce (undated) in the Ruston/North Tacoma area detected no methylated arsenic compounds in soil, road dust, or household dust samples. The authors concluded that the non-detection of methylated forms suggested that either methylation was not occurring, or that the methylated compounds were not extractable during analysis. Although this study was performed for a different site, conditions were sufficiently similar to the Everett Smelter study area that it leads one to believe that methylation and subsequent volatilization are not expected to be a significant transport mechanism for arsenic in the residential or lowland area.

4.1.2 Surface Water

Samples collected in the residential and lowland area have demonstrated that surface water is a route of migration for arsenic and metals. Arsenic, lead, and to a lesser extent cadmium, are found in surface water at elevated levels (see Section 3.4). Arsenic and cadmium appear to be primarily transported in the dissolved form; lead is primarily transported as particulates. In the residential area, the source material most likely consists of exposed residential soil, unpaved areas, and dust from paved surfaces such as roads, playgrounds, and parking lots. In the lowland area, shallow soil appears to act as a source to the surface water in the drainage ditches and natural depressions. As the result of surface water transport, metals are redistributed within the study area. This may lead to elevated concentrations in sediments near catchment basins in the residential area, in sediments in the combined storm and sanitary sewer system itself, and in the lowland drainage system.

Due to the fact that surface water from the residential area does not discharge directly to the Snohomish River but is captured in a combined storm and sanitary sewer system, it is unlikely that Snohomish River water and sediments are adversely affected by runoff from the residential area. Further investigation of the drainage ditch system in the lowland area will be required to determine if the lowland surface water has the potential to affect the Snohomish River. This investigation will have to be extended to additional Burlington Northern and Weyerhaeuser property located between the present study area and the Snohomish River.

4.1.3 Groundwater

Soil analyses indicate that elevated arsenic levels occur within the native glacial till at depths of up to approximately 15 feet in the "smelter" area. However, groundwater analyses from residential well EV-3 seem to indicate that arsenic, cadmium, and lead are not transported into and by the deep confined groundwater system (see Section 3.5.1). Cadmium and lead do not persist at elevated levels beyond the fill/till interface in residential soils.

Since native till itself is not a source of arsenic, the arsenic must have been derived from the overlying fill material. Within this stratigraphic unit, arsenic may be leached from the soil and transported downward by infiltration of precipitation under unconfined, unsaturated conditions. Due to the dense, impermeable nature of the till, the downward vertical movement of precipitation most likely is limited to fractures. These fractures have been observed while collecting soil samples from residential borings. They are characterized by a rust-colored coating, indicative of atmospheric interaction with iron, resulting in the formation of iron(hydr)oxides. Based on analyses of groundwater samples from the deeper, confined aquifer, it appears that the fractures are not pervasive throughout the entire glacial till unit, but are restricted to its upper region.

Horizontal transport of arsenic and metals by groundwater in the residential area is another possible transport route. A continuous shallow groundwater system is absent. Instead, shallow groundwater appears to occur as perched lenses within the fill material. Although horizontal transport cannot be ruled out, due to the low horizontal groundwater flux, metals loadings associated with this movement will be small and are not thought to contribute significantly to the lowland groundwater system if at all.

In the lowland area, both the shallow fill and deep alluvial groundwater units contain elevated concentrations of arsenic, cadmium, and lead (see Section 3.5.2). Therefore, transport of these elements in the lowland fill and alluvial aquifers is certain to occur. Due to the complexity of the lowland area, further investigation is required to determine the nature and extent of this transport. This investigation will include, but is not limited to, evaluation of flowpaths, flow velocity, interaction between aquifers, composition of aquifer material, tidal effects, physical characteristics of aquifer material, etc. To arrive at meaningful conclusions, it is anticipated that this investigation will require incorporation of information from additional Burlington Northern and Weyerhaeuser property located between the present study area and the Snohomish River.

4.1.4 Tracking

Tracking (movement of particles adhering to objects) can be important in redistributing arsenic, cadmium, and lead within the study area. In the residential area, soil, dust, and slag particles can be tracked indoors by clothing and pets. Vehicular tracking from tires may result in transport of metals from unpaved areas to public streets. The following three studies illustrate the significance of tracking as a transport mechanism.

An investigation by Roberts and Spitler (1988) found that tracking of particulates by shoes, pets, and other objects could be responsible for 50 to 95% of the dust found on residential floors. Also, Roberts et al. (1990) demonstrated the importance of tracked-in dust as a route of migration by determining that removal of shoes or the presence of a floor mat significantly reduced indoor. lead dust loadings. This study concerned itself with over 400 homes in Washington State. Lastly, in the Ruston/North Tacoma area, dust samples from paved streets showed metal concentrations that were quite high relative to bulk soil samples from that same area (Willenberg and Butler, 1984). Although stack emissions from the operating smelter may have contributed, it was thought that mobilization and transport of particulates by vehicular tracking played a role of importance. Due to the limited nature of human activities in the lowland area, tracking is not thought to be of particular significance in this part of the study area.

4.1.5 Transport Related to Human Development

Transport of soil as the result of human development has played an important role in the redistribution of arsenic, cadmium, and lead throughout the site. However, despite its significance, this transport is difficult to assess quantitatively due to its extended duration (in excess of 70 years), as well as the large number of different activities that have contributed on various scales. Large-scale redistribution occurred as the result of smelter demolition, highway construction, and residential and commercial development. These activities were limited to relatively short intervals and have largely ceased. However, smaller-scale redistribution of metals has been a ongoing process and continues to affect the present residential area on a daily basis. Such activities include maintenance of utilities, landscaping, gardening, etc. The volumes of soil involved, the areas where removal took place, the areas where soils were disposed, and the nature of the soils all are largely unknown. Despite the importance of these processes, it is not likely that they will ever be quantified satisfactorily. In the lowland area, continued maintenance and construction activities related to the various operations (e.g., Burlington Northern, Weyerhaeuser) may lead to redistribution of soil and associated metals.

4.2 ENVIRONMENTAL CHEMISTRY

As mentioned previously, the fate and transport of arsenic, cadmium, and lead are determined by the properties of these elements and the physicochemical characteristics of the environment. In this section, the environmental chemistry of arsenic, cadmium, and lead is summarized as well as its relationship to fate and transport. The main reference for this section is EPA (1979): Water-Related Environmental Fate of 129 Priority Pollutants.

4.2.1 Arsenic

The geochemistry of arsenic is very complex. Its fate depends largely on ambient pH and Eh conditions. Processes that affect fate and transport of arsenic include speciation, adsorption, co-precipitation, biotransformation, and volatilization. Arsenic is very mobile in the aqueous environment and readily cycles through the water column, sediments/soils, and biota.

4.2.1.1 General Geochemistry

In the natural environment, arsenic can exist in four oxidation states: +5, +3, 0, and -3. The most common oxidation states are +3 (trivalent) and +5 (pentavalent). Elemental arsenic (0) can be found in some ores, whereas gaseous arsines (-3) are found under very reducing conditions only. Arsenic can form a wide variety of inorganic and organic compounds, with toxicities largely dependent on the oxidation state of arsenic and the nature of the ligands. The toxicity of arsenic compounds from greatest to least is as follows: arsine (-3), organo-arsine compounds, arsenites (+3), arsenates (+5), and native arsenic (0).

Arsenic has been identified in more than 320 minerals (Fleischer, 1983). Of these minerals, two are of particular importance to the study area; arsenopyrite (FeAsS) was the primary arsenic-bearing mineral in ores processed by the smelter, and arsenolite (As_2O_3) was the main arsenic-bearing smelter product. Also, slag may contain amorphous or crystalline arsenolite. Both arsenopyrite and arsenolite may be stable in the marginally oxygenated environment of dense subsurface soils. Under atmospheric conditions, weathering products may include hydrated metal arsenates such as scorodite ($FeAsO_4.2H_2O$) or mixed arsenic oxides containing both trivalent and pentavalent arsenic. Due to the fact that most of these weathering products either occur in small quantities or as amorphous phases, it is very difficult to identify them using standard mineralogical techniques. Therefore, no attempt has been made to do so and the existence of these compounds on the site remains speculative.

In the aqueous environment, arsenic can be very mobile depending on arsenic speciation, with trivalent species (As(III)) generally considered to be more mobile than pentavalent species (As(V)). Arsenic speciation is controlled by redox conditions. Arsenic has no cationic species, but occurs as triprotic arsenious acid (H_3AsO_3), arsenic acid (H_3AsO_4), and the various ionization products. In oxidizing environments characteristic for most surface waters, the pentavalent oxyanions $H_2AsO_4^-$ and $HAsO_4^{2-}$ predominate. Under more reducing conditions, the trivalent species H_3AsO_3 is the most stable form in the pH range commonly found in groundwater (6.0 to 9.0). However, in most natural waters, trivalent and pentavalent species coexist in various proportions based on redox conditions, solution composition, and presence or absence of other compounds. The redox transformation from one species to the other is a relatively slow process. While oxidation of As(III) to As(V) in oxic surface water is thermodynamically favored, the kinetics of this process are such that oxidation is slow. As a result, rapid changes in groundwater redox conditions may not be reflected by changes in arsenic speciation for a period of several months (Tallman and Shaikh, 1980). For instance, Cherry et al. (1979) found that in arsenic-containing laboratory solutions, only 5 to 7% As(III) had converted to As(V) after 2.5 months in the absence of redox agents other than atmospheric oxygen. However, in a "stable" groundwater, the arsenic speciation is a reflection of current redox conditions. In most instances, use of arsenic speciation is a more reliable indicator of redox conditions than field Eh measurements or use of another redox couple such as Fe^{2+}/Fe^{3+}.

Due to the fact that arsenic concentrations in both residential wells EV-1 and EV-3 were at or below the detection limit, arsenic speciation results from these wells did not lend themselves to interpretation. In the lowland area, arsenic concentrations in some wells were sufficiently high to obtain meaningful arsenic speciation results (see Section 3.5.2.2). In general, trivalent arsenic is the dominant species, indicating that conditions in groundwater are reducing and that the arsenic itself is relatively mobile. Exceptions are wells EV-4B (upland outwash), and EV-7B and EV-9B (lowland alluvium), in which pentavalent arsenic predominates. Since these three wells are completed at considerable depth in confined aquifers, it is not clear what causes the high As(V) to As(III) ratio. However, it is interesting to note that wells EV-4B, EV-

7B, and EV-9B also distinguish themselves from the remaining alluvial wells EV-5, EV-8B, and MW-4B based on their common ion signature. A more detailed evaluation of this issue is provided in Section 3.1.2.4.

Although arsenic speciation was not measured in residential or lowland surface water samples, due to prolonged contact with the atmosphere, pentavalent arsenic species should predominate. As a result, arsenic in surface water should be relatively immobile and adsorb easily onto various particulate surfaces (see Section 4.2.1.2).

4.2.1.2 Sorption

In soil and the aquatic environment, arsenic behavior is dominated by sorption processes. These mechanisms include adsorption, co-precipitation, and precipitation as a stoichiometric phase. Adsorption can be non-specific or specific. Non-specific adsorption is the result of physical interaction between the solute and the adsorbent resulting from small electrostatic forces. Specific adsorption consists of direct interaction between adsorbate and adsorbent surface, which results in a more permanent removal from solution. Co-precipitation is the process by which arsenic would be incorporated in the interior of a solid either in lattice sites or in interstices. Formation of a stoichiometric phase (amorphous or crystalline) is the most effective way by which arsenic can be removed from solution.

Depending on redox conditions, both As(III) and As(V) may adsorb onto metal (hydr)oxides (especially Al, Fe, and Mn), clays, and particulate organic matter. Adsorption of trivalent species decreases with increasing pH above pH 9.0; adsorption of pentavalent species decreases above pH 7.0 (Gupta and Chen, 1978). In general, at a pH below 7.0, As(V) is more effectively adsorbed than As(III). The rate of adsorption and extent of arsenic removal from solution decrease with increasing salinity.

Another mechanism through which arsenic may be removed from solution is through co-precipitation or formation of a stoichiometric phase. These two processes are difficult to distinguish in the laboratory and the field, and are usually treated as one. The oxyanions of both arsenic and arsenious acid can coprecipitate with iron and manganese (hydr)oxides to form the corresponding hydrated metal arsenates and arsenites. Wagemann (1978) investigated the formation of a wide variety of metal arsenates and concluded that four metals (Ba, Cr, Fe, and Cu) were capable of controlling the arsenic concentration in freshwater. However, of these four metals, only iron occurs in sufficient amounts to result in arsenate precipitation. In several field studies (e.g. Sakata, 1987; Agett and Roberts, 1986; Crecelius et al., 1975), a good correlation was observed between the presence of iron (hydr)oxides in sediments and the amount of arsenic in these sediments. In addition, the relative insolubility of iron arsenate (scorodite, $FeAsO_4.2H_2O$) has led to the development of treatment applications for arsenic-containing wastewater by addition of ferric iron.

The extent and effectiveness of adsorption and co-precipitation of arsenic in the study area have not been investigated. Although the iron contents of soil, groundwater, and surface water are not known, the reddish brown color of oxidized fractures in fill and till material as well as the presence of reddish precipitates in some lowland surface water suggest that the soils contain iron in sufficient quantities to affect arsenic mobility. In addition, lead slag generally is rich in iron. Release of even a small fraction of this iron would provide additional opportunity for significant retardation of arsenic. Also, the slightly acidic to neutral groundwater and surface water conditions in residential and lowland groundwater favor arsenic adsorption.

4.2.1.3 Biotransformation

Biologically mediated transformation of arsenic is an important process, which significantly affects the mobility of arsenic in the aqueous environment. Most of these transformations involve formation of methylarsenic and dimethylarsenic acids from arsenates and arsenites. Certain bacteria, yeasts and fungi may transform these methylated arsenic acids to methyl derivatives of arsine, such as trimethylarsine and dimethylarsine (Ferguson and Gavis, 1972; Woolson, 1977; Cox and Alexander, 1973; Wood, 1975). The conditions required for formation of these organo-arsenic compounds are not well understood. Consequently, it is very difficult to assess the possible role of biotransformation of arsenic within the study area, and this has not been attempted.

4.2.1.4 Volatilization

Arsine (AsH_3) and methylated arsenic compounds formed by microbial transformation are relatively volatile. Consequently, volatilization may be an important mechanism in determining the fate of arsenic, especially in the highly reducing environments required for formation of arsine. However, arsine is rapidly oxidized upon contact with oxygenated waters or the atmosphere. The extent of loss of arsenic through volatilization may be negligible where non-porous soil and/or a dense vegetative cover are present. In addition, in oxygenated soils, the volatile arsenic species will be transformed to less volatile ones that will be readily adsorbed by a wide variety of adsorbents. Also, volatilized methylated arsenicals readsorb to airborne particulates.

Volatilization of arsenic is exceedingly difficult to measure and quantify other than under controlled experimental conditions. Consequently, no attempt has been made to assess the role of volatilization at the site. However, volatilization is thought to play an insignificant role in the overall arsenic cycle in the residential and lowland areas due to the absence of strongly reducing conditions, the density of the soil material, and the absence of exposed soil.

4.2.2 Cadmium

Cadmium is relatively mobile in the aqueous environment. Its fate and pathway are strongly affected by sorption processes. Cadmium is strongly accumulated by organisms at all trophic levels.

4.2.2.1 General Geochemistry

In the aqueous environment, cadmium exists exclusively as Cd(II). Consequently, redox conditions have little direct effect on cadmium. Cadmium can be found in several chemical forms, ranging from simple aquated ions and metal-inorganic complexes to organic compounds. Inorganic ligands include OH^-, Cl^-, CO_3^{2-}, and SO_4^{2-} (Long and Angino, 1977). The affinity of these complexing ligands for cadmium decreases as follows: CO_3^{2-}, OH^-, Cl^-, and SO_4^{2-}. Bingham et al. (1984) reported that cadmium complexed readily with chloride and sulfate in soil solutions such that its availability was significantly reduced. Humic substances may also play an important role. Fulvic acids and other natural organic complexing agents can maintain cadmium ions in a bound form at a pH as low as 3 (Guy and Chakrabarti, 1976). This is yet another process by which the release of cadmium from sediments may be controlled.

Cadmium occurs in minerals usually associated with zinc-bearing sulfide ores. In the ores processed by the smelter, cadmium is thought to substitute for zinc in sphalerite (ZnS). In slag, no crystalline cadmium-bearing phases have been identified. It is unclear which mineral phases control cadmium behavior in the study area. Conditions are generally not sufficiently alkaline or reducing to result in formation of $Cd(OH)_2$ or greenockite (CdS), respectively. Also, the absence of calcareous soils precludes formation of otavite ($CdCO_3$). Cadmium phosphates and sulfates are too soluble to form in average soils (Lindsay, 1979), and therefore would not be expected at this site.

4.2.2.2 Sorption

Sorption processes are considered the most important factor in reducing cadmium mobility. Sorption by mineral surfaces (particularly clays), hydrous metal oxides, and particulate organic matter is probably more effective in removing cadmium from solution than does precipitation. Due to the cationic nature of aqueous cadmium complexes, adsorption increases with increasing pH. Below pH 6 to 7, cadmium is desorbed from most adsorbents (Huang et al., 1977). The presence of competing cations such as Ca^{2+} and Mg^{2+} also reduces adsorption of cadmium. In unpolluted waters, exchange of cadmium for calcium in the lattice structure of carbonates can remove cadmium from solution (Perhac, 1974). However, in polluted or organic-rich waters, adsorption of cadmium by humic substances and other organic complexing agents will be the controlling factor for cadmium mobility (Huang et al., 1977).

Adsorbed cadmium may be released from soil by physicochemical changes in the soil environment induced by microbial activity. During metabolism, micro-organisms can excrete products that may alter soil conditions or produce water-soluble organic compounds or ligands capable of forming mobile cadmium complexes. Chanmugathas and Bollag (1987) conducted experiments on the microbial mobilization of cadmium, and found that release of cadmium was more rapid in an anaerobic than in an aerobic environment.

The extent and effectiveness of adsorption of cadmium in the study area are unknown. The clay content of the soils in the study area is moderate to low, which would suggest that adsorption of cadmium may not be very effective. Also, the slightly acidic to neutral groundwater and surface water conditions in the residential area do not favor cadmium adsorption. As a result, cadmium may be relatively mobile in surface water and groundwater on the site.

4.2.2.3 Biotransformation

Biomethylation of cadmium does not appear to occur in nature.

4.2.2.4 Volatilization

Cadmium is not known to form volatile compounds in the aquatic environment.

4.2.3 Lead

Lead is relatively immobile in the aqueous environment. Its fate and pathway are controlled by sorption processes, as well as the low solubility of lead compounds. Lead is generally not biomagnified; bioconcentration factors tend to decrease as the trophic level increases.

4.2.3.1 General Geochemistry

In the aqueous environment, lead can exist in three oxidation states: +4, +2, and 0. The most common oxidation state is +2 (divalent). Tetravalent lead (+4) is stable only under highly oxidizing conditions, and has very little significance in the aquatic system. When sulfur activity is very low, metallic lead (0) can exist in a slightly alkaline to alkaline environment.

Under most redox conditions, lead exists as Pb^{2+}. However, it may form complexes with inorganic ligands such as OH^-, Cl^-, HCO_3^{2-}, CO_3^{2-}, and SO_4^{2-} (Long and Angino, 1977). Also, as for cadmium, fulvic acids and other natural organic complexing agents can maintain lead ions in a bound form at a pH as low as 3 (Guy and Chakrabarti, 1976).

Lead is a major constituent of over 200 minerals. The primary mineral in the smelter feed was galena (PbS). Another confirmed lead-bearing phase in the ore was jamesonite ($2PbS.Sb_2S_3$). It is likely that in addition to these two minerals, the ores contained a wide variety of other lead sulfo-salts and their alteration products. In slag, the lead sesquioxide Pb_2O_3 has been identified. Under current conditions at the former smelter site, the very insoluble minerals cerussite ($PbCO_3$) or anglesite ($PbSO_4$) may control lead behavior. Although soils have not been analyzed for sulfur, it is likely that a significant sulfur reservoir is available for formation of anglesite. Also, despite the absence of calcareous soils, even small concentrations of inorganic carbonate formed by dissolution of atmospheric CO_2 may result in formation of cerussite. Consequently, it would be expected that dissolved lead concentrations in water on the site are held to very low values. Analyses of dissolved lead both in groundwater and surface water show that this is the case; dissolved lead is rarely detected in residential and lowland groundwater.

4.2.3.2 Sorption

Sorption processes exert a dominant effect on the behavior of lead in the aqueous environment. Adsorbents include particulate organic matter, clays, and metal (hydr)oxides. As for cadmium, lead adsorption increases with increasing pH. Above pH 7, essentially all lead available is in the solid phase (Huang et al., 1977). The addition of organic complexing agents increases lead's affinity for adsorption. Although the relative importance of individual sorption processes varies widely, it is believed that hydrous iron and manganese oxides are the most important adsorbents (e.g. Jenne, 1968; Lee, 1975; Hohl and Stumm, 1976). Adsorbed lead can only be released to the aquatic system under very acidic conditions. The fact that lead is almost exclusively detected as total lead at the site, i.e. attached to particulates, suggests that adsorption of lead may be an important factor in controlling lead mobility.

4.2.3.3 Biotransformation

Lead can be methylated by micro-organisms commonly present in anoxic sediments. The main product of the biomethylation is tetramethyl lead ($(CH_3)_4Pb$). Although the stability of this compound in aerobic waters in unknown, it will probably not persist in oxidizing conditions. Other biogenic ligands may play a role in complexing of lead, thereby impacting its fate and transport. Due to the complexities associated with assessment of the role of biotransformation of lead in the study area, no such attempt has been made. However, biotransformation is not thought to play a role of significance.

4.2.3.4 Volatilization

The most important volatile lead-bearing compound is tetramethyl lead. However, the importance of its volatilization is not known. As mentioned above, it may not be stable under atmospheric conditions, and as such have no impact on aerial distribution of lead. The presence of aerobic water between reducing sediments and the atmosphere is probably sufficient to preclude any tetramethyl lead from escaping into the atmosphere. Consequently, volatilization of lead in the study area most likely is of no importance.

5.0 RISK ASSESSMENT

The purpose of this risk assessment is to evaluate the potential human health effects associated with chemicals remaining in residential soil, surface water, and groundwater as a result of past smelter operation and demolition. The intent is to comply with the MTCA regulation which requires including a risk assessment characterizing the current and potential threat to human health and the environment that may be posed by hazardous substances in the Remedial Investigation report (WAC 173-340-350(6)(d)).

Typically, risk assessments evaluate the likelihood of adverse effects occurring in human or non-human populations due to exposure to chemicals in the environment. Risk assessments are not intended to predict the actual risk of an individual, rather they provide conservative, upper-bound estimates with an adequate margin of safety for the protection of public health and the environment. The risk assessment procedures use the available sampling data to identify chemicals of potential concern, analyze how one might be exposed to the chemicals, and calculate risks based on estimated chemical exposure and toxicity. The results of the risk assessment provide the information necessary for evaluating overall protectiveness of cleanup actions under WAC 173-340-360(5)(d). Risk management decisions on soil remediation and cleanup actions for the protection of current and future health are usually a separate process from the risk assessment.

The methodology for this risk assessment is based on Washington state guidance for defining cleanup levels as presented in the MTCA regulation (Chapter 173-340 WAC). The risk assessment approach under MTCA was adapted from U.S. EPA guidelines for Superfund sites; however, the result of the MTCA risk assessment is the selection of chemicals requiring cleanup levels. This report meets MTCA requirements as identified in Ecology's enforcement order.

This chapter selects the chemicals of potential concern, assesses exposure for populations at risk, evaluates the toxicity of the chemicals, calculates site risks, and presents cleanup levels for the chemicals of concern. Although the MTCA regulation does not specify the calculation of risk, at Ecology's request, this chapter calculates potential health risks over a range of soil concentrations using the MTCA cleanup level equations. The final section of the risk assessment contains a glossary of terms, acronyms, and abbreviations used in the text. The accuracy of this chapter depends on the quality and representativeness of the available sampling, exposure, toxicological data, and assumptions. Uncertainties associated with the risk assessment process are discussed in an addendum (Appendix J).

5.1 DATA EVALUATION

The initial step in the risk assessment develops a framework for how chemicals were released and migrated to soil, water, or air at the site. Within this framework, the available sampling data and site information are reviewed in order to evaluate which chemicals and environmental sources (e.g. soil, water, air) may be potential health concerns. A number of studies have been conducted by the Department of Ecology, their contractors, and private parties, in addition to the most recent and extensive sampling conducted by Hydrometrics (see Sections 1 through 4).

Under both the MTCA regulation (WAC 173-340-708(2)) and U.S. EPA guidelines (U.S. EPA, 1989, 1991), an initial screening is conducted in which the available site data are reviewed to select chemicals of concern based on inherent toxicity, concentration, environmental fate properties, and elevation over background concentrations. This approach allows early elimination of chemicals, exposure pathways, and receptors for which risks are negligible, thereby allowing the evaluation of cleanup actions to focus on the chemicals and media contributing significantly to potential site health risks (WAC 173-340-708(4)and(5)).

The following section discusses the release and transport of smelter-related chemicals into the environment, evaluates the site data, describes the chemical selection process, and discusses the results of the chemical screening by media and chemical.

5.1.1 Chemical Release and Transport

Historical releases to the atmosphere during the smelter operation transported chemicals to soil in the "smelter" and "peripheral" areas. Direct releases to soil also occurred on the smelter property. Demolition activities after smelter closure removed standing structures but left smelter debris and other miscellaneous materials in soil. The secondarily impacted medium (e.g., soil) serves as a source for further releases. Soils may be a secondary source of metals to surface water, groundwater, garden vegetables, airborne dust, and indoor dust. Groundwater and surface water in turn may be serving as a source of chemicals to the lowland areas and possibly the Snohomish River.

5.1.2 Relevant Site Data

The screening evaluation for chemicals of concern requires an analysis (from a risk perspective) of the site data that have been collected during the remedial investigation and during prior investigations (see Sections 1.5 through 3). Only sample data collected from the study area are included in the risk assessment. The relevant data include 13 metals and arsenic in soil; four metals and arsenic in groundwater; and arsenic, cadmium and lead in surface water after rainfall. Household dust samples were analyzed for arsenic and lead. Slag was occasionally noted in soil, primarily at depth. Slag sample results are included in the soil sample data set and are evaluated as soil for the purposes of screening and later assessment. Decreases in surface soil concentrations due to the Interim Action (Section 1.5) in the "smelter" area are not considered in the presentation of site concentrations.

5.2 CHEMICAL SELECTION PROCESS

The sampling data for soil, groundwater, and surface water were screened to establish a list of chemicals that, based on their concentration and toxicity, are judged to contribute significantly to site risks. A chemical was selected for further assessment if the maximum site concentration of the chemical before the interim actions exceeded MTCA cleanup levels specified in the regulation (WAC 173-340-720 through -750). In addition, the selection process considered the frequency of detection, the magnitude by which concentrations exceeded criteria, background concentrations, and other relevant information.

Chemicals were eliminated from the evaluation based on insignificant contribution to site risks if (1) all concentrations were below the screening criteria, (2) concentrations were undetectable in any sample, or (3) chemical levels were below background concentrations. Detection limits were sufficiently low to rule out the possibility of undetected chemicals exceeding screening levels. The specific selection process is described below for each of the environmental media (e.g. soil, water, air) sampled.

5.2.1 Results of Screening

Chemicals of concern in soil are antimony, arsenic, cadmium, lead, mercury, and thallium. None of the chemicals sampled were selected as a concern for drinking groundwater in the residential area. The current data are insufficient to adequately determine whether groundwater in the residential area may be contaminated and affecting groundwater in the lowland areas; however, initial screening indicates that arsenic, cadmium, copper, lead, and zinc are exceeding screening concentrations in the lowland wells. Further monitoring has been proposed. Chemicals of concern in surface water are arsenic, cadmium, and lead. Levels of lead and arsenic in house dust were undetectable in most houses, although the few detections are difficult to interpret because of a lack of standards. The results of this screening process are described below for soil, groundwater, surface water, and house dust. Sheets 1-3 and 2-1 list sample locations for all media.

5.2.1.1 Soil

Chemicals which exceed the screening levels in surface soil samples from the "smelter" area include arsenic, cadmium, and lead (Table 5-1). The chemicals which exceed the screening levels for soil in the subsurface "smelter" samples include antimony, arsenic, cadmium, lead, mercury, and thallium. Arsenic and lead exceed screening concentrations in the "peripheral" area. For all chemicals of concern, the maximum concentration reported at the site was located in subsurface soil of the "smelter" area. Table 5-1 lists the concentrations and locations of the maximum value for each chemical screened.

No analytical results are available for antimony and thallium in surface soil in the "smelter" area or in samples from any depth in the "peripheral" area. Because these metals were only measured in samples with the highest metals concentrations (at depth), selecting them as chemicals of concern in all soils is a conservative assumption.

5.2.1.2 Groundwater

Of the chemicals sampled in monitoring wells in the residential area, only total arsenic and lead concentrations exceeded screening levels for groundwater (Table 5-2). Arsenic in groundwater does not exceed local background concentrations, reported as 1 to 18 parts per billion (ppb) (Ebbert, 1987). The highest lead level (16 ppb) is only slightly higher than the background concentration of lead in groundwater in Washington (up to 11 ppb; Ebbert, 1987). Given the precision of the analytical method at these low levels, these two numbers are likely to be statistically indistinguishable, i.e., there is no real difference between 11 and 16 ppb. The maximum lead sample is only marginally greater than the EPA action level for lead in drinking water at the tap (15 ppb). The only other sample with detectable lead was

TABLE 5-1
CHEMICAL SCREENING FOR SOIL

Chemical	Screening Conc.[a] (ppm)	Smelter Site Maximum				Peripheral Site Maximum	
		Surface		Subsurface			
		Concentration (ppm)	Location (Depth)	Concentration (ppm)	Location (Depth)	Concentration (ppm)	Location (Depth)
Antimony	32			15,000	S-111 (1')		
Arsenic	20	26,550	S-113 (0")	727,000	S-111 (1')	994	S50-4 (2')
Barium	5,600			1,704	S-111 (3')	238	HA-3 (1-3')
Beryllium	0.233			<0.16	S-111 (1')		
Cadmium	80	137	S78-1 (0")	230	S-112 (0.5')	14	S64-2 (0.5)
Chromium (total)	400	21	SS-13 (0-2")	54	S-113 (2")	56.5	HA-5 (1-3')
Copper	2,960	96	SS-13 (0-2")	460	S-111 (1')	56	SS-5 (0-2")
Lead	250	4,540	S61-1 (0")	11,000	S111 (1')	1,160	S64-2 (0.5)
Mercury	24			1,250	S-112 (0.5')	0.64	HA-5 (1-3')
Nickel	1,600	43	SS-11 (0-2")	21	S-111 (1')	35	SS4 (0-2")
Selenium	400			208	S-112 (0.5')	0.5	HA-5 (1-3')
Silver	400			53	S-111 (1')	6.1	HA-6 (1-3')
Thallium	5.6			200	S-111 (1')		
Zinc	24,000	187	SS-8 (0-2")	310	S-111 (1')	312	SS-2 (0-6")

NOTES:

ppm: parts per million

Boxed values exceed screening concentrations.

All concentrations are prior to interim remedial actions.

[a] MTCA health-based Method B values were used for the screening concentration except for arsenic and lead. Method A values were used instead because the Method B value for arsenic is below background and lead has no Method B value.

TABLE 5-2
CHEMICAL SCREENING FOR GROUNDWATER

Chemical	Screening Concentration [a] (ug/l)	Background [b] (ug/l)	Residential Area Wells			Lowland Area Wells		
			Maximum Sample Concentration (ug/l)	Location of Max. Sample	Frequency of Detection	Maximum Sample Concentration (ug/l)	Location of Max. Sample	Frequency of Detection
Arsenic	0.05	1-18	12	EV-1/EV-3	5/9	36,097	EV-6A	40/55
Cadmium	8.0		<5.0		0/9	558	EV-6A	5/55
Copper	592		66	EV-1	4/5	12,078	EV-6A	26/45
Lead	5.0	0-11	16	EV-1	2/9	51,100	EV-6A	26/55
Zinc	4,800		130	EV-1	6/6	219,333	EV-6A	39/45

NOTES:
Total metals were used for maximum concentrations.
[a] MTCA risk-based Method B formula values were used for the screening concentration except for lead.
The Method A value was used instead because lead has no Method B value.
[b] Source: Ebbert et al., 1987

within the background range at 5.4 ppb (out of 9 samples). Therefore, neither arsenic nor lead appear to be above background in groundwater in the residential area.

Groundwater in the lowland area does exceed screening levels (based on drinking water criteria) for arsenic, cadmium, copper, lead and zinc (see Table 5-2). Because of several data gaps, additional study of this area is planned. Groundwater from the lowland area will not be addressed further in this risk assessment except to note the possibility of its contribution to potential chemical exposures for ecological receptors and humans if upland chemical concentrations in groundwater reach the Snohomish River.

5.2.1.3 Surface Water

This section relates to surface water in the residential area. The Snohomish River and lowland area surface water may potentially be impacted by site chemicals; however, a detailed evaluation of this area awaits more investigation.

Surface water runoff was tested for arsenic, cadmium and lead in seven grate cover access points to the storm water collection system on three days during rain events. Eleven samples were collected in the "smelter" area and 19 samples were collected in the "peripheral" area. Five samples were collected at a grate cover location (SW-12) estimated to be "background" (i.e., unaffected by site chemicals). This grate cover was located southeast of the former plant where soil arsenic, lead, and cadmium concentrations are likely near background levels (Sheets 2-1, 3-4, 3-16, and 3-28). Arsenic and cadmium were not detected in any surface water background samples; however, lead was detected (see section 5.1.5.4). Maximum concentrations of the three chemicals in "smelter" and "peripheral" surface water samples exceeded screening levels (Table 5-3). The highest surface water concentration for lead (SW-6) was collected under the overpass where Marine View Drive, Highway 529, and Broadway meet, and the highest concentration for both arsenic and cadmium was at the southern boundary of the former smelter (SW-7). The "peripheral" sample locations with maximum metal concentrations receive runoff water from the "smelter" area.

TABLE 5-3
CHEMICAL SCREENING FOR SURFACE WATER

Chemical	Screening Concentration [a] (ug/l)	Smelter Site Maximum Sample Conc. (ug/l)	Smelter Site Location of Max. Sample	Smelter Site Frequency of Detection	Peripheral Site Maximum Sample Conc. (ug/l)	Peripheral Site Location of Max. Sample	Peripheral Site Frequency of Detection	Maximum Background [b] (ug/l)
Arsenic	0.05	$\boxed{12,000}$	SW-7	11/11	$\boxed{6,200}$	SW-10	16/19	< 5.0
Cadmium	8.0	$\boxed{60}$	SW-7	2/11	$\boxed{25}$	SW-10	1/19	< 5.0
Lead	5.0	$\boxed{150}$	SW-6	11/11	$\boxed{116}$	SW-9	12/19	$\boxed{25}$

NOTES:
Boxed concentrations exceed the screening concentrations.
All concentrations are prior to interim remedial actions.
Total metals measured in samples were compared to screening concentrations.

[a] MTCA risk-based Method B values for groundwater were used for the screening concentration except for lead. The Method A value was used instead because lead has no Method B value.

[b] Background samples were taken at the SW-12 location, which was off-site.

5.2.1.4 House Dust

Household dust was collected and analyzed for arsenic and lead at six residences within the "smelter" area in August 1993 by Hydrometrics. Arsenic and lead were measured in terms of "loading" in dust, which is the amount of chemical per surface area. Arsenic was only detected in one sample (HD-1) at 362 micrograms of arsenic per square foot (ug/ft^2). Lead was only detected in two homes, with the highest concentration (39 ug/ft^2) in sample HD-1. Sample HD-1 was from the house with the highest measured soil concentration of arsenic.

Although federal or Washington state standards for house dust levels of arsenic or lead are lacking, the Department of Housing and Urban Development (HUD; 1990) has established lead dust clearance criteria for specific interior surfaces: 200 ug/ft^2 for floors; 500 ug/ft^2 for window sills; and 800 ug/ft^2 for window wells. These guidelines are well above the levels measured in the six houses, indicating that the measured amounts of lead in dust were low.

Lead and arsenic concentrations in dust were also quantified by the Washington Department of Health (DOH) and the Snohomish Health District (SHD). Nevertheless, because of incomplete information on the sampling and analytical procedures, dust data collected by the DOH and SHD could not be interpreted for use in the risk assessment (see also discussion in Section 3.6).

5.2.2 Chemicals of Concern

Selected chemicals of concern in "smelter" soils were arsenic, lead, cadmium, antimony, mercury, and thallium. Arsenic and lead were also above screening levels in "peripheral" area soils. Antimony, mercury and thallium were not sampled for in “peripheral” area soils; therefore, these metals were conservatively selected as chemicals of concern for this area, although they may be below screening levels. The other metals analyzed in soil were approximately 2 to 71 times below their screening concentrations. Although fewer data are available for these latter chemicals, they are not expected to be present at the site at levels that would have caused a health concern for community soils. Arsenic, cadmium, and lead were also selected for surface water.

5.3 EXPOSURE ASSESSMENT

This section identifies the potentially exposed human populations and evaluates the means by which exposure occurs. The MTCA regulation states that cleanup evaluations shall be defined by the "highest beneficial use" of the site under "reasonable maximum exposure" conditions and this combination is specified as residential use (WAC 173-340-708(3) and WAC 173-340-720 through -760). Therefore, potential exposure pathways for current and future land-use conditions will be evaluated for residents.

5.3.1 Exposed Populations

Populations considered by this risk assessment to be potentially exposed at the site are the residents of the community. Short-term exposures for populations other than residents (e.g., utility workers disturbing soil) are possible, but cleanup levels protective of chronic exposure for residents would also be protective of short-term exposures for other populations. Within the exposed populations, sensitive sub-populations are also reviewed to avoid underestimation of risks. Sensitive groups may include children and a minority of people who are unable to detoxify arsenic (see Section 5.3). In addition, long-term residents who grew up in the community would receive the most cumulative exposure. Those living in the "smelter" area would also have potentially higher exposure due to higher chemical concentrations than the "peripheral" area. In addition to children, certain subpopulations in the Everett community may also have increased exposure to soil because of cultural practices regarding increased vegetable gardening or in the interim before remediation because they are unable to read the health advisories. The elderly is also a group generally considered more sensitive to the toxic effects of chemicals, although not necessarily for the cumulative effects of arsenic and cadmium and the neurological effects of lead (unless they lived in the community all their life).

5.3.2 Characterization of Exposure Pathways

An exposure pathway is the mechanism by which one may be exposed to chemicals from a source. A *complete pathway* includes 1) a source, 2) a retention or transport medium (e.g., soil or air), 3) a point of contact for receptors (i.e., residents) with the affected medium, and 4) a route of entry into the body (e.g., ingestion) at the contact point. Only complete pathways containing all four elements result in exposure and risks. According to MTCA and EPA risk assessment guidelines (WAC 173-340-708(3); U.S. EPA, 1989B), pathways may be considered potentially complete for risk calculations even if no exposure is currently occurring, since both current and hypothetical future conditions are to be considered.

Possible pathways at the site for human receptors include:

- Incidental ingestion of soil and indoor dust.
- Dermal contact with soil and indoor dust.
- Incidental ingestion of surface water runoff in the residential area.
- Inhalation of airborne dust.
- Ingestion of garden vegetables.
- Ingestion of groundwater.

Current use of groundwater as a drinking water supply is an incomplete pathway. No one in the community is presently using the groundwater for drinking water or other purposes. This situation is unlikely to change in the near future given the urbanized nature of the area, and readily available supply of municipal water. MTCA regulation WAC 173-340-708(3)(b) and WAC 173-340-720(1)(a), however, require that risk assessments assume that groundwater could be used for domestic purposes at some point in the future. Surface water which enters the storm water runoff system is not contributing to chemical concentrations in the lowland areas, but groundwater may be contributing to exposures indirectly as a source of chemicals to the Snohomish River. This later pathway has not been quantitatively evaluated in this report because of lack of data. They are noted here as potential pathways of concern and may be evaluated in-depth at some point in the future.

Dermal contact with soil or surface water can be a complete pathway for children playing in dirt, mud or puddles, adults working in the garden or digging holes, or construction workers who excavate soil. Dermal absorption can be a route of exposure and can contribute to systemic levels of chemicals; however, this exposure route is generally not a concern for most metals. For most metals, the amount of dermal exposure and risk is small compared to the amount ingested. MTCA does not have an equation to evaluate dermal exposure; however, Method B equations are conservative in part to account for lack of assessment for dermal exposure (Chapter 173-340 WAC).

Of the remaining pathways, the soil ingestion pathway is addressed by the MTCA equations and is quantitatively evaluated in this chapter. Pathways not addressed by MTCA are discussed in an addendum.

Ingestion of soil (which may include slag or demolition debris) or house dust is a primary route of exposure to chemicals in soil. Children are more likely to ingest soil during outdoor play and to ingest dust during indoor activities than adults because of their more frequent hand-to-mouth actions. Adults may also ingest small amounts of soil during gardening, while caring for pets, by eating or smoking with dirty hands, or by dust deposited on food. Indoor dust may contain chemicals from outdoor soil by resuspension of outdoor dust and airborne transport indoors or by tracking indoors on the feet of occupants or pets.

Samples of soil may include some chunks or particles of slag as well as demolition debris (e.g., bricks). Exposure to coarse material such as slag may differ from exposure to soil in that exposure would be reduced by the lesser tendency of large particles to cling to children's hands and be inadvertently ingested (Duggan et al., 1985) and by lower solubility of the material in the digestive tract. Indoor dust concentrations from slag are also likely to be considerably less than outdoor concentrations. Because of the dense, coarse nature of slag, erosion into fine dust that can be transported by wind or by tracking indoors is minimal compared to soil. Because the sampling data on chemical concentrations do not note the composition, we assume that all materials in the soil are as easily absorbed into the body as fine smelter emissions.

5.4 TOXICITY ASSESSMENT

A fundamental principle of toxicology is that the dose determines whether a chemical is toxic, and that any chemical can therefore be toxic. Toxicity criteria, developed by the U.S. EPA, describe the numerical relationship between the dose of a chemical and the magnitude of the toxic effect. This section presents the relevant toxicity criteria which are used to assess the risk associated with a given dose of the chemicals of concern. In addition, MTCA equations were used to calculate potential arsenic doses which were then compared to doses associated with health effects from epidemiological studies of ingested arsenic. The types of criteria are discussed below followed by a discussion of specific doses associated with health effects for arsenic, and a brief discussion of health effects and lead soil concentrations.

5.4.1 Toxicity Criteria

Key dose-response criteria used to quantify risks and hazards are U.S. EPA slope factors for assessing cancer risks, and U.S. EPA-verified reference dose values for evaluating noncarcinogenic hazards. Sources of these criteria are the U.S. EPA on-line data base, Integrated Risk Information System (IRIS; U.S. EPA, 1995), and Health Effects Assessment Summary Tables (HEAST; U.S. EPA, 1994b).

The carcinogenic slope factor [expressed in units of inverse milligrams of chemical per kilogram of body weight per day $(mg/kg/day)^{-1}$] is typically determined by the upper 95 percent confidence limit of the slope of the linearized multistage model, which expresses excess cancer risk as a function of dose. The model is based on high to low dose extrapolation, and also assumes that there is no lower threshold dose for cancer risk. A summary of carcinogenic slope factors for the chemicals of concern is presented in Table 5-4.

The chronic reference dose (RfD), expressed in units of mg/kg/day, is an estimated daily chemical intake for the human population, including sensitive subgroups, that appears to be without appreciable risk of noncarcinogenic effects if ingested over a lifetime. Chronic criteria are thus usually calculated based on lifetime (average) body weights and intake assumptions. A summary of reference doses and reference concentrations for the chemicals of concern is presented in Table 5-5.

5.4.2 Arsenic Doses and Health Effects

In this section, potential doses (amount of chemical ingested into the body) of arsenic from soil are compared to doses from the scientific literature on arsenic that have been associated with health effects (for methods see Appendix H). The relevant literature studies quantifying oral doses and health effects are almost exclusively of populations exposed to drinking water. Doses from soil must therefore be corrected for lower gastrointestinal absorption[1] in soil in order to be comparable.

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[2] Arsenic is absorbed into the body more easily from water than from soil. Arsenic in water is nearly 100% absorbed. The Department of Ecology has reviewed the scientific literature on arsenic absorption and has selected a gastrointestinal absorption rate of 40% for use in MTCA soil ingestion calculations (Kissinger, 1991).

TABLE 5–4
CARCINOGENIC TOXICITY CRITERIA
SLOPE FACTORS

Chemical	Exposure Route	Criteria Value[a]	Weight of Evidence[b]	Toxic Endpoint	Source
Arsenic	Oral	1.5	A	skin cancer	IRIS
Cadmium	Inhalation	6.3	B1	lung tumors	IRIS

NOTE
IRIS = Integrated Risk Information System, U.S. EPA (1995).
[a] Units $(mg/kg/day)^{-1}$
[b] Classification definitions: A – Human Carcinogen, sufficient evidence in humans.
B1 – Probable Human Carcinogen, limited human data available.

TABLE 5−5
NONCARCINOGENIC TOXICITY CRITERIA
REFERENCE DOSES

Chemical	Exposure Route	RfD mg/kg/day	Uncertainty Factor	RfD Confidence	Toxic Endpoint	Source
Antimony	Oral	0.0004	1000	Low	reduced lifespan, altered cholesterol levels	IRIS
Arsenic	Oral	0.0003−0.0008	3	Medium	hyperpigmentation, hyperkeratosis of skin	Glass & SAIC (1992) IRIS
Cadmium	Oral	0.0005 (water)	10	High	kidney proteinuria	IRIS
		0.001 (food)	10	High		
Lead	Oral	none			neurological and behavioral effects	U.S. EPA (1990)
Mercury	Oral	0.0003	1000		kidney effects	HEAST
	Inhalation	0.0003	30		neurotoxicity	HEAST
Thallium	Oral	0.00007	3000		hair loss, possible liver effects	HEAST

NOTE
IRIS = Integrated Risk Information System, U.S. EPA (1995).
HEAST = Health Effects Assessment Summary Tables, U.S. EPA (1994).

RfD = Reference Dose.

Table 5-6
Arsenic Doses & Carcinogenic Health Effects at Various Soil Concentrations

Soil Concentration (mg/kg)	MTCA Dose ug/kg-day	Doses - other studies[a] ug/kg-day	Carcinogenic Health Effects[b]	Location of Study	Reference
7	0.0028				
20	0.008				
76	0.03				
100	0.04				
152	0.061				
230	0.092				
500	0.2				
1,000	0.4				
		0.57	lifetime dose from drinking water at the MCL		1
		1.5	no skin cancers	Fairbanks, Alaska	2,3
		2.9	no skin cancers	Fallon, Nevada	2,4
10,000	4	4.6	no skin cancers	Fairbanks, Alaska	2,3
		6	no skin cancers	Millard Co., Utah	2,5
		12	skin cancer, average for low dose group	Taiwan	1,6
		34	skin cancer, average for medium dose group	Taiwan	1,6
100,000	40	46	possible threshold for bladder cancer	Taiwan	7
		57	skin cancer, average for high dose group	Taiwan	1,6
720,000	288				

NOTES

(a) Doses from the scientific literature. Human arsenic ingestion studies were chosen to most closely approximate arsenic ingestion from soil. Study results are primarily from drinking water containing As. Doses corresponding to health effects are based on adult intake assumptions and body weight. See Appendix H for dose calculations.

(b) Additional health effects were seen in some of these studies. Details are presented in the text. See also Table 5-7.

$$\text{MTCA soil dose} = \text{soil concentration} \times \frac{\text{SIR} \times \text{AB1} \times \text{DUR} \times \text{FOC}}{\text{ABW} \times \text{LIFE} \times \text{UCF1}} = (\text{soil concentration})\ (4 \times 10^{-7})$$

SIR = Soil Ingestion Rate -- 200 mg/day
AB1 = Gastrointestinal Absorption Rate -- 40%
DUR = Duration of Exposure -- 6 years
FOC = Frequency of Contact -- 1.0
ABW = Average Body Weight over period of exposure -- 16 kg
LIFE = Lifetime -- 75 years
UCF1 = Unit Conversion Factor -- 1,000,000 mg/kg

REFERENCES

1 U.S. EPA, 1988, 1989, 1995
2 Valberg et al., 1993
3 Harrington et al., 1978
4 Vig et al., 1984
5 Southwick et al., 1983
6 Abernathy et al., 1989
7 Guo et al., 1995

Table 5-7
Arsenic Doses & Noncarcinogenic Health Effects at Various Soil Concentrations

Soil Concentration (mg/kg)	MTCA Dose ug/kg-day	Doses - other studies[a] ug/kg-day	Noncarcinogenic Health Effects[b]	Location of Study	Reference
7	0.035				
20	0.10				
76	0.38				
100	0.5				
152	0.8				
230	1.2				
		1.8	no dermal effects observed (NOAEL)	Taiwan	1,2
500	2.5				
1,000	5				
		10	hypo- & hyperpigmentation, hyperkeratosis of the skin	Chile	3,4
		17	Raynaud's disease, thrombosis	Chile	3,5
		30	hyperpigmentation, keratosis, & vascular effects (LOAEL)	Taiwan	1,2
10,000	50				
		60	keratosis in children, arterial thickening, Raynaud's disease	Chile	3,6,7
		430	GI irritation, skin discoloration, anemia, neuropathy	Washington	8
100,000	500	640	anemia, severe GI irritation, paresthesia	New York	9
		1,560	severe peripheral neuropathy, GI irritation	Washington	8
720,000	3,600				

NOTES

NOAEL: No-observed-adverse-effect-level

LOAEL: Lowest-observed-adverse-effect-level

GI: Gastrointestinal

(a) Doses from the scientific literature except for reference #8 which used MTCA equations. Adjustments were made for the Taiwan NOAEL and the New York study to equate to a child dose (see text). Human arsenic ingestion studies were selected to most closely approximate arsenic ingestion from soil. Studies are primarily from drinking water containing arsenic.

(b) Additional health effects were seen in some of these studies. Details are presented in the text.

$$\text{MTCA soil dose} = \text{soil concentration} \times \frac{\text{SIR} \times \text{AB1} \times \text{FOC}}{\text{ABW} \times \text{UCF2}} = (\text{soil concentration})(5 \times 10^{-6})$$

SIR = Soil Ingestion Rate -- 200 mg/day
AB1 = Gastrointestinal Absorption Rate -- 40%
FOC = Frequency of Contact -- 1.0
ABW = Average Body Weight over period of exposure -- 16 kg
UCF2 = Unit Conversion Factor -- 1,000,000 mg/kg

REFERENCES

1 Tseng, 1968
2 U.S. EPA, 1995
3 ATSDR, 1993
4 Borgono, 1980
5 Zaldivar, 1974
6 Zaldivar and Guillier, 1977
7 Zaldivar, 1977
8 Washington State Department of Health, 1991
9 Franzblau and Lilis, 1989

Because unknown factors are present even in well conducted epidemiological studies, calculations of doses presented in the "other studies" column of Tables 5-6 and 5-7 are estimated numbers assuming, for example, populations in Taiwan and Chile have equivalent sensitivity to those in Everett (see uncertainty discussion in Addendum). MTCA equations for calculating dose specify certain assumptions (e.g., young child, 16 kg body weight, U.S. health standards) which were not always the case in the epidemiological studies used for comparison. Consequently, noncarcinogenic doses estimated for adults from literature studies were adjusted to a child dose using the ratio between adults and children for water intake and body weight according to MTCA (see Appendix H for calculations). These adjustments were made to estimate doses comparable to MTCA calculations which assume exposure to a young child. Unlike carcinogenic MTCA doses which assume lifetime exposure, carcinogenic doses in theliterature studies were not adjusted for less than lifetime exposure. The populations in Taiwan and Chile were generally exposed for their whole lifetime, whereas the exposure duration was not always known in the U.S. studies.

Tables 5-6 and 5-7 show estimated doses based on MTCA carcinogenic and noncarcinogenic exposure parameters, respectively, at various soil concentrations from ingesting arsenic in soil and house dust and doses correlated to health effects from epidemiological studies. As the tables show, some noncarcinogenic skin effects are first noted in Chilean populations at doses equivalent to a MTCA dose from soil of 2,000 ppm. No reports of health effects were found below this exposure level. Skin cancer was not observed until a dose greater than an equivalent MTCA dose from 10,000 ppm arsenic in soil was reached.

Arsenic soil concentrations at various depths at the Everett site range from 7 ppm or less (area natural background concentration) to 727,000 ppm. The dose assuming MTCA exposure assumptions was calculated for 11 arsenic concentrations found at the site from natural background up to the maximum site soil concentration. A discussion of health effects associated with doses equivalent to the specified soil concentration ranges is presented below.

7 to 1,000 ppm

Soil concentrations of 7 to 1,000 ppm arsenic correspond to doses of 0.0028 to 0.4 ug/kg/day using MTCA carcinogenic soil ingestion assumptions or 0.035 to 5 ug/kg/day using MTCA noncarcinogenic soil ingestion assumptions. The maximum arsenic concentration found in the "peripheral" area of 994 ppm falls within this range. No studies could be found where adverse health effects occurred after exposure to doses in this range.

- A study of 17,000 people in Taiwan detected no dermal effects in any person at an average chronic daily intake from food and water of 0.8 ug/kg/day for an adult (estimated by U.S. EPA, 1995). This dose was adjusted to a child's dose of 1.8 ug/kg/day.

1,000 to 10,000 ppm

This soil concentration range would be equivalent to MTCA carcinogenic and noncarcinogenic dose ranges of 0.4 to 4 ug/kg/day and 5 to 50 ug/kg/day, respectively. Epidemiological studies of populations exposed to arsenic in this dose range did not find evidence of increased skin cancer, but other skin and vascular effects were seen in this range. Gastrointestinal irritation, hyperpigmentation, keratoses in children, hyperpigmentation, liver effects, Raynaud's disease, and thrombosis have also been noted after chronic exposure within this dose range (Cebrian et al., 1983; Tseng, 1968; Zaldivar, 1974). The lowest doses associated with skin effects, notably hyperpigmentation and hyperkeratosis are first observed after chronic long-term exposure to doses of from 10 to 17 ug/kg/day. Some of the epidemiological studies are described briefly below.

- An examination of a group of people in Fairbanks, Alaska, found no skin cancers among 49 persons exposed to 401 ug/L or 30 persons exposed to 76 ug/L arsenic in their drinking water (Harrington et al., 1978). The estimated dose was 1.5 and 4.6 ug/kg/day, respectively (Valberg et al., 1993).

- One hundred and five people in Fallon, Nevada, were examined who were exposed to naturally-occurring arsenic in their drinking water (Vig et al., 1984). The average arsenic concentration was 100 ug/L, with an estimated daily dose of 2.9 ug/kg/day (Valberg et al., 1993). No skin cancers were observed.

- Children in Antofagasta, Chile, were exposed for 11 to 15 years to arsenic in drinking water at concentrations of 800 ug/L and carbonated beverages at concentrations of 300 to 700 ug/L (Borgono et al., 1977, 1980). Their dose was estimated at 10 ug/kg/day (ATSDR, 1993). Hypo- and hyperpigmentation and hyperkeratosis were observed. Skin effects were not seen in children under six years old. This may be due to the shorter period of exposure or because a water treatment plant had been installed six years prior which greatly reduced the level of exposure. Raynaud's disease and thrombosis were observed in children and adults in Antofagasta in 1974 at a dose of 17 ug/kg/day (Zaldivar, 1974).

- The Taiwanese study (described above) observed the lowest-dose health effects (hyperpigmentation, keratosis, and vascular effects) at 14 ug/kg/day in adults (Tseng, 1968; U.S. EPA, 1995), adjusted to 30 ug/kg/day in a child.

<u>10,000 to 100,000 ppm</u>

A soil concentration range of 10,000 to 100,000 ppm would be equivalent to a MTCA dose range of 4 to 40 ug/kg/day if prorated over a lifetime for evaluating carcinogenic effects or 50 to 500 ug/kg/day for evaluating noncarcinogenic effects. Skin cancer has been observed in adults from other countries who have been exposed to doses in the mid to upper portion of this range for usually 30 or more years. Epidemiological studies in the United States of populations exposed to oral arsenic doses in this range generally have not seen carcinogenic health effects. Some health effects associated with this dose range are described below.

- In Antofagasta, Chile, 265,000 persons (106,000 infants and children) were exposed to arsenic in water and food (Zaldivar and Guillier, 1977). Between 1968-1971, 337 infants and children were examined at the regional hospital for chronic arsenical dermatosis. These children's symptoms included arterial spasms in the fingers and toes, Raynaud's disease, and vasospasms of the digital arteries. Malnutrition was common in the study population. The arsenic dose in children between 1955 and 1970 was estimated, based on a dietary survey of 36 children in Antofagasta and analysis of the drinking water (n=877), to be between 24 to 148 ug/kg/day, with the doses decreasing in the late 1960's and with all children receiving higher doses during their early years of life. ATSDR (1993) estimated a dose of 60 ug/kg/day for 15 years was associated with keratosis and hyperpigmentation in children, and for 1 to 39 years of exposure with arterial thickening and Raynaud's disease (Zaldivar, 1977; Zaldivar and Guillier, 1977). Of the 337 children, 5 died. For the five children who died (2 yrs of age to 7 years of age), the mean arsenic dose for their first year of life was 130 ug/kg/day with an average dose over their individual lifetime of 50 - 100 ug/kg/day (Zaldivar and Guillier, 1977). The primary causes of death were late signs of chronic poisoning, such as pneumonia, bronchiectasis, or intestinal hemorrhage, complicated by malnutrition.

- No skin cancers were observed among 145 persons exposed to arsenic in drinking water in Millard County, Utah (Southwick et al., 1983). The average arsenic concentration in the drinking water was 208 ug/L, corresponding to an estimated daily dose of 6.0 ug/kg/day for an adult (Valberg et al., 1993).

- A study was conducted for over 40,000 people in Taiwan who were exposed most of their life to arsenic in drinking water and dietary arsenic (U.S. EPA 1988c; Abernathy, 1989). Subjects were classified into three exposure groups based on arsenic concentrations in well water low (170 ug/L), medium (470 ug/L), and high (800 ug/L). The average dose from water and food was estimated as 12, 34, and 57 ug/kg/day for the three groups (doses of 54 ug/kg/day fall in the next soil concentration range section). The exact exposure concentrations for the individuals in the various dose groups were unknown. Four hundred and twenty-eight cases of skin cancer were found within the study population. Many also had hyperkeratosis and hyperpigmentation. Prevalence of skin cancer increased with age and dose group.

- A woman exposed to arsenic in her drinking water well in Granite Falls, Washington was diagnosed with arsenic poisoning characterized by gastrointestinal distress, hyperpigmentation, anemia and a progressive neuropathy (Washington State Department of Health, 1991). Symptoms were reduced when she discontinued water consumption from that well and began again when she returned to drinking water from the well. Arsenic concentrations found in the well were 7,000 ug/L and were converted to a child dose using MTCA equations of 430 ug/kg/day.

100,000 to 720,000

Exposure to a soil concentration range between 100,000 to 720,000 would be equivalent to a dose range of 40 to 288 ug/kg/day using the MTCA carcinogenic exposure assumptions or 500 to 3,600 ug/kg/day using MTCA noncarcinogenic exposure assumptions. The high dose group of the Taiwanese population described above falls within this soil concentration range. The lower end of this dose range was observed to be the threshold dose for bladder cancer according to a recent epidemiological study in Taiwan. Three studies which examine populations exposed to arsenic doses in this range are described below.

- Arsenic concentrations in well water were compared with the cancer incidence from the National Cancer Registration Program in Taiwan by township. Data was available for 243 townships representing 11.4 million people. A relationship between bladder cancer and arsenic concentration was only statistically significant at the highest exposure category (>640 ug/L, 45.8 ug/kg/day; Guo et al., 1995). No significant association was seen between arsenic concentrations and kidney cancer, although kidney cancer was found at higher concentrations in the exposed townships than in the rest of Taiwan.

- Two persons experienced acute and chronic arsenic poisoning from a well with elevated arsenic due to a nearby abandoned mine (9,000 to 10,900 ug/L; Franzblau and Lilis, 1989). Their dose was estimated at 290 ug/kg/day (ATSDR, 1993). After one to two months exposure, the two people developed severe gastrointestinal irritation, anemia, liver toxicity, fatigue, and neurological abnormalities. One developed a skin rash and the other reported central nervous system symptoms. The dose was converted to an equivalent child dose of 640 ug/kg/day.

- Three members of a family drinking an average of 25,000 ug/L of naturally-occurring arsenic in their well water in Granite Falls, Washington, were diagnosed with arsenic poisoning and one experienced severe peripheral neuropathy (Washington State Department of Health, 1991). This water concentration corresponds to a child-dose of 1,560 ug/kg/day using MTCA equations.

5.4.3 Lead Soil Concentrations and Health Effects

As summarized by ATSDR (1993) and U.S. EPA (1986), lead is ubiquitous in the environment due to its widespread historical uses as a fuel additive, in paints, solders, and other consumer products. Lead can cause a wide range of toxic effects, mainly at high doses. The primary effects of concern for chronic exposures to environmental lead levels, however, are subtle neurobehavioral effects in young children. Subclinical effects on the blood-forming system are a secondary issue at low levels of exposure. Controversy continues to surround the question of low-level health effects from lead, which are often indistinguishable from other factors, particularly socioeconomic influences.

Recent investigations of the relative contribution of lead from various sources and pathways (Clark et al., 1991; Kimbrough, 1992; Ryan, 1993) have noted that other urban sources may have a greater impact on blood lead levels than lead in soil. In fact, declines in blood lead have been observed in smelting and mining towns that mirror national declines attributed to the decrease in dispersive lead sources such as interior house paint, leaded gasoline, lead soldered cans, and stricter controls on emissions sources (U.S. EPA, 1989a). These declines have occurred without remediation of soil lead.

Recent studies in smelting and mining areas have found low blood levels in children tested, despite high lead concentrations in surrounding soil. For example, a recent University of Cincinnati study (1994) in a historical smelting area in Sandy, Utah, found that none of the children living in housing adjacent to lead soil concentrations of up to 4,000 ppm had blood levels exceeding 10 ug/dl and the average blood lead level of these children was around 3 ug/dl. Similarly, the Smuggler Mountain Technical Advisory Committee report (1993) found geometric mean blood lead levels of 2.6 ug/dl in children who were exposed to soil lead levels in excess of 11,000 ppm (maximum soil lead concentrations at the Everett site are 1,160 ppm and 11,000 ppm for the "peripheral" and "smelter" areas, respectively). The relationship between blood lead and soil lead levels is thus very uncertain.

As a point of reference, the U.S. EPA recently recommended under Section 403 of TSCA a series of responses for residential, urban sites with elevated soil lead concentrations (U.S. EPA, 1994a). As noted in the NHANES III results, such locations are the most likely to contain children at risk for increased blood lead levels due to deteriorated lead-based paint in poor housing, as well as other socioeconomic disadvantages (Brody et al., 1994). Notwithstanding the greater sensitivity of these populations, EPA's soil response recommendations do not suggest abatement even in areas frequented by children except where bare soil concentrations of 5,000 ppm or greater are found.

5.5 CALCULATION OF SITE RISKS AND SOIL CLEANUP LEVELS

Cleanup levels under MTCA are specified by regulation without regard for site-specific considerations. MTCA identifies Method A cleanup levels for several chemicals in soil, groundwater, and surface water. According to the regulation (WAC 173-340-740(2)):

> *Method A tables have been developed for specific purposes. They are intended to provide conservative cleanup levels for sites undergoing routine cleanup actions or those sites with relatively few hazardous substances. The tables may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in these tables should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in these tables do not necessarily trigger requirements for cleanup action under this chapter.*

These levels are also not necessarily based on human health risk. MTCA regulations also include Method B equations, intended for development of "risk-based" cleanup levels. Ecology provides these Method B levels for various chemicals (WDOE, 1994a). This section presents (1) the results of risks calculated by modifying the MTCA Method B equations and (2) the cleanup levels for the site.

5.5.1 Potential Site Risks

The MTCA regulation provides equations for calculating cleanup levels (WAC 173-340-720 through 173-340-760) but not health risks. At the request of Ecology, these equations were manipulated to calculate risks at particular soil concentrations. Cancer risks and noncarcinogenic hazards are calculated for arsenic and cadmium, respectively, using the MTCA equations. Because lead lacks a reference dose, hazards associated with lead could not be calculated according to MTCA.

Potential health effects for noncarcinogenic chemicals are quantitatively estimated by calculating a hazard quotient. A hazard quotient is the ratio of the estimated intake or dose of a chemical to the chemical-specific reference dose. At a hazard quotient of 1.0, the estimated dose equals the upper dose associated with no adverse health effects (i.e., the RfD). In contrast, potential health effects for carcinogenic chemicals are quantitatively estimated by calculating a risk which represents the upper-bound chance of developing cancer in a lifetime in addition to a background U.S. cancer risk of one chance in three (3×10^{-1}). The target goal under the MTCA regulation for carcinogenic effects is an upper-bound cancer risk of 10^{-6} (one-in-a-million hypothetical risk of developing cancer in excess of background cancer risk).

Table 5-8 shows estimated excess risks of developing skin cancer associated with ranges of arsenic concentrations in soil that may be present at the site based on the highest concentrations at any soil depth. Sheet 5-1 graphically depicts MTCA risks shown in Table 5-8 that are associated with maximum concentrations measured in soil. These risks assume one were continuously exposed to soil at depth, despite the occurrence of some of the higher soil concentrations much below the surface. The maximum surface soil concentration in the "smelter" area is 26,550 ppm; the maximum in the "peripheral" area is 994 ppm. Arsenic risks for the total range of concentrations are 4×10^{-6} (a 4-in-a-million risk) at 7 ppm to 0.4 (a 4-in-10 risk or a 40% chance) at 720,000 ppm. Table 5-9 shows estimated hazards from cadmium exposure at the minimum and maximum soil concentrations found at the site (<1 ppm and 230 ppm). Hazards range from 0.01 up to 2.9.

5.5.2 MTCA Soil Cleanup Levels

Risk-based cleanup levels (Methods B) are based on estimated exposure below the EPA chronic RfD for noncarcinogenic effects (hazard quotient = 1) and a 10^{-6} risk for cancer. According to the MTCA regulation, the final cleanup levels for noncarcinogenic chemicals should not result in a combined hazard in excess of 1.0 for all chemicals with additive effects (WAC 173-340-708(5)). For carcinogenic chemicals, the total risk for all chemicals for a particular site should be no more than 10^{-5} (WAC 173-340-708(5)). Other considerations according to the MTCA regulation (WAC 173-340-700) were also considered as noted below:

Chemical	MTCA Cleanup Level (ppm)	Explanation
Antimony	32	Method B
Arsenic	7	Background
Cadmium	2	Method A (protect plants)
Lead	250	Method A (no Method B level)
Mercury	24	Method B
Thallium	6	Method B

Table 5-8
Risk of Skin Cancer at Various Arsenic Soil Concentrations

Soil Concentration Ranges (mg/kg)			MTCA Risk (unitless)		
0	-	7	0	-	4×10^{-6}
7	-	20	4×10^{-6}	-	1×10^{-5}
20	-	50	1×10^{-5}	-	3×10^{-5}
50	-	76	3×10^{-5}		5×10^{-5}
76	-	100	5×10^{-5}		6×10^{-5}
100	-	152	6×10^{-5}	-	9×10^{-5}
152	-	270	9×10^{-5}		2×10^{-4}
270	-	500	2×10^{-4}	-	3×10^{-4}
500	-	1,000	3×10^{-4}	-	6×10^{-4}
1,000	-	10,000	6×10^{-4}	-	6×10^{-3}
10,000	-	100,000	6×10^{-3}	-	6×10^{-2}
100,000	-	720,000	6×10^{-2}	-	4×10^{-1}

NOTE -- Risks are excess risks in addition to the background cancer risk of 3×10^{-1} (i.e., one chance in three) for U.S. populations.

Carcinogenic Risk (skin cancer) =

$$\text{Soil Concentration} \times \frac{\text{CPF} \times \text{SIR} \times \text{AB1} \times \text{DUR} \times \text{FOC}}{\text{ABW} \times \text{LIFE} \times \text{UCF1}}$$

CPF = Cancer Potency Factor -- 1.5 $(\text{mg/kg-day})^{-1}$
SIR = Soil Ingestion Rate -- 200 mg/day
AB1 = Gastrointestinal Absorption Rate -- 40%
DUR = Duration of Exposure -- 6 years
FOC = Frequency of Contact -- 1.0
ABW = Average Body Weight over period of exposure -- 16 kg
LIFE = Lifetime -- 75 years
UCF1 = Unit Conversion Factor -- 1,000,000 mg/kg

Table 5-9
Noncarcinogenic Hazards for the Range of Cadmium Concentrations in Soil

Soil Concentration (mg/kg)	Hazard Quotient (unitless)
1	0.01
230	2.9

Hazard Quotient =

$$\text{Soil Concentration} \times \frac{\text{SIR} \times \text{AB1} \times \text{FOC}}{\text{RfD} \times \text{ABW} \times \text{UCF2}}$$

RfD = Reference Dose -- 0.001 (mg/kg-day)
SIR = Soil Ingestion Rate -- 200 mg/day
AB1 = Gastrointestinal Absorption Rate -- 100%
FOC = Frequency of Contact -- 1.0
ABW = Average Body Weight over period of exposure -- 16 kg
UCF2 = Unit Conversion Factor -- 1,000,000 mg/kg

Method B levels were selected as appropriate for antimony, mercury and thallium. The cleanup level for arsenic was set at the background level (WDOE, 1994b) of 7 ppm which is higher than the Method B level of 1.67 ppm. Under MTCA, site remediation is not expected to go below background concentrations. The Method A value of 2 ppm for cadmium is selected as a cleanup level for protection of vegetation. Lead lacks toxicity criteria (see Tables 5-4 and 5-5); therefore a Method B value cannot be calculated and the cleanup level becomes the Method A concentration.

In considering chemical interactions, possible chemicals with additive effects are cadmium and mercury which both potentially affect the kidney at their lowest effect levels. However, because the Method A value selected as a cleanup level for cadmium is considerably below the Method B level, no additive effects would be expected with mercury.

Cadmium, lead, and arsenic exceed cleanup concentrations in both the "smelter" and "peripheral" areas. Antimony, mercury, and thallium exceed cleanup concentrations in the smelter area and it is not known if they also exceed cleanup levels in "peripheral" soils.

5.6 SUMMARY AND CONCLUSIONS

Chemicals of concern for the residential study area include arsenic, lead, cadmium, antimony, mercury, and thallium. According to MTCA risk assessment assumptions, soil ingestion represents the greatest source of exposure to these chemicals for current and future residents. Risks to ecological and human receptors associated with the Snohomish River and wetlands area could not be evaluated at this time. Exposures are potentially highest for those in the former "smelter" area where soil concentrations of chemicals are highest. The actual amount of exposure for an individual will vary depending on personal characteristics; however, cleanup levels are designed to be protective of the most-exposed groups (e.g., young children). The criteria used to incorporate chemical toxicity into the cleanup level calculations also are protective of to the most sensitive members of the population.

Arsenic is the primary determinant of site risks. Although calculated arsenic risks are high, the dose associated with the maximum arsenic concentration in the "peripheral" area (994 ppm) is well below the doses associated with skin cancer or any noncarcinogenic effects seen in the available scientific literature. A soil concentration of 1,000 ppm, however, corresponds to a calculated carcinogenic risk of 6×10^{-4} which exceeds the MTCA target risk levels.

Conservative estimates of cleanup levels were developed in accordance with the MTCA regulations. The calculated levels thus provide protection of public health under reasonable maximum exposure conditions which may be in excess of those actually experienced in the community.

5.7 GLOSSARY OF RISK ASSESSMENT TERMS, ACRONYMS, AND ABBREVIATIONS

AB: Percent Absorption. Fraction of a chemical dose that contacts the skin, lungs, or digestive tract and gets into the blood stream.

Action Level: The concentration of lead at a drinking water tap at which treatment may be required.

Acute Exposure: Short-term exposure usually over a few hours to a few days.

AT: Averaging Time. Period over which exposure is averaged in years or days.

ATSDR: Agency for Toxic Substances and Disease Registry.

Blood Lead Level: Amount of lead in the blood typically measured in micrograms of lead per deciliter of blood, ug/dl.

Bronchiectasis: Irreversible or chronic dilation of lung passageways as a sequal of an inflammatory disease.

BW: Body Weight. Average weight of adults or children.

Carcinogen: Any substance that is suspected to cause or contribute to the production of cancer.

Carcinogenic: Cancer-producing.

Chronic Exposure: Long-term exposure lasting from seven years to a lifetime (as defined by U.S. EPA).

Cleanup Levels: The concentrations of a hazardous substance in soil, water, air, specified by the MTCA regulation for triggering some remedial action at a site.

Detection Limit: The lowest level of a chemical that can be measured by an instrument.

Digital Arteries: Arteries located in the arms or legs.

Dose: The amount of substance that is taken into the body. See absorbed dose and administered dose.

Exposure Assessment: The evaluation of how chemicals might reach humans or the environment and the nature and amount of chemical contacted.

ED: Exposure Duration. The length of time over which exposure occurs in years.

Environmental Medium: A category of material found in the physical environment that surrounds or contacts organisms (e.g., surface water, groundwater, soil, or air).

Exposure: Contact of a chemical, physical, or biological agent with the outer boundary of an organism. Exposure is quantified as an average daily dose of chemical in an environmental medium over the period of exposure.

Exposure Pathway: The mechanism or physical course by which chemicals migrate from their source or point of release to the population at risk.

Exposure Route: The point and means by which a chemical enters the body. Examples of exposure routes are inhalation into the lungs, oral ingestion and absorption in the gastrointestinal tract, and absorption of chemicals across the skin.

GI: Gastrointestinal tract. Part of the body composed of the esophagus, stomach, and small intestine.

HEAST: Health Effects Assessment Summary Table. The U.S. EPA's table of chemical-specific toxicity values and the studies from which the values were derived. Published once a year.

Hazard Quotient: The ratio of the estimated intake or dose of a chemical to the chemical-specific reference dose.

Hyperkeratosis: Thickening of the skin.

Hyperpigmentation of the skin: Discoloration of the skin, increased melanin deposition.

Intake: The process by which a substance crosses the outer boundary of the body (e.g., mouth or nose) without passing an absorption barrier (e.g., lung tissue, and gastrointestinal tract wall) per unit body weight per unit time (e.g., mg/kg/day).

Intake Rate: The amount of a given media (air, soil, vegetables) that a person ingests, breathes, or touches in a day.

IR: Intake or Contact Rate. Rate of the amount of a given environmental medium that a person ingests, breathes, or touches in a day.

IRIS: Integrated Risk Information System. The U.S. EPA's on-line data base of toxicity values and toxicity information for over 600 chemicals.

Keratosis: Pathologic changes (lesions) of the skin.

LOAEL: Lowest Observed Adverse Effect Level. The lowest study-specific dose of a chemical at which the study population (animals or humans) showed a measurable adverse response.

Median: The middle value in a data set such that half the values are greater and half are less.

NOAEL: No Observed Adverse Effect Level. A study-specific dose of a chemical at which the study population (animals or humans) showed no measurable adverse response.

Paresthesia: Abnormal spontaneous sensations such as burning, tickling, or tingling.
Percentile: One of 100 equal consecutive groups arranged in order of magnitude (therefore, the 75th percentile is the amount which is greater than 75 percent of the population or group and less than 25 percent of the population).

Proteinuria: Presence of excess protein in the urine, can indicate malfunctioning of the kidneys.

Raynaud's Disease: Disease resulting from constriction of small blood vessels leading to intermittent pallor of the skin and numbness of the extremities, particularly the fingers.

Receptor: An individual exposed to a chemical, either human or non-human.

RfD: Reference Dose. A concentration that represents an estimated daily dose of a chemical for populations (including sensitive individuals) that appears to be without appreciable risk of noncarcinogenic effects if ingested over a lifetime. Chronic RfDs are developed to be protective for long-term exposure to a compound (i.e. seven years to a lifetime

Risk: The likelihood of adverse health or environmental effects. Risks are evaluated separately for carcinogenic and noncarcinogenic effects. Carcinogenic risks are an incremental chance in addition to background risks of developing cancer in a lifetime. Noncarcinogenic hazards are assessed by evaluating whether site exposure exceeds a reference dose at and below which no health effects are expected.

Sample: A small part of something designed to show the nature or quality of the whole. Exposure-related measurements are usually samples of environmental media, or biological tissue or fluid that are analyzed for chemical content.

Slope Factor: The relationship between the dose of a carcinogen and the magnitude of risk. Larger slope factors denote more potent carcinogens.

Thrombosis: Clotting within a blood vessel.

U.S. EPA: United States Environmental Protection Agency.

Vascular: Relating to blood vessels.

Vasospasms: Contractions of the muscles surrounding blood vessels.

Risk Assessment Measurement Abbreviations

g	gram
kg	kilogram
kg/mg-day	kilograms per milligram - day: also (mg/kg/day)$^{-1}$
kg/day	kilograms per day
L	liter
L/day	liters per day
mg	milligrams
mg/day	milligrams per day
mg/kg	milligrams per kilogram (equal to ppm)
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter
ppb	parts per billion
ppm	parts per million
ug	micrograms
ug/day	micrograms per day
ug/dl	micrograms per deciliter (of blood)
ug/g	micrograms per gram (equal to ppm)
ug/ft^2	micrograms per square foot
g/kg	micrograms per kilogram (equal to ppb)

ug/kg/day	microgrmas per kilogram per day
ug/L	micrograms per liter
ug/mg	micrograms per milligram

6.0 SUMMARY AND CONCLUSIONS

To satisfy the objectives as promulgated under WAC 173-340-350, the Remedial Investigation (RI) of the Everett Smelter Site was designed to characterize the nature and extent of chemicals of concern in soil, surface water, groundwater, and household dust. The purpose of the RI is to collect, develop, and evaluate sufficient information regarding the Everett Smelter Site to enable the selection of a cleanup action. The RI was also meant to acquire sufficient information for development of a range of appropriate remedial actions for the site. During the RI effort, it was determined that the site should be divided into two separate units based on distinctly different characteristics: the upland residential area and the lowland industrial area. Due to the enhanced complexity of the lowland, this area required continued investigation while completing the RI for the residential area. Therefore, this report primarily addresses the RI results from the residential area.

6.1 SOIL

Soil quality in the residential area was investigated by analysis of approximately 550 soil samples collected from residential soil borings, deep soil borings, and monitoring wells. In the lowland area, approximately 140 soil samples were collected from monitoring wells. All soil samples were analyzed for arsenic, cadmium, and lead, whereas a small number of selected samples was also submitted for analysis of total metals and TCLP testing.

Analytical results were evaluated using 1) statistical techniques, 2) contour maps showing maximum concentrations of arsenic, cadmium, and lead, and 3) cross-sections and concentration profiles for individual borings showing vertical metals distributions. Due to the different nature of the two processes contributing metals to the environment (stack and fugitive emissions, and disposal of smelter demolition debris), for the statistical analysis, data from the residential area were divided into two sample groups; the "smelter" samples and the "peripheral" samples. It was determined that arsenic and cadmium concentrations in smelter soils may exceed their respective natural background values of 7 and 1 ppm at depths in excess of 15 feet. Lead concentrations in smelter soils generally exceed the natural background value of 24 ppm to a depth between 4 and 6 feet. In peripheral soils, arsenic concentrations may exceed the natural background concentration to the maximum sampling depth of 6 feet; cadmium and lead concentrations generally are within natural background ranges below a depth of 1 to 2 feet. A significant decrease in concentration is found for cadmium and lead at the interface between the anthropogenic fill material and the native glacial till. This is caused by the physicochemical characteristics of cadmium and lead, as well as the dense, homogeneous nature of the till. However, arsenic appears more mobile and significantly elevated arsenic concentrations are found well within the till. In all likelihood, arsenic is transported downward by precipitation that infiltrates through small fractures in the till. However, groundwater analyses demonstrate that arsenic and metals do not reach the confined aquifer in the residential area. Correlation analysis shows that arsenic, cadmium, and lead are positively correlated both in smelter and peripheral soils. In general, correlation is better for peripheral soils that for smelter soils. This is indicative of the fact that metal distribution through fugitive and stack emissions is much more regular than distribution through random disposal of demolition debris. Scattergrams are used to illustrate this relationship.

The maximum concentration contour maps show that, in general, highly elevated arsenic, cadmium, and lead levels are confined to the footprint of the former smelter, i.e. the area where demolition debris is present. Metal concentrations generally decrease with distance from the former plant site, although areas with anomalously high concentrations exist in the peripheral area. In all but a few cases, the sampling program has delineated the nature and extent of the cadmium and lead contamination with respect to their respective cleanup value of 2 and 250 ppm both laterally and vertically. However, the nature and extent of the arsenic contamination has not been defined with respect to its cleanup level of 7 ppm. In the smelter area, at several locations, arsenic concentrations exceed background ranges at the maximum depths. TCLP analysis shows that an approximately linear relationship exists between the logarithms of the total and TCLP arsenic concentrations. The leaching behavior of soils is most likely controlled by the amount of fluedust present in a sample. Based on linear regression, soil with an arsenic concentration of approximately 3,700 ppm and higher may exceed the TCLP criterion for arsenic of 5 ppm. The lower 95% confidence limit associated with this trend corresponds to a soil arsenic concentration of approximately 2,100 ppm. With the exception of one mercury value, metals other than arsenic do not exceed their respective TCLP criteria.

In the lowland area, elevated arsenic, cadmium, and lead concentrations appear confined to the fill and slag material present. However, due to the relatively small number of monitoring well locations from which soil samples were obtained, the lateral and vertical distribution of metals in soil has not been delineated adequately. Further collection of soil samples is necessary to satisfactorily characterize the nature and extent of metals in soil and to evaluate their potential role as a source material to surface water and groundwater.

6.2 SURFACE WATER

Surface water quality in the residential was investigated by collecting samples from seven locations during three individual precipitation events. In general, surface water samples were analyzed for total and dissolved arsenic, cadmium, and lead.

Results show that surface water originating within the footprint of the former smelter site frequently exceeds freshwater and marine water acute and chronic criteria for arsenic, cadmium, and lead. The behavior of arsenic, cadmium, and lead in surface water is very different. Arsenic and cadmium are primarily transported in the dissolved form, whereas lead is almost exclusively transported as total lead. It appears that arsenic and cadmium concentrations in runoff are controlled by the duration of a precipitation event, which is directly related to the degree of saturation of soil material and subsequent leaching. The longer a precipitation event, the higher the potential for leaching. Lead concentrations, however, appear to be determined by the amount of surface runoff, i.e. the intensity of a precipitation event. The higher the flow, the higher its potential to transport lead-bearing particles, including those from paved roadways containing vehicular lead.

In the lowland area, surface water quality was investigated through collection of samples from six locations during three sampling rounds. The data show that exceedances of the various freshwater and marine criteria occurred at all locations. Further collection of surface water is required for a more comprehensive assessment of lowland surface water quality and behavior.

6.3 GROUNDWATER

Groundwater quality in the residential area was investigated by collecting samples from two monitoring wells during five sampling rounds. EV-1 was located just over the crest of the hill to the west of the former smelter site, and completed in the glacial till unit. Its hydrologic relationship with the former smelter site is unclear. EV-3 was located immediately downgradient of the former smelter footprint, and completed in the underlying glacial outwash sediments. Groundwater samples were analyzed for total and dissolved metals, common ions, arsenic speciation, and organic parameters.

Results indicate that groundwater in the residential area does not appear to have been adversely affected by the presence of soils containing elevated levels of arsenic, cadmium, and lead. The absence of groundwater adversely affected by conditions in overlying soil suggests that downward migration of water through the glacial till does not occur to any significant extent. However, lateral groundwater flow in the fill material may be a mechanism by which arsenic and metals are transported.

Due to the low arsenic concentrations in both wells, arsenic speciation results cannot be used to draw any conclusion regarding groundwater geochemistry. Analysis of organic parameters indicates that organic constituents in residential groundwater are not an issue of concern. The only organic compounds detected are phthalates, which are common components of labware plastics, and are usually considered the result of laboratory contamination.

In the lowland area, groundwater quality was investigated by collecting samples from up to eighteen wells during six sampling rounds. The data show that elevated arsenic concentrations occur in both the shallow, fill aquifer and the deep, alluvial aquifer. Arsenic concentrations generally are highest in the alluvial aquifer. It has not been possible to unequivocally identify a source material. Further delineation of the groundwater plumes and aquifer characteristics will require more study.

6.4 HOUSEHOLD DUST

The quality of household dust was investigated by collecting dust samples from six residences within the footprint of the former smelter site. Concurrent samples were collected by a "vacuuming" method and a "wipe" method. Samples were analyzed for arsenic and lead.

Results show that, with the exception of one location, arsenic and lead could not be detected in either sample type. Arsenic and lead were found in samples from a residence located on soils that contain the highest metal levels in the study area. Interpretation of the data is difficult. Regulatory criteria for household dust do not exist, and it has been established that sampling results are directly dependent on the sampling technique used. Consequently, it is not possible to draw any quantitative conclusions.

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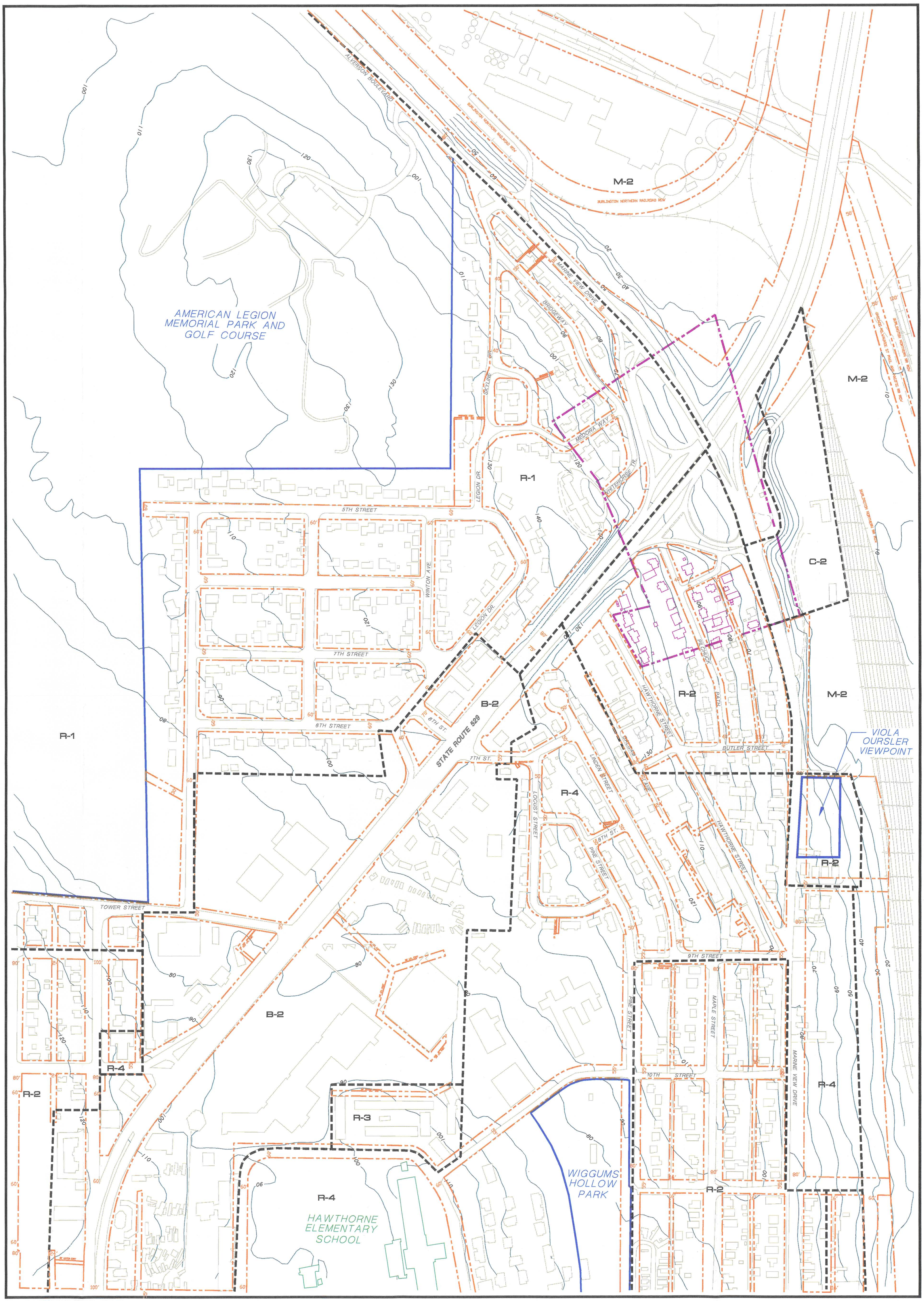

LEGEND

–··	HISTORIC PLANT BOUNDARY
☐	RESIDENTIAL PROPERTIES
☐	ASARCO-OWNED PROPERTIES
☐	SCHOOLS
☐	PARKS
–·–	CITY OF EVERETT AND STATE OF WASHINGTON R.O.W.
- - -	SEPARATION LINE BETWEEN ZONES
B-2	COMMUNITY BUSINESS ZONE
C-2	HEAVY COMMERCIAL-LIGHT INDUSTRIAL ZONES
M-2	HEAVY MANUFACTURING ZONE
R-1	SINGLE FAMILY DETACHED LOW DENSITY ZONE
R-2	SINGLE FAMILY DETACHED MEDIUM DENSITY ZONE
R-3	MULTIPLE FAMILY MEDIUM DENSITY ZONE
R-4	MULTIPLE FAMILY HIGH DENSITY ZONE
—100—	CONTOUR LINE CONTOUR INTERVAL IS 10 FEET

SOURCE: AERIAL TOPOGRAPHIC MAP CITY OF EVERETT
WALKER AND ASSOCIATES, INC.
3-2-87

NORTH

200' 0 200' 400'

CONTOUR INTERVAL 10 FT.

Everett Smelter Site
Everett, Washington

Site Topography and Land Use

Designed: R.B.V.
Drawn By: S.T.R.
Checked By: R.B.V.
Approved By: J.M.G.
Date: 3/21/95
Rev. Date: 4/10/95
Project No.: ASEV01

Hydrometrics, Inc.
Consulting Scientists and Engineers
950 Pacific Ave, Seafirst Center, Suite 610
Tacoma, Washington 98402
(206) 572-5481

SHEET
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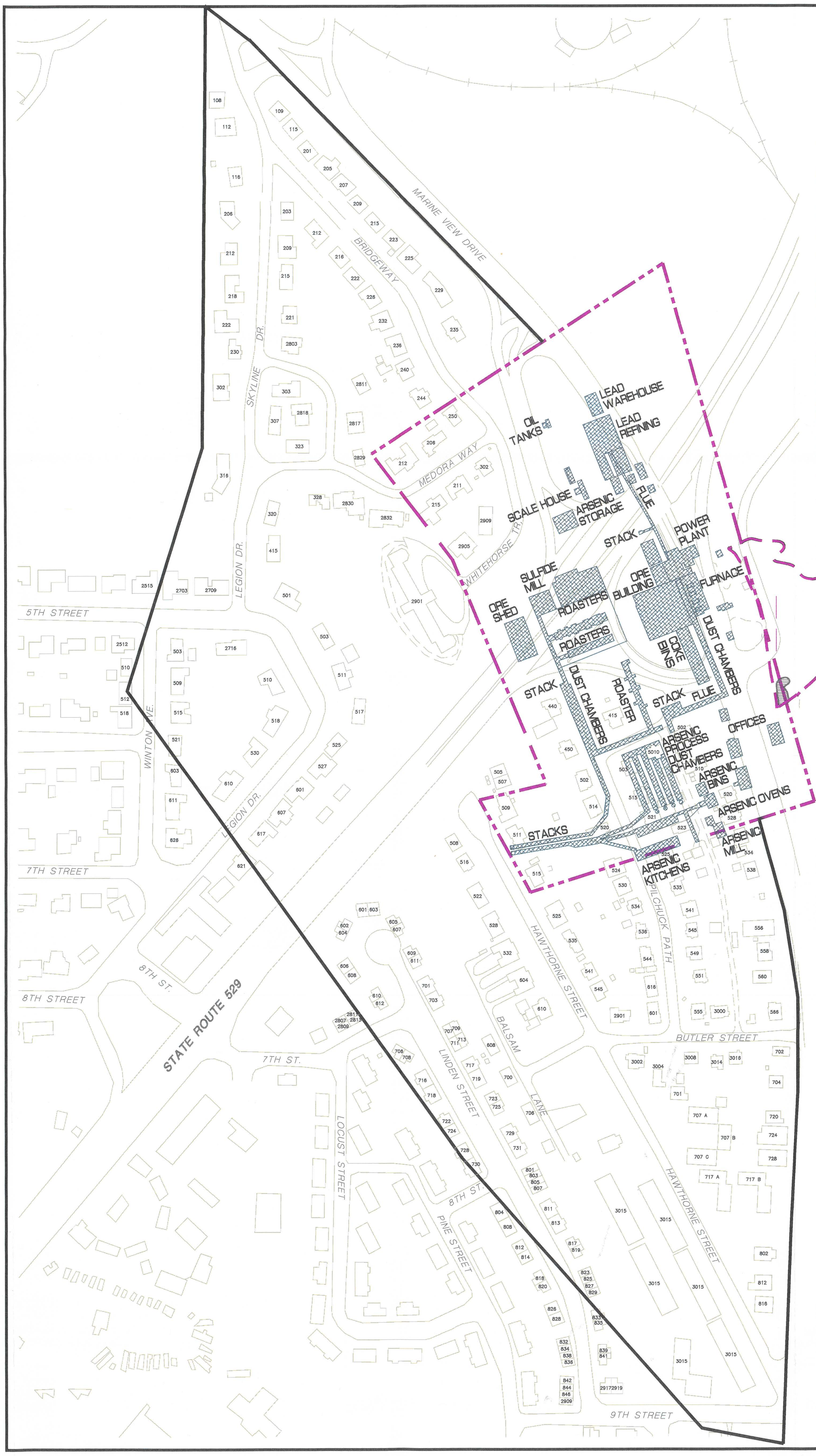

LIST OF ADDRESSES

Domestic Realty	505/507 Hawthorne Street
Domestic Realty	508 A & B Hawthorne Street
Domestic Realty	509 Hawthorne Street
Domestic Realty	511 Hawthorne Street
Domestic Realty	515 Hawthorne Street
Barbara Paris	516 A & B Hawthorne Street
Ray Sutton	522 Hawthorne Street
George Deane	525 Hawthorne Street
Lynn L. Osborne	528 Hawthorne Street
Hiraki Enterprises	532 A & B Hawthorne Street
Mildred Wick	535 Hawthorne Street
Mary Decelle	541 Hawthorne Street
Timothy Smith	545 Hawthorne Street
Hiraki Enterprises	604 A & B Hawthorne Street
Jack Willet Jr.	610 Hawthorne Street
Sadiri & Agatha Maza	701 Hawthorne Street
Halpin E Caryl/North	707 A,B & C Hawthorne Street
Halpin E Caryl/North	717 A & B Hawthorne Street
Domestic Realty	5010 Fifth Street
Domestic Realty	502 East Marine View Drive
Domestic Realty	510 East Marine View Drive
Ruben Gamon	520 East Marine View Drive
Domestic Realty	528 East Marine View Drive
Paul & Anna Powers	534 East Marine View Drive
David & Jean Taylor	538 East Marine View Drive
David & Jean Taylor	556 East Marine View Drive
Roy Chambers	558 East Marine View Drive
Sauda Lal	560 East Marine View Drive
George Kurschner	566 East Marine View Drive
Rolan McDaniel	702 East Marine View Drive
Kimberly Granger	704 East Marine View Drive
Bertha M. Cope	720 East Marine View Drive
Robert & Karen Maples	724 East Marine View Drive
Mrs. Marie Herschlip	728 East Marine View Drive
John H. Clark	812 East Marine View Drive
Richard D. Anderson	816 East Marine View Drive
Domestic Realty	415 Pilchuck Path
Domestic Realty	440 Pilchuck Path
Domestic Realty	450 Pilchuck Path
Domestic Realty	502 Pilchuck Path
Domestic Realty	503 Pilchuck Path
Domestic Realty	514 Pilchuck Path
Domestic Realty	515 Pilchuck Path
Domestic Realty	520 Pilchuck Path
Domestic Realty	521 Pilchuck Path
Domestic Realty	523 Pilchuck Path
Domestic Realty	524 Pilchuck Path
Domestic Realty	525 Pilchuck Path
Lewis Lemire	530 Pilchuck Path
Steven Kerber	534 Pilchuck Path
Marion Williden	535 Pilchuck Path
D.M. Linke	536 Pilchuck Path
Paul Erdman	541 Pilchuck Path
A.W. Christensen	544 Pilchuck Path
Jesse Towne	545 Pilchuck Path
Fred Bauman	549 Pilchuck Path
Viola Oursler	551 Pilchuck Path
Jerry Hale	555 Pilchuck Path
Ronnie Moe	616 Pilchuck Path
Evelyn Powell	620 Pilchuck Path
Audrey J. Smith	2901 Butler Street
Caress Walker	3002 Butler Street
Kevin Aldrich	3004 Butler Street
Doris Robinson	3007 Butler Street
Robert Johnson	3008 Butler Street
Barbara Knapp	3014 Butler Street
Kevin Aldrich	3016 Butler Street

Steve L. Parker	503 Winton Ave.
Roy B & K. Brodyskov	509 Winton Ave.
Darrell Thurston	510 Winton Ave.
David Geary	512 Winton Ave.
Ed & Lois Christensen	515 Winton Ave.
Peter J. Brashler	518 Winton Ave.
James Falkner	521 Winton Ave.
Stuart W. Howes	603 Winton Ave.
Ralph Holte	611 Winton Ave.
Stephen Wamba	415 Legion Dr.
Eugene S & Carol Rich	501 Legion Dr.
Roy F. Allen	503 Legion Dr.
Billy D. Harrell	510 Legion Dr.
Robert H. Johnson	511 Legion Dr.
Murray G. & D. Moulton	517 Legion Dr.
Gordon O. & Ruth Reese	518 Legion Dr.
Roxlyn R. Sansaver	525 Legion Dr.
Dedevin J.O. Harstad	527 Legion Dr.
Rick J. & Kathrine Elias	530 Legion Dr.
Clarence A. Lentz	601 Legion Dr.
Iver Lawson	607 Legion Dr.
Leonard A.E. Zareizke	610 Legion Dr.
Clyde T. Hensley	617 Legion Dr.
Douglas Greenshields	621 Legion Dr.
Joseph Taylor Jr.	108 Skyline Dr.
Gary H. & Daryl Bunger	112 Skyline Dr.
Michael J. Paeth	116 Skyline Dr.
William V. Udman	203 Skyline Dr.
Sam C. Bagley	206 Skyline Dr.
Marion O. Lamb	209 Skyline Dr.
Gary S. Kindness	212 Skyline Dr.
John A Martinis	212 Skyline Dr.
Jeanette L. Day	215 Skyline Dr.
Dorothy H. Larson	218 Skyline Dr.
Robert R. Redline	221 Skyline Dr.
Sheila Knudson Mcrehan	222 Skyline Dr.
Kurt D. Bertilson	230 Skyline Dr.
T.E. Baumgartner	302 Skyline Dr.
Kirk Greene	303 Skyline Dr.
Harold Hogle	303 Skyline Dr.
Fred W. Brown	307 Skyline Dr.
Aldred R. Vandenbosch	316 Skyline Dr.
Alan Sorenson	320 Skyline Dr.
Aldred R. Vandenbosch	323 Skyline Dr.
John D. & Christ. Bull	328 Skyline Dr.
Douglas & Wil. Monroe	2818 Skyline Dr.
Nick A. Reeff	2905 Whitehorse Terrace
Margie M. Legg	2909 Whitehorse Terrace
Pete C. Hegge	706 Balsam Lane
Maxine Rice	206 Medora Way
Timothy D. Smith	211 Medora Way
Robert M. Stevenson	212 Medora Way
Robert & Kathy Leedy	215 Medora Way
Betty L. Griffin	2803 Medora Way
Tery A. & Li Tavares	2811 Medora Way
Duane L. & Ed Rapelje	2817 Medora Way
Virginia K. Kingston	2829 Medora Way
R.T. Sylvester	2830 Medora Way
Robert E. Lowe	2832 Medora Way
Bud E. Kast	109 Bridgeway
Paul E. & Kyung Boyce	115 Bridgeway
Kerry Barnett	201 Bridgeway
William J. Tocco	205 Bridgeway
Donnie D. Smith	207 Bridgeway
J.C. Robinett	209 Bridgeway
Beverly Innes	212 Bridgeway
John E. Tardiff	215 Bridgeway
Karen K. Lewis	216 Bridgeway
Scott Schoeder	222 Bridgeway
Godfrey W. Holzinger	223 Bridgeway
Janice Stephenson	225 Bridgeway
Mark M Leonard	226 Bridgeway
Elizabeth B Heil	229 Bridgeway
Jean M. Burt	232 Bridgeway
Jonathon L. & C. Bates	235 Bridgeway
Timothy J. Murphy	236 Bridgeway
Robert G. & John Buse	240 Bridgeway
Martha Watkins	244 Bridgeway

LEGEND

— · · —	HISTORIC PLANT BOUNDARY
▨	PLANT BUILDING LOCATION 1913
— —	SLAG PILE LIMIT 1913
☐	EXISTING BUILDING
—	PHASE I STUDY AREA
812	ADDRESS

NORTH

125' 0 125' 250'

Everett Smelter Site
Everett, Washington

Historic Smelter Layout

Designed: R.B.V
Drawn By: J.G.N
Checked By: R.B.V.
Approved By: J.M.G
Date: 5/18/94
Rev. Date: 4/6/95
Project No.: ASEV01

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SHEET
1-2

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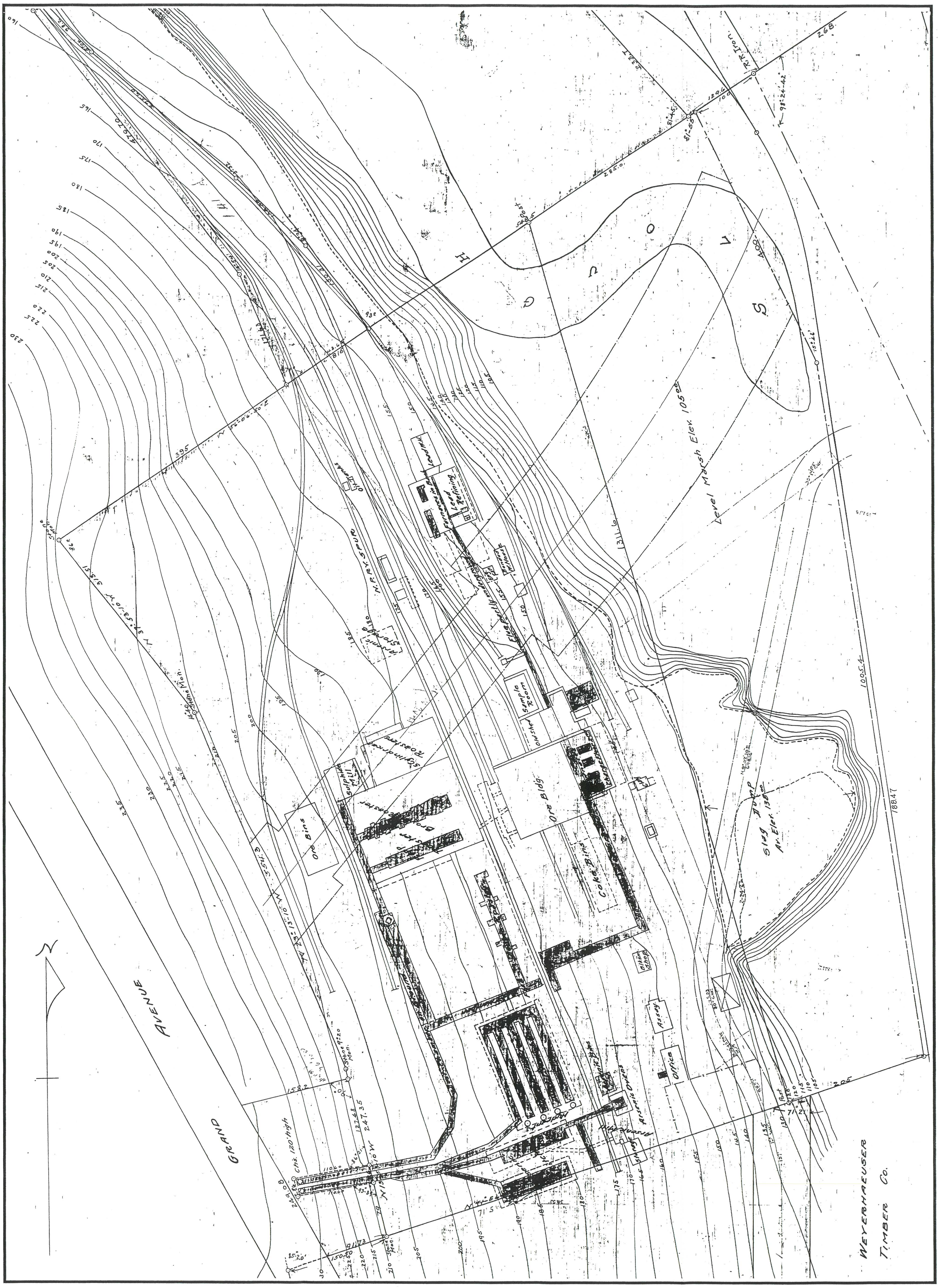


TOPOGRAPHICAL MAP
~OF~
SMELTER TRACT

Everett, Wash.
Scale 1"=62.5'
Cutter & Tegtmeier, Engineers
April, 1913.

Note:- All Elevations refer to "City of Everett Datum Plane," which is 88.68 ft. above U.S. Eng's Datum Plane or Mean Extreme Low Tide.

Everett Smelter Site
Everett, Washington

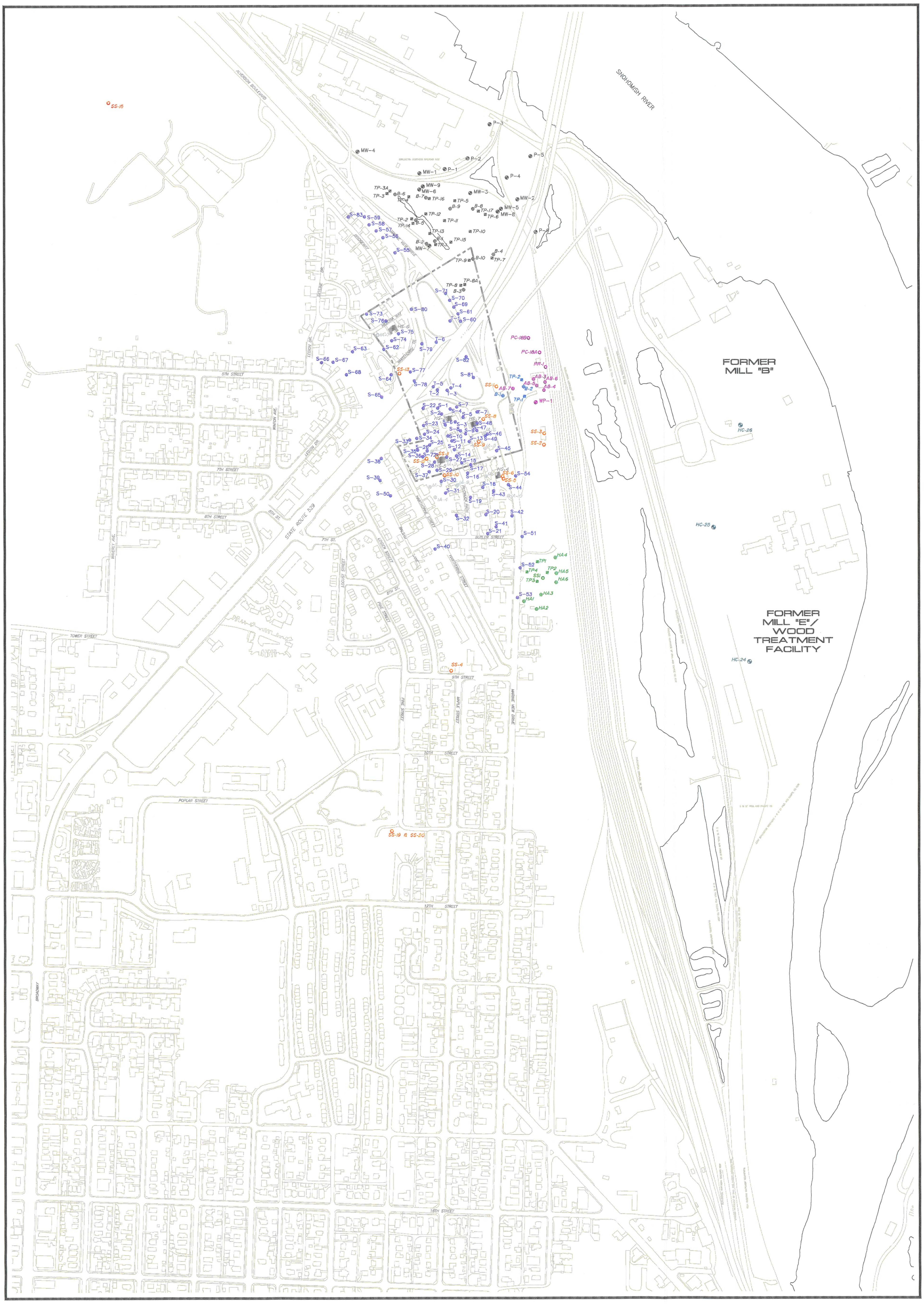
1913 Topographical Map
of Smelter Tract

Designed: R.B.V
Drawn By: S.T.R.
Checked By: R.B.V.
Approved By: J.M.G.
Date: 4/1/13
Rev. Date: 3/24/95
Project No.: ASEV01

Hydrometrics, Inc.
Consulting Scientists and Engineers
950 Pacific Ave, Seafirst Center, Suite 700
Tacoma, Washington 98402
(206) 572-5481

SHEET
1-3

EVRI45R5



LEGEND

- HISTORIC PLANT BOUNDARY
- BUILDING
- SLAG OUTCROP

SYMBOLS

- ⊛ MONITORING WELL
- ⊕ BORING
- ⧄ TEST PIT
- ○ SURFACE SOIL

STUDY

1 - SWEET-EDWARDS/EMCON (1988)
2 - HART CROWSER (1990)
3 - GEOENGINEERS (1990)
4 - HART CROWSER (1991)
5 - SAIC (1991a)
6 - SAIC (1991b)
7 - HYDROMETRICS (1992)
8 - DAMES & MOORE (1993)
9 - WASHINGTON DEPT. HEALTH / SNOHOMISH HEALTH DISTRICT (1991)

NORTH

300' 0 300' 600'

Everett Smelter Site
Everett, Washington

Sampling Locations
Previous Studies

Designed:R.B.V.
Drawn By:S.T.R.
Checked ByR.B.V.
Approved By:J.M.G.
Date:3/31/95
Rev. Date:
Project No.:ASEV01

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Tacoma, Washington 98402
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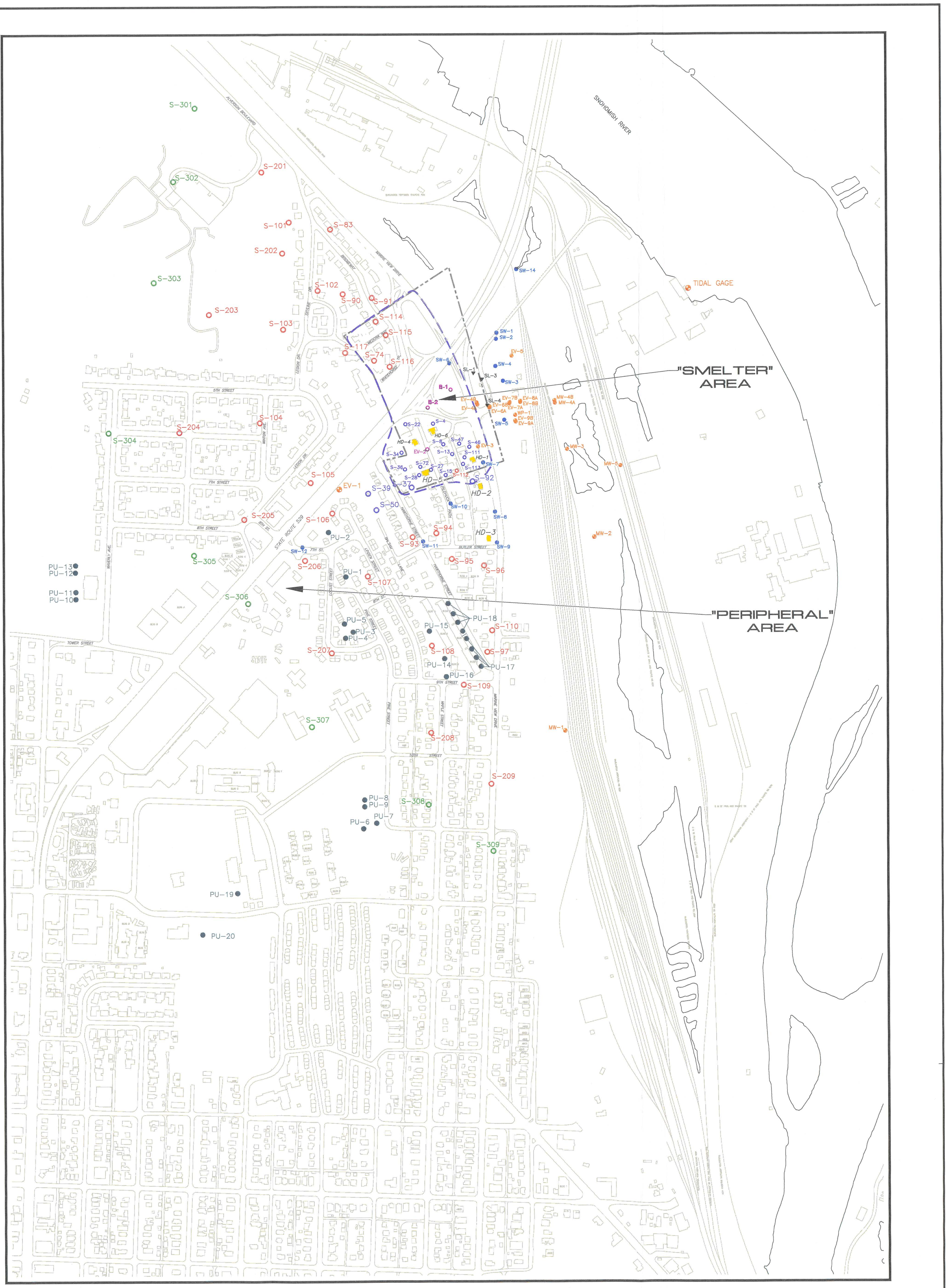
SHEET
1-4

EVRI44R5



LEGEND

HISTORIC PLANT BOUNDARY

"SMELTER" AREA BOUNDARY

BUILDING

HD-1 HOUSEHOLD DUST SAMPLING SITE

SOIL BORINGS		WATER MONITORING	
○ B-1	20 FOOT BORING	● EV-3	GROUNDWATER MONITORING WELL
○ S-34	4 TO 20 FOOT BORING	● SW-7	SURFACE WATER SAMPLING SITE
○ S-207	4 FOOT BORING	▼ SL-3	SLAG BORING
○ S-309	2 FOOT BORING		
● PU-4	PUBLIC USE SOIL SAMPLE		

NORTH

300' 0 300' 600'

Everett Smelter Site
Everett, Washington

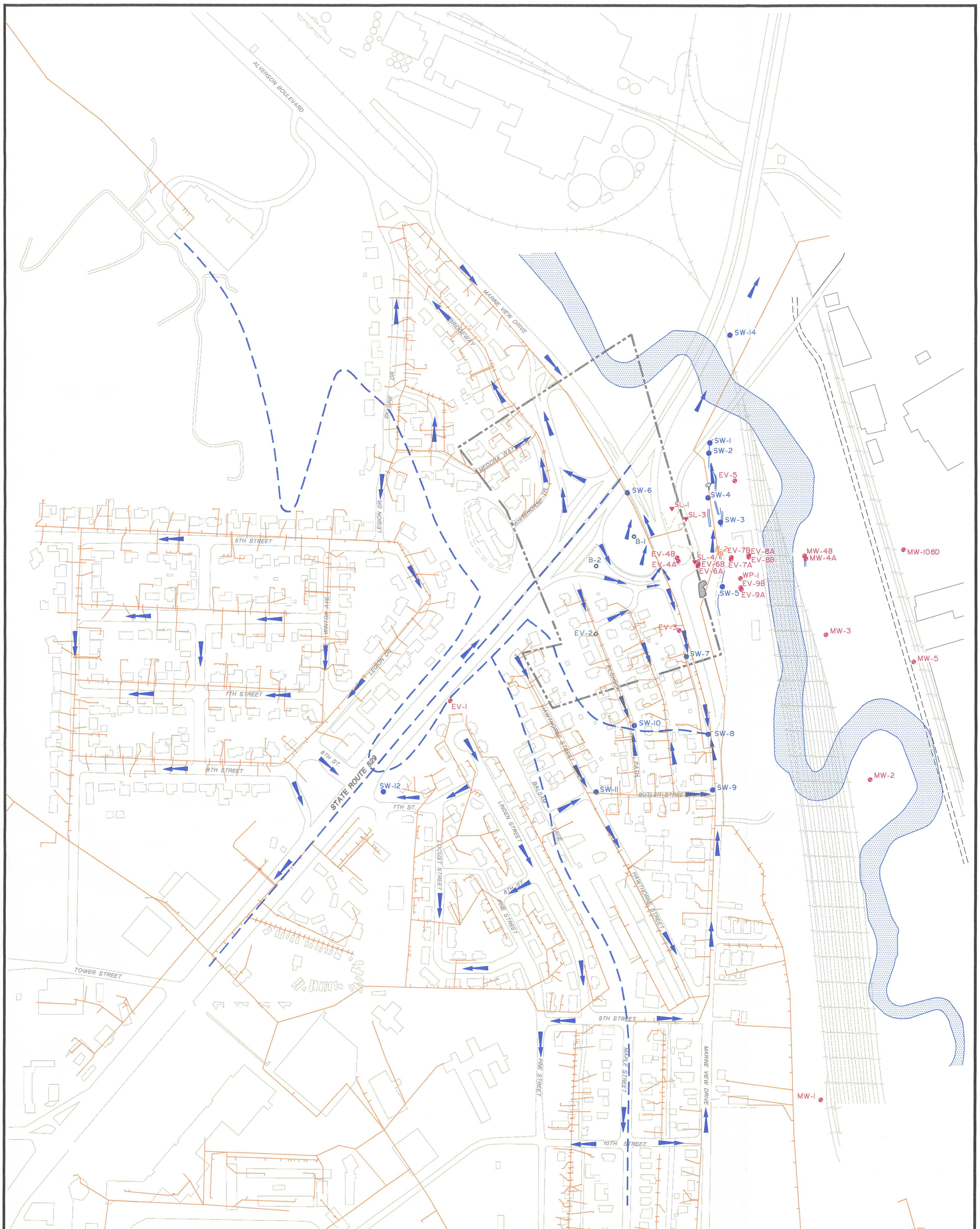
Everett RI
Sampling Locations

Designed:R.B.V.
Drawn By:S.T.R.
Checked ByR.B.V.
Approved By:J.M.G.
Date:4/14/95
Rev. Date:
Project No.:ASEV01

Hydrometrics, Inc.
Consulting Scientists and Engineers
950 Pacific Ave, Seafirst Center, Suite 700
Tacoma, Washington 98402
(206) 572-5481

SHEET
2-1

EVRI46R5



LEGEND

▬ · · ▬	HISTORIC PLANT BOUNDARY	⊕	MONITORING WELL
☐	BUILDING	○	BORING
▬	SLAG OUTCROP	⊕	LOWLAND BORING (WEYERHAEUSER 1990)
▨	HISTORIC SLOUGH LOCATION	▼	SLAG BORING
—	COMBINED SANITARY/ STORM SEWER	●	SURFACE WATER SAMPLE LOCATION
– – –	APPROXIMATE DRAINAGE AREA BOUNDARY	➡	SURFACE WATER FLOW DIRECTION

NORTH

200′ 0 200′ 400′

Everett Smelter Site
Everett, Washington

Surface Water Flow Directions and Drainage Areas

Designed: W.R.T.
Drawn By: J.G.N.
Checked By: W.R.T
Approved By: J.M.G.
Date: 5/10/95
Rev. Date: 5/24/95
Project No.: ASEV01

Hydrometrics, Inc.
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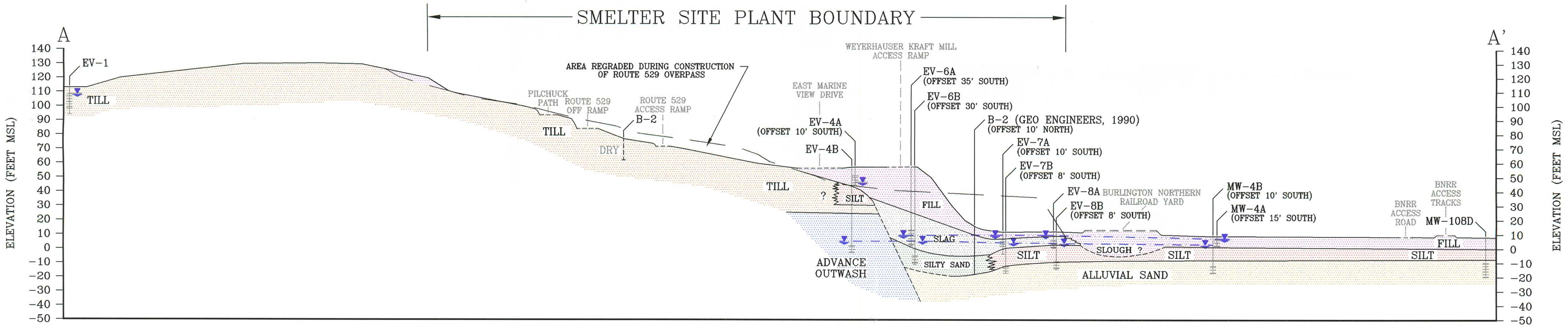
950 Pacific Ave, Seafirst Center, Suite 610
Tacoma, Washington 98402
(206) 572-5481

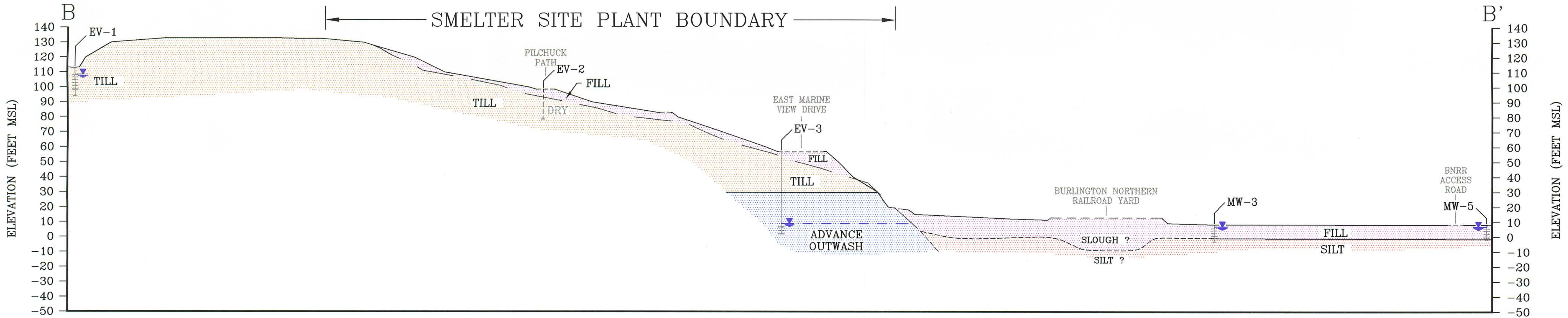
SHEET
3-1

EVRI33N4



HORIZONTAL SCALE: 1"=100'
2:1 VERTICAL EXAGGERATION

Cross−Section A−A'



HORIZONTAL SCALE: 1"=100'
2:1 VERTICAL EXAGGERATION

Cross−Section B−B'

LEGEND

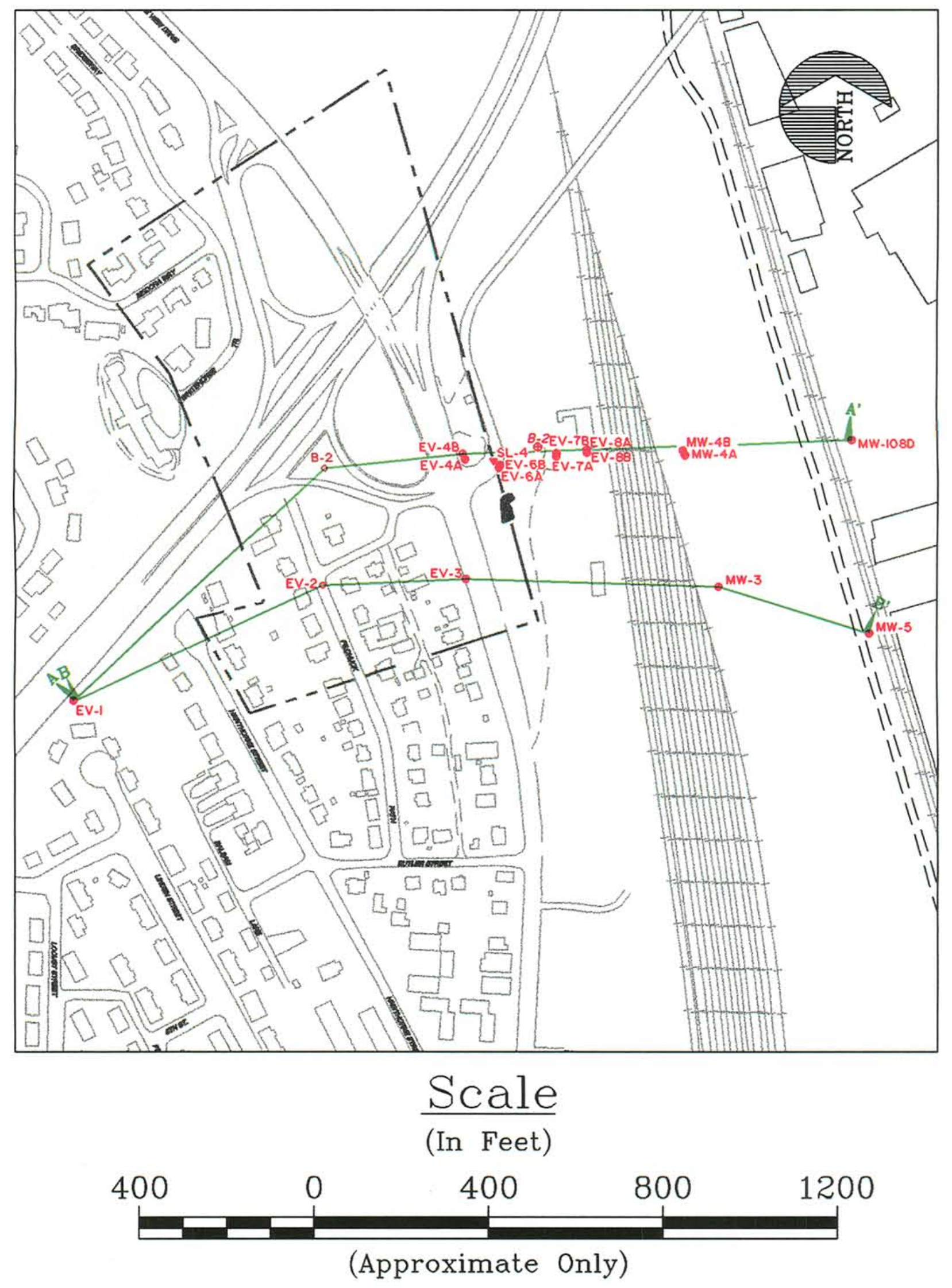
— —	1913 TOPOGRAPHY (CUTTER & TEGTMEIER ENGINEERS APRIL 1913.)
——	EXISTING TOPOGRAPHY
——	GEOLOGIC CONTACT (DASHED WHERE INFERRED)
- - - -	ROAD
— — —	RAILROAD TRACKS
—·—·—	INFERRED POTENTIOMETRIC SURFACE FOR SHALLOW GROUNDWATER SYSTEM
—·—·—	INFERRED POTENTIOMETRIC SURFACE FOR DEEP GROUNDWATER SYSTEM
WELL NUMBER → MW−5 WATER LEVEL IN WELL SCREENED INTERVAL OF WELL	MONITORING WELL
BORING NUMBER → B−2	BORING

UPLAND STRATIGRAPHIC UNITS

▨	FILL
▨	TILL
▨	ADVANCE OUTWASH

LOWLAND STRATIGRAPHIC UNITS

▨	FILL
▨	SLAG
▨	SILTY SAND
▨	SILT (SNOHOMISH RIVER FLOOD PLAIN DEPOSITS)
▨	ALLUVIAL SAND (SNOHOMISH RIVER ALLUVIUM)



ASARCO INCORPORATED
EVERETT, WASHINGTON

GENERALIZED GEOLOGIC
CROSS SECTIONS

Drawn: 0072
Checked:
Approved:
Date: 5/24/95
Rev. #:
Proj. #: ASEV01

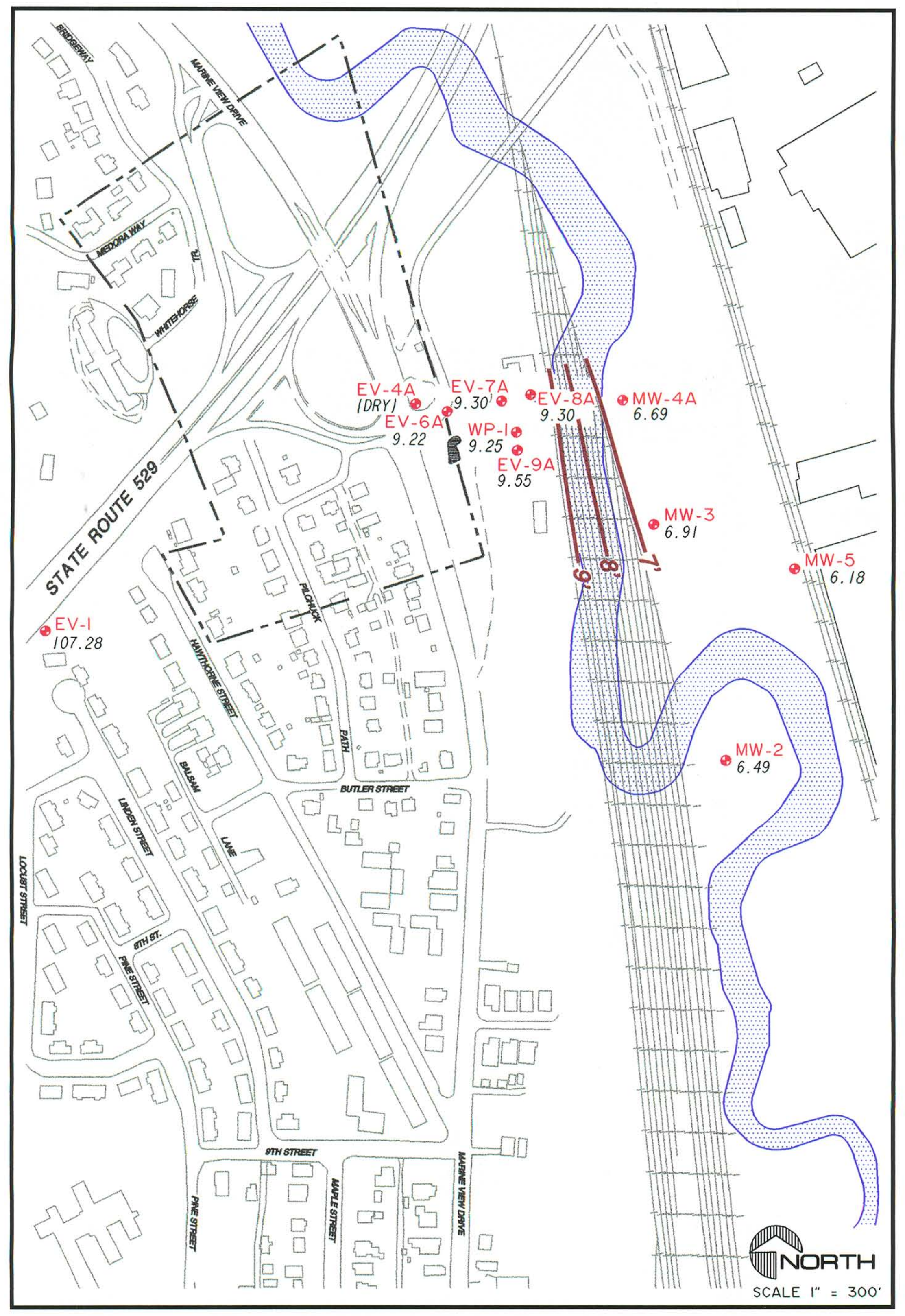
EXHIBIT
3−2

AUTOCAD REL. 12 (DWG)
HEL−03095A01

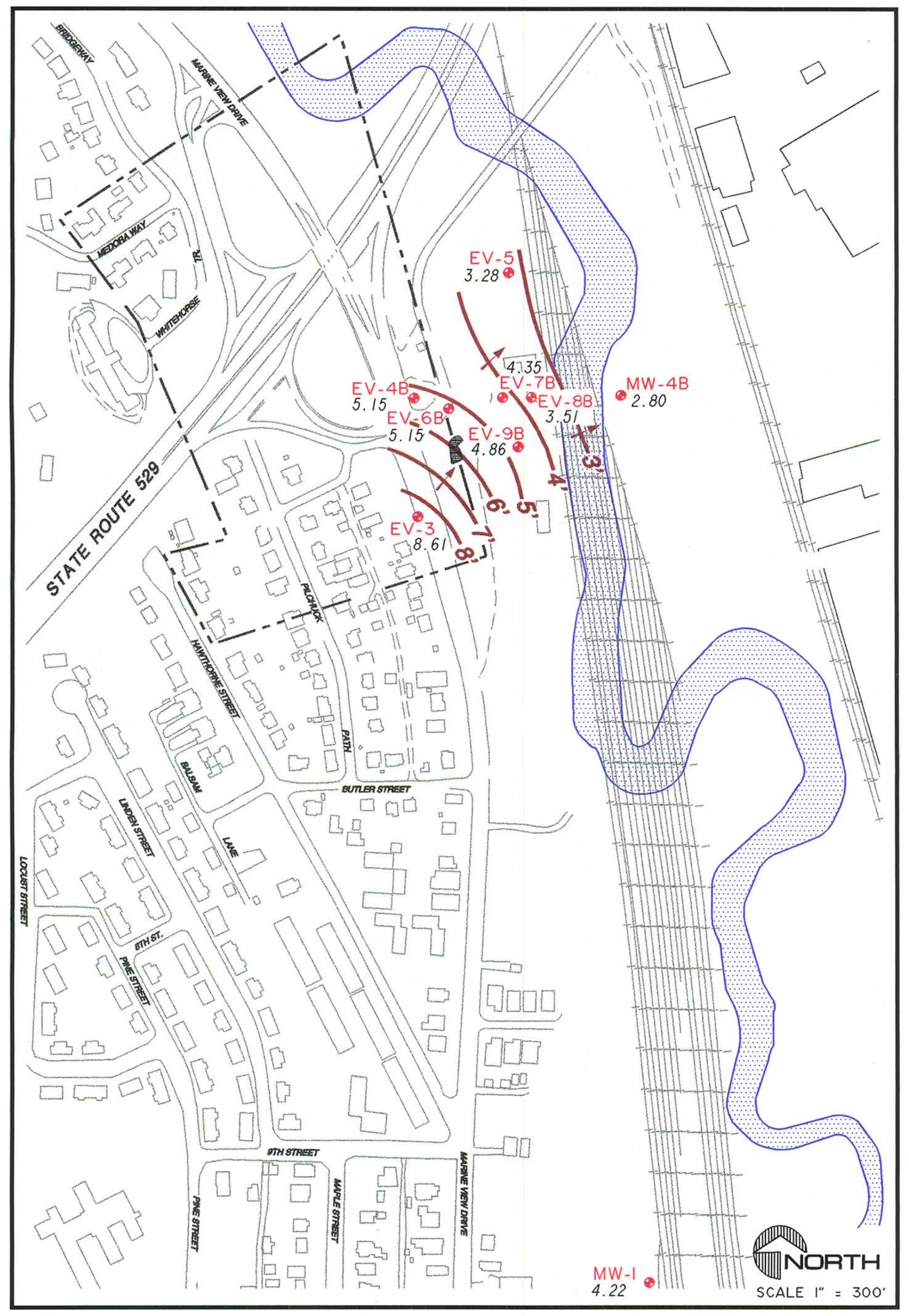
Hydrometrics, Inc.
Consulting Scientists, Engineers, and Contractors
Tacoma, Washington
Suite 700, Seafirst Building (206) 572-5481

I:\STORAGE\03095A01 Fri Jul 21 08:59:10 1995 0037

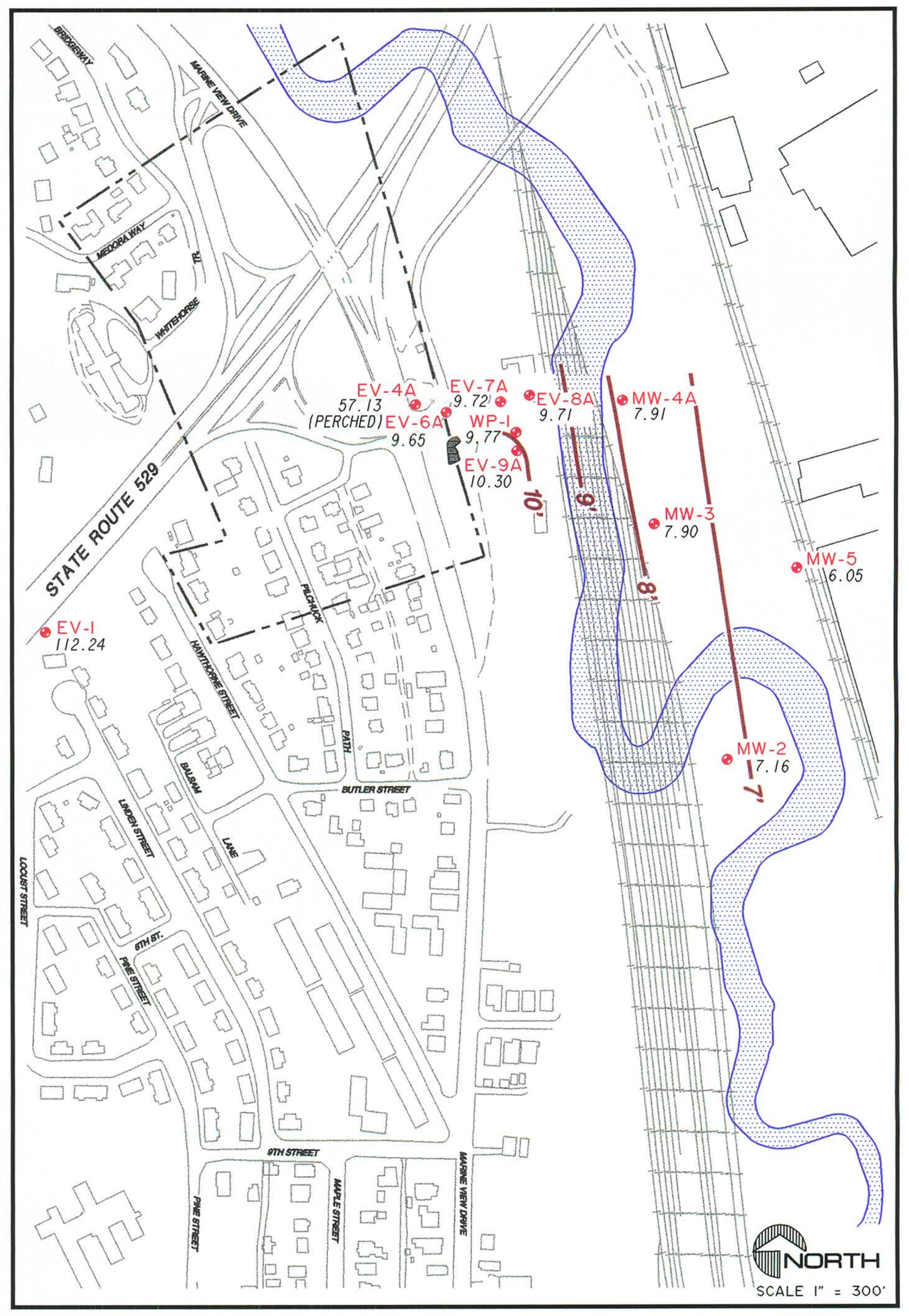
LAST UPDATE: 9:30AM



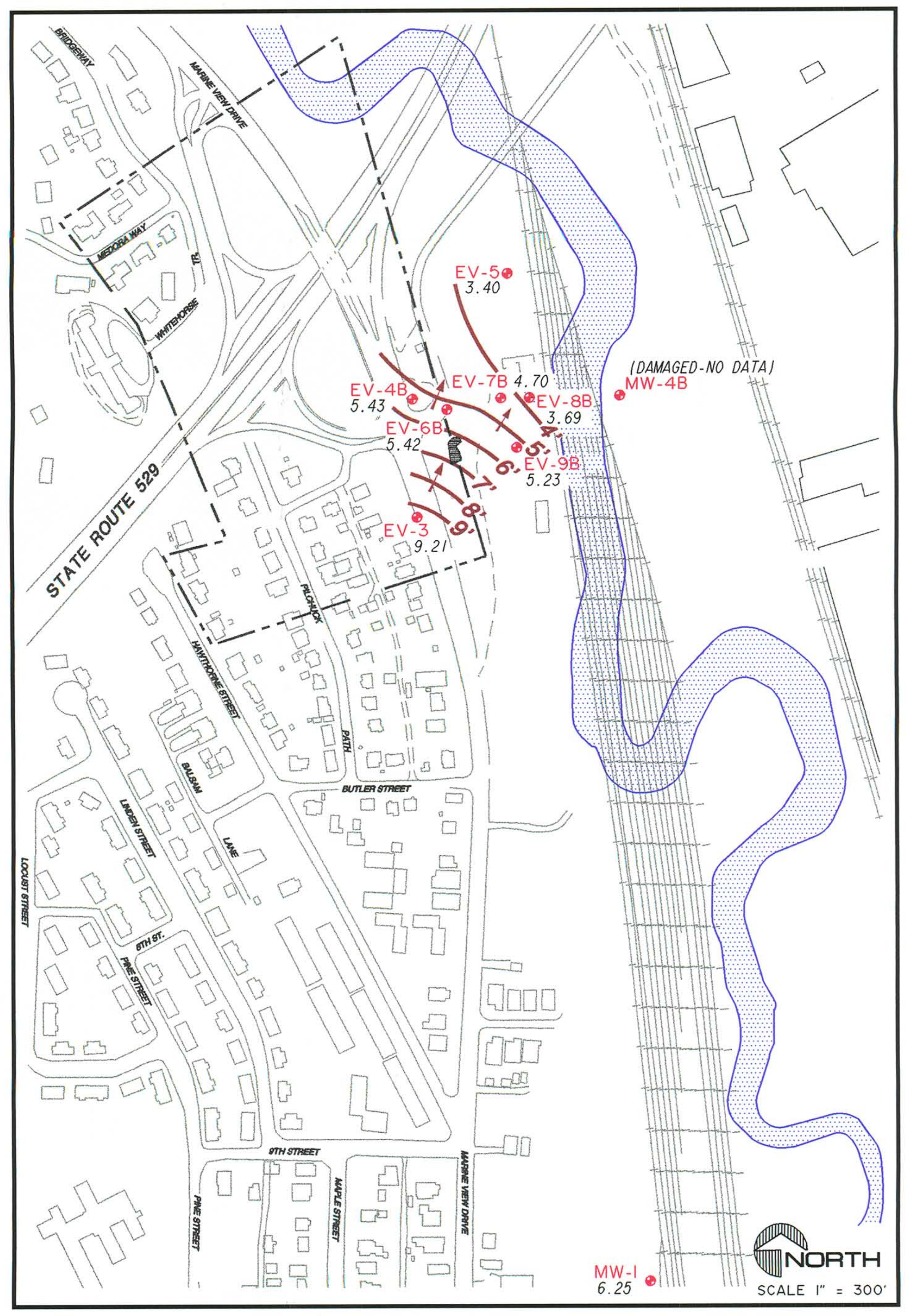
October 1993 Potentiometric Map
Of Groundwater Levels In Shallow Wells



October 1993 Potentiometric Map
Of Groundwater Levels In Deep Wells



April 1994 Potentiometric Map
Of Groundwater Levels In Shallow Wells



April 1994 Potentiometric Map
Of Groundwater Levels In Deep Wells

LEGEND

—·—·—	HISTORIC PLANT BOUNDARY
☐	BUILDING
	BURLINGTON NORTHERN R.R. TRACKS (SWITCH YARD)
	SLAG OUTCROP
	HISTORIC SLOUGH LOCATION
MW-4A ●	MONITORING WELL
● 9.25	STATIC WATER LEVEL ELEVATION (FT MSL)
	POTENTIOMETRIC CONTOUR (ARROW INDICATING INFERRED GROUNDWATER FLOW DIRECTION)

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POTENTIOMETRIC MAPS

Drawn: 0072
Checked:
Approved:
Date: 5/24/95
Rev. #:
Proj. #: ASEV01

EXHIBIT
3–3
AUTOCAD REL. 12 (DWG)
HEL–03095A02

Hydrometrics, Inc.
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Tacoma, Washington
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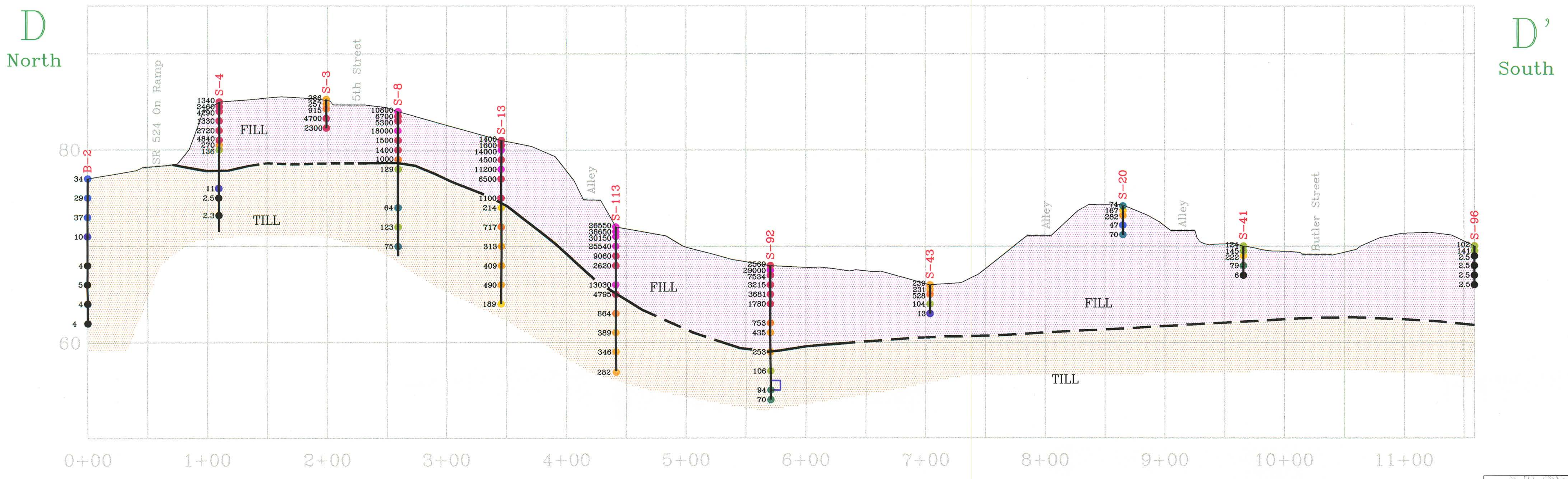
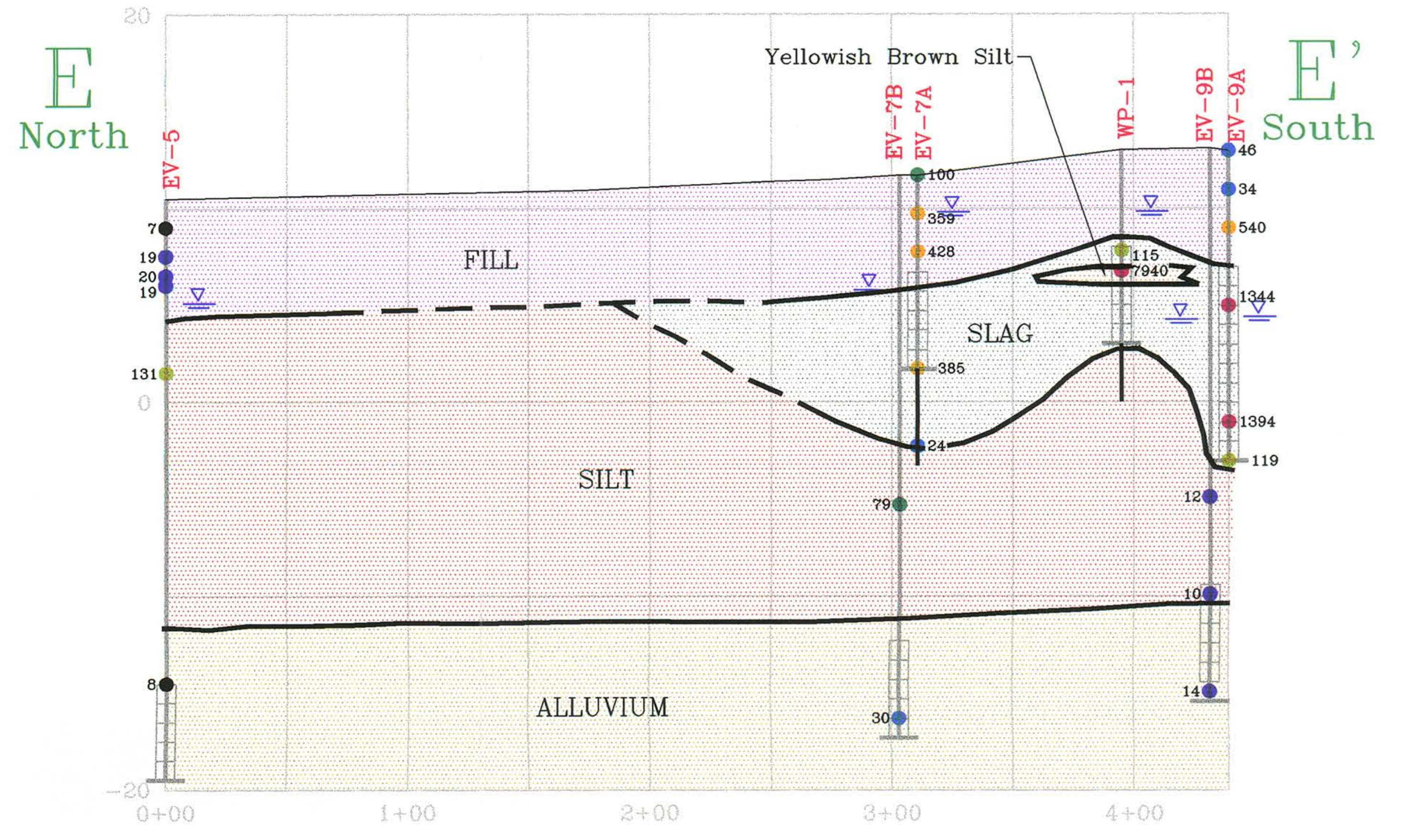
(206) 572-5481

I:\STORAGE\03095A02 Fri Jul 21 09:13:42 1995 0037

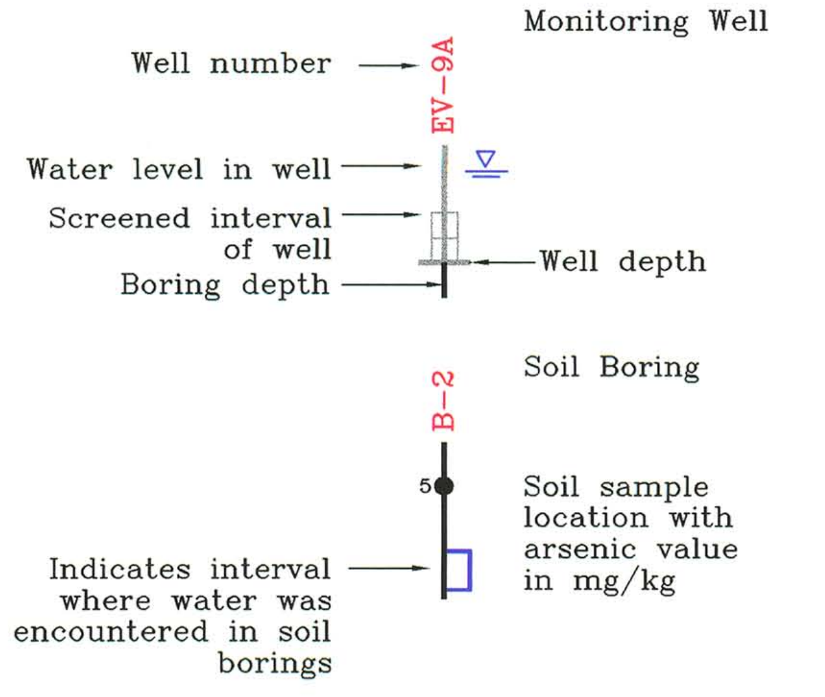
LAST UPDATE: 9:30AM





LEGEND

──	Existing Topography
━━	Geologic Contact (Dashed where inferred)
‒ ‒ ‒	Railroad Tracks
┈┈┈	Road
	Monitoring Well
	Soil Boring



UPLAND STRATIGRAPHIC UNITS

▨	Fill
▨	Till
▨	Advance Outwash

LOWLAND STRATIGRAPHIC UNITS

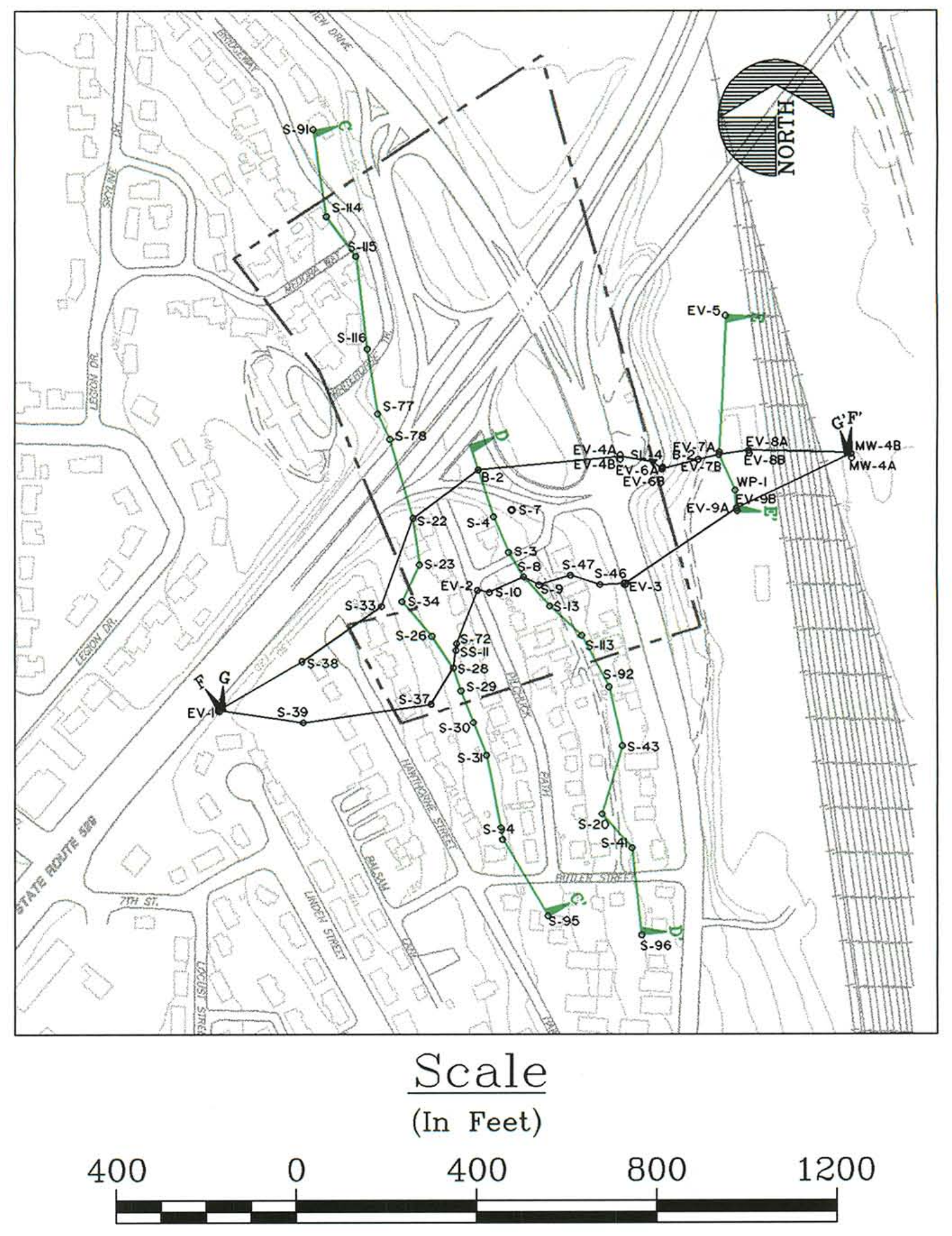
▨	Fill
▨	Slag
▨	Silty Sand
▨	Silt (Snohomish River Flood Plain Deposits)
▨	Alluvial Sand (Snohomish River Alluvium)

COLOR KEY OF ARSENIC CONCENTRATIONS

■	0 – 7 mg/kg	■	153 – 230 mg/kg
■	8 – 20 mg/kg	■	231 – 500 mg/kg
■	21 – 50 mg/kg	■	501 – 1000 mg/kg
■	51 – 76 mg/kg	■	1001 – 10,000 mg/kg
■	77 – 100 mg/kg	■	10,001 – 100,000 mg/kg
■	101 – 152 mg/kg	■	100,001 – 700,000 mg/kg

Horizontal Scale: 1"=60'
Vertical Scale: 1"=7.5'
Vertical Exaggeration = 8:1

*Note: Slough location inferred from 1917 topographic maps (see sheet 3–1)



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EVERETT, WASHINGTON

DETAILED GEOLOGIC CROSS SECTIONS
WITH SOIL ARSENIC CONCENTRATIONS

Drawn: 0072
Checked:
Approved:
Date: 7/20/95
Rev. #:
Proj. #: ASEV01

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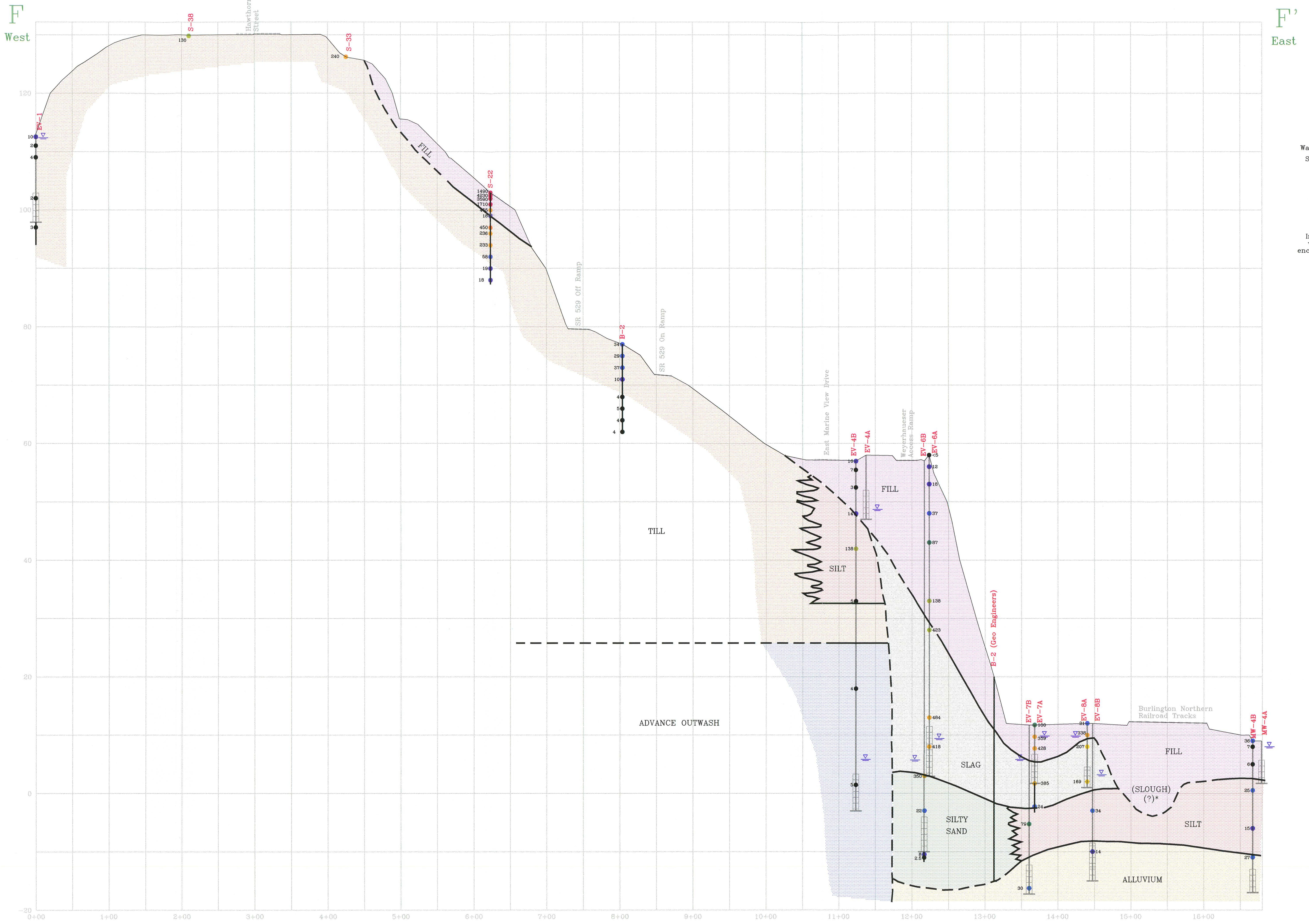
Tacoma, Washington
Suite 700, Seafirst Building (206) 572-5481

EXHIBIT
3–4
AUTOCAD REL. 12 (DWG)
HEL–03095001

I:\STORAGE\03095001 Fri Jul 21 08:16:16 1995 0037

LAST UPDATE: 4:00PM



F'
East

LEGEND

Existing Topography
Geologic Contact (Dashed where inferred)
Railroad Tracks
Road
Monitoring Well
Well number
EV-9A
Water level in well
Screened interval of well
Well depth
Boring depth
Soil Boring
B-2
5
Soil sample location with arsenic value in mg/kg
Indicates interval where water was encountered in soil borings

UPLAND STRATIGRAPHIC UNITS

- ▨ Fill
- ▨ Till
- ▨ Advance Outwash

LOWLAND STRATIGRAPHIC UNITS

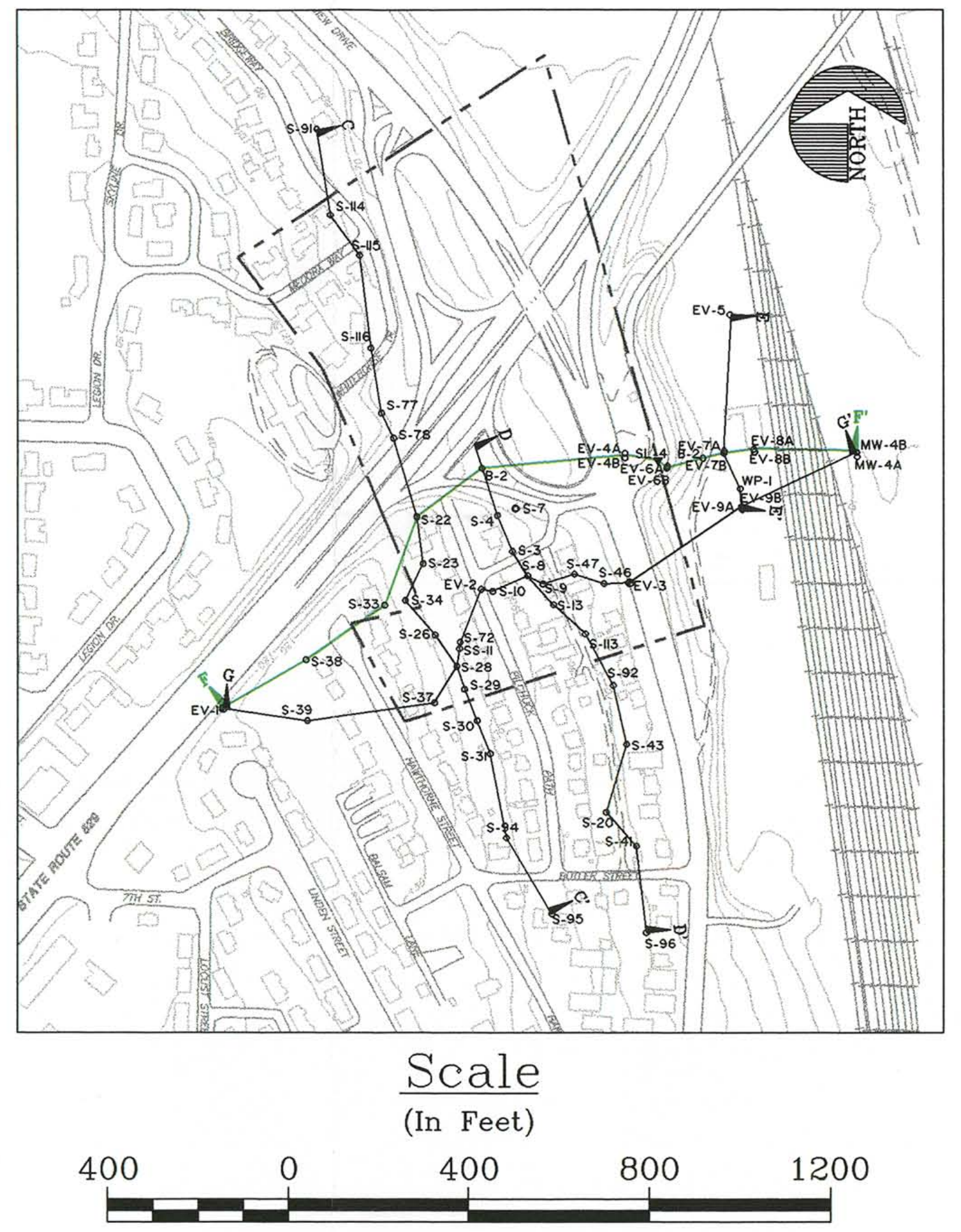
- ▨ Fill
- ▨ Slag
- ▨ Silty Sand
- ▨ Silt (Snohomish River Flood Plain Deposits)
- ▨ Alluvial Sand (Snohomish River Alluvium)

COLOR KEY OF ARSENIC CONCENTRATIONS

■	0 – 7 mg/kg	■	153 – 230 mg/kg
■	8 – 20 mg/kg	■	231 – 500 mg/kg
■	21 – 50 mg/kg	■	501 – 1000 mg/kg
■	51 – 76 mg/kg	■	1001 – 10,000 mg/kg
■	77 – 100 mg/kg	■	10,001 – 100,000 mg/kg
■	101 – 152 mg/kg	■	100,001 – 700,000 mg/kg

Horizontal Scale: 1"=60'
Vertical Scale: 1"=7.5'
Vertical Exaggeration = 8:1

*Note: Slough location inferred from 1917 topographic maps (see sheet 3–1)



ASARCO INCORPORATED
EVERETT, WASHINGTON

DETAILED GEOLOGIC CROSS SECTIONS
WITH SOIL ARSENIC CONCENTRATIONS

Drawn: 0072
Checked:
Approved:
Date: 7/20/95
Rev. #:
Proj. #: ASEV01

EXHIBIT
3–5

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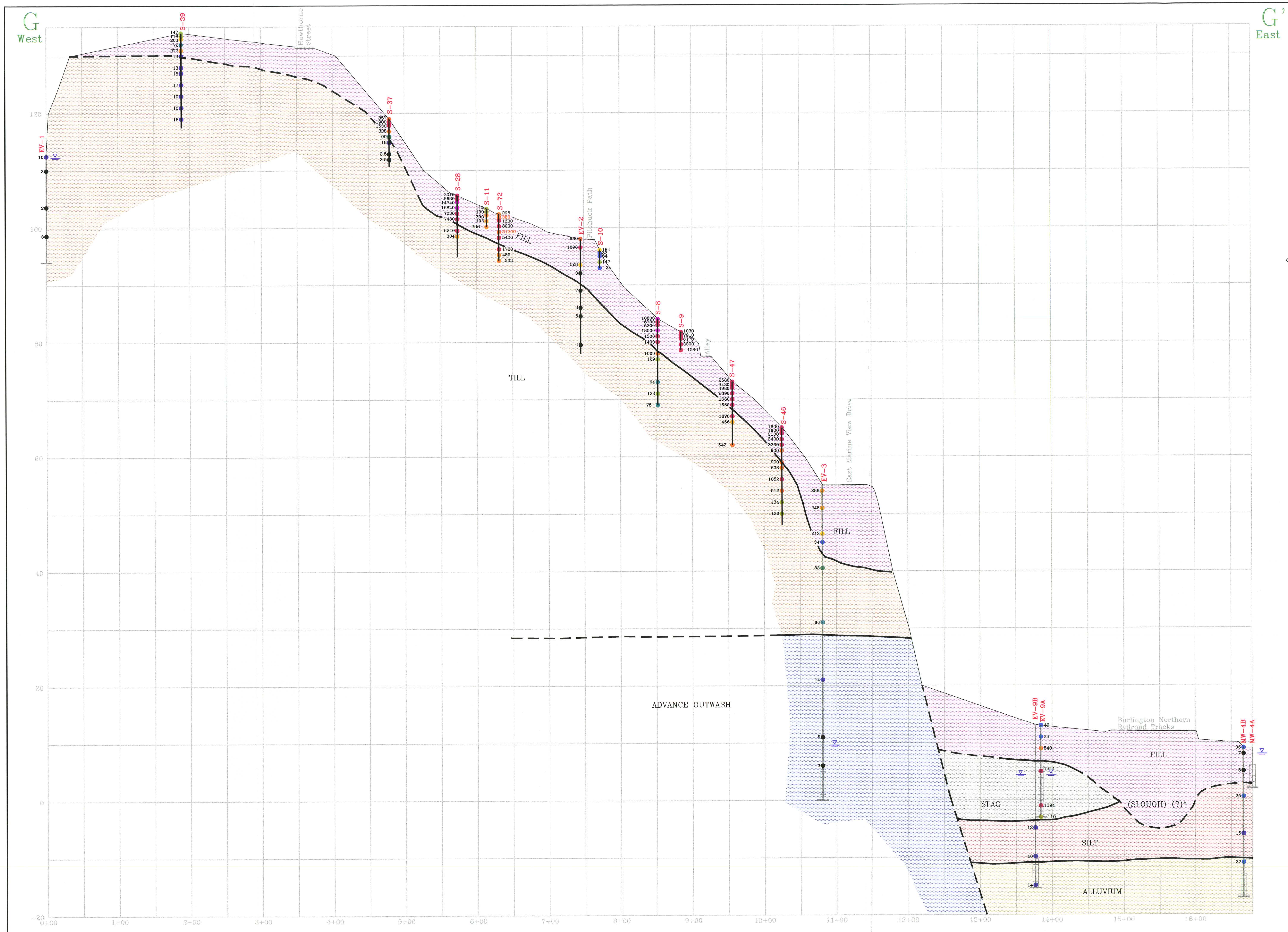
Consulting Scientists, Engineers, and Contractors
Tacoma, Washington
Suite 700, Seafirst Building (206) 572–5481

AUTOCAD REL. 12 (DWG)
HEL–03095045

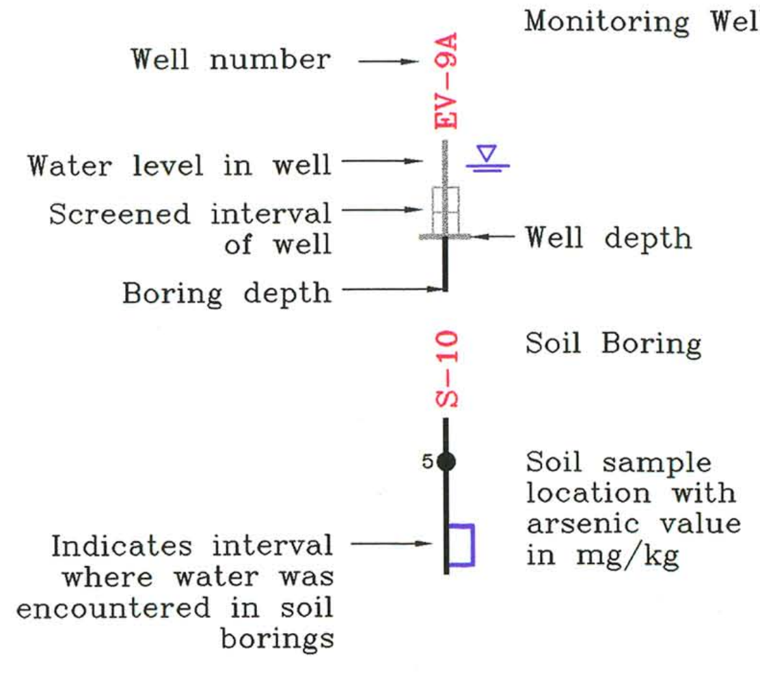
LAST UPDATE: 3:55pm
030\080\0072\HEL\950720\\I:\STORAGE\(SEE TITLEBLOCK)

I:\STORAGE\03095045 Fri Jul 21 08:46:51 1995 0037



LEGEND

- Existing Topography
- Geologic Contact (Dashed where inferred)
- Railroad Tracks
- Road
- Monitoring Well



UPLAND STRATIGRAPHIC UNITS

- ▨ Fill
- ▨ Till
- ▨ Advance Outwash

LOWLAND STRATIGRAPHIC UNITS

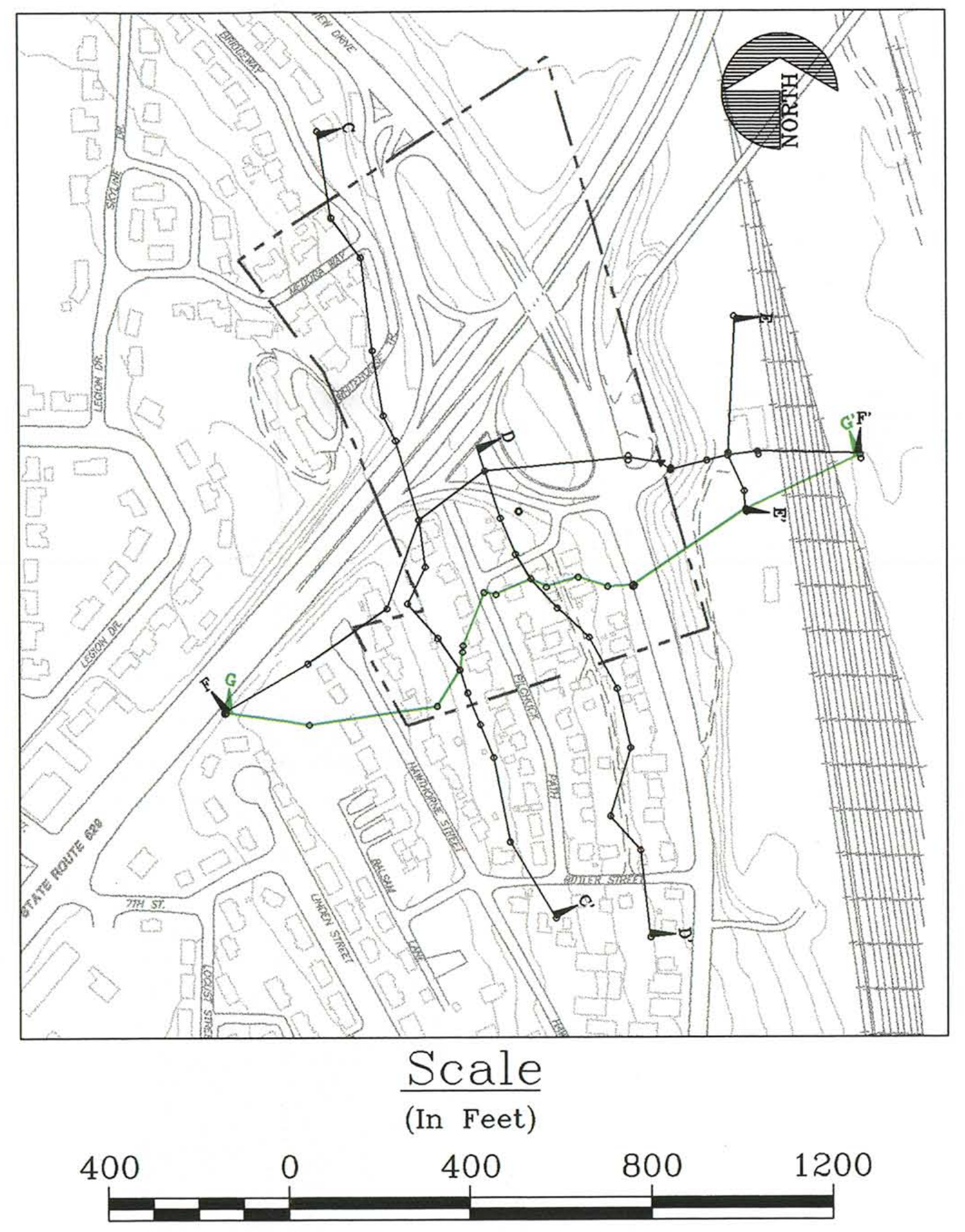
- ▨ Fill
- ▨ Slag
- ▨ Silty Sand
- ▨ Silt (Snohomish River Flood Plain Deposits)
- ▨ Alluvial Sand (Snohomish River Alluvium)

COLOR KEY OF ARSENIC CONCENTRATIONS

⬛	0 – 7 mg/kg	🟨	153 – 230 mg/kg
🟪	8 – 20 mg/kg	🟧	231 – 500 mg/kg
🟦	21 – 50 mg/kg	🟧	501 – 1000 mg/kg
🟦	51 – 76 mg/kg	🟥	1001 – 10,000 mg/kg
🟩	77 – 100 mg/kg	🟪	10,001 – 100,000 mg/kg
🟩	101 – 152 mg/kg	🟪	100,001 – 700,000 mg/kg

Horizontal Scale: 1"=60'
Vertical Scale: 1"=7.5'
Vertical Exaggeration = 8:1

*Note: Slough location inferred from 1917 topographic maps (see sheet 3-1)



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EVERETT, WASHINGTON

DETAILED GEOLOGIC CROSS SECTIONS
WITH SOIL ARSENIC CONCENTRATIONS

Drawn: 0072
Checked:
Approved:
Date: 7/24/95
Rev. #:
Proj. #: ASEV01

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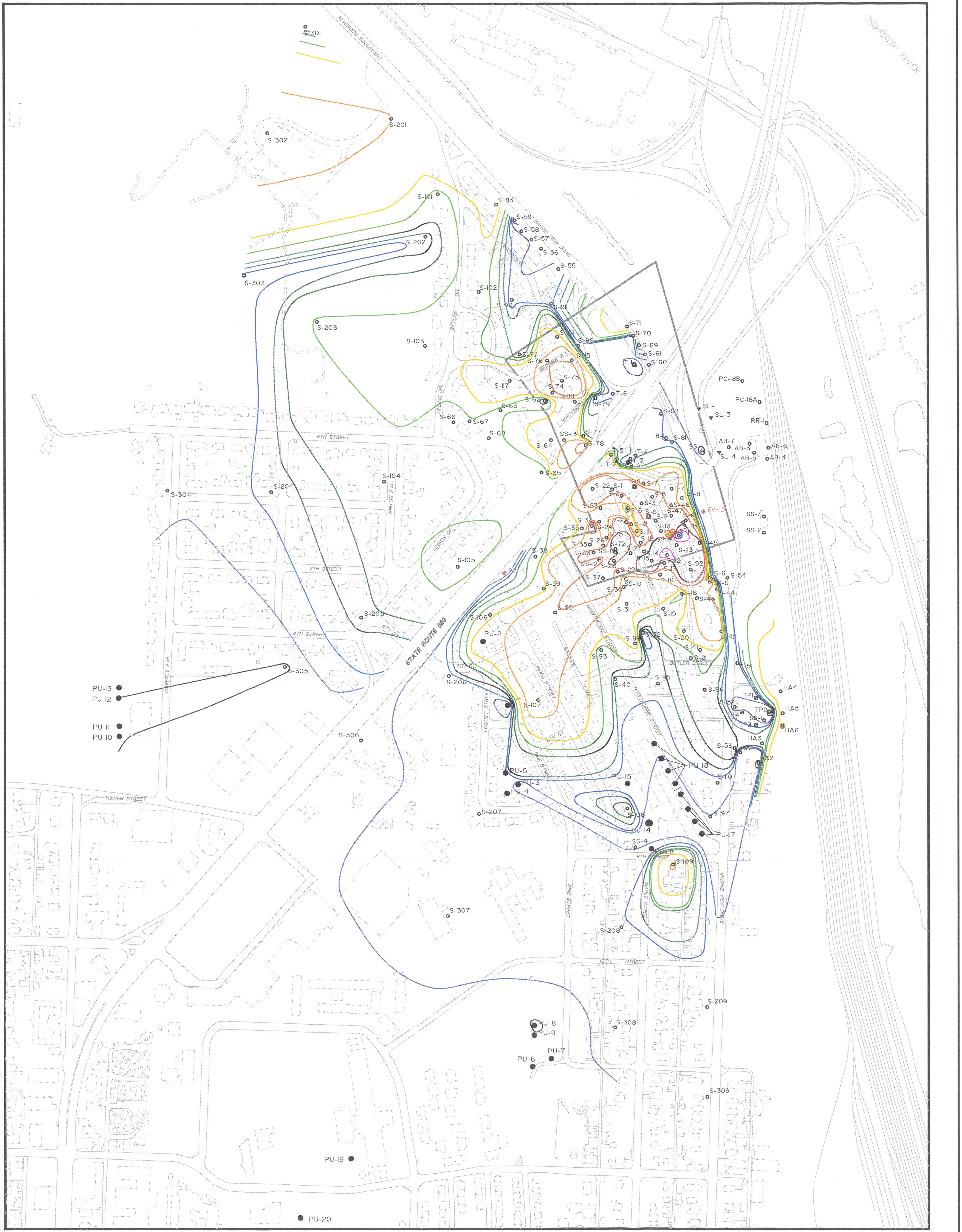
Consulting Scientists, Engineers, and Contractors
Tacoma, Washington
Suite 700, Seafirst Building (206) 572-5481

EXHIBIT
3–6
AUTOCAD REL. 12 (DWG)
HEL-03095046

LAST UPDATE: 4:00pm
030\080\0083\HEL\950724\\I:\STORAGE\(SEE TITLEBLOCK)

LAST UPDATE: 5/24/95 3:30 PM



LEGEND

- - - HISTORIC PLANT BOUNDARY

BUILDING

SS-10 ⊕ SURFACE SOIL

S-75 ○ SOIL BORING

TP2 ▨ TESTPIT

EV-1 ◐ MONITORING WELL

PU-4 ● PUBLIC USE SOIL SAMPLE LOCATION

ARSENIC
ISO-CONCENTRATION CONTOURS

——— 7 ppm
——— 20 ppm
——— 50 ppm
——— 76 ppm
——— 100 ppm
——— 152 ppm
——— 230 ppm
——— 500 ppm
——— 1,000 ppm
——— 10,000 ppm
——— 100,000 ppm
——— 700,000 ppm

MAXIMUM ARSENIC CONCENTRATION (ppm)

LOC.	As	LOC.	As	LOC.	As	LOC.	As	LOC.	As
B-1	24	HA5	273	S-33	240	S-72	53,100	S-203	159
B-2	37	HA6	505	S-34	1,550	S-73	84.5	S-204	58
EV-1	10	SS-1	5.6	S-35	727	S-74	788	S-205	87
EV-2	1,687	TP1	27	S-36	3,260	S-75	8,080	S-206	32
EV-3	288	TP2	2.7	S-37	1,900	S-76	556	S-207	26
AB-3	-	TP3	43	S-38	130	S-77	114	S-208	44
AB-4	-	TP4	23	S-39	203	S-78	1,460	S-209	22
AB-5	-	S-1	1,010	S-40	68.4	S-79	33.5	S-301	52
AB-6	-	S-2	952	S-41	222	S-80	39.6	S-302	771
AB-7	-	S-3	4,700	S-42	858	S-81	53.9	S-303	38
PC-18A	-	S-4	10,500	S-43	528	S-82	54.8	S-304	21
PC-18B	-	S-5	6,890	S-44	341	S-83	276	S-305	6.8
RR-1	-	S-6	138	S-45	13,700	S-90	30	S-306	13
SL-1	-	S-7	480	S-46	3,400	S-91	48	S-307	32
SL-3	-	S-8	18,000	S-47	5,380	S-92	29,000	S-308	25
SL-4	-	S-9	7,210	S-48	791	S-93	132	S-309	31
SS-1	7.2	S-10	194	S-49	2,010	S-94	245	PU-1	12
SS-2	-	S-11	355	S-50	994	S-95	57	PU-2	334
SS-3	-	S-12	758	S-51	49.3	S-96	141	PU-3	2
SS-4	14	S-13	14,000	S-52	9.6	S-97	20	PU-4	36
SS-5	541	S-14	6,490	S-53	145	S-101	120	PU-5	48
SS-6	131	S-15	44,700	S-54	34.8	S-102	200	PU-6	9.8
SS-8	345	S-16	732	S-55	24	S-103	192	PU-7	17
SS-9	182	S-17	1,190	S-56	10	S-104	132	PU-8	2.5
SS-10	381	S-18	131	S-57	18	S-105	205	PU-9	9
SS-11	4,670	S-19	159	S-58	16	S-106	180	PU-10	6.6
SS-12	864	S-20	282	S-59	4	S-107	730	PU-11	6.5
SS-13	476	S-21	132	S-60	23.3	S-108	130	PU-12	6.7
T-1	6.2	S-22	4,230	S-61	80.0	S-109	525	PU-13	17
T-2	100	S-23	475	S-62	90	S-110	48	PU-14	6
T-3	49.5	S-24	456	S-63	141	S-111	727,000	PU-15	28
T-4	68.3	S-25	311	S-64	363	S-112	143,600	PU-16	29
T-5	285	S-26	800	S-65	131	S-113	38,650	PU-17	11
T-6	42.2	S-27	5,306	S-66	134	S-114	375	PU-18	17
T-7	1,050	S-28	16,840	S-67	143	S-115	725	PU-19	2.5
HA1	13	S-29	935	S-68	100	S-116	400	PU-20	2.5
HA2	2.7	S-30	432	S-69	121	S-117	413		
HA3	81	S-31	333	S-70	51.2	S-201	500		
HA4	380	S-32	47.4	S-71	333	S-202	52		

NORTH

200' 0 200' 400'

Everett Smelter Site
Everett, Washington

Maximum Arsenic Concentrations in Soil

Designed: R.B.V.
Drawn By: G.J.F.
Checked By: R.B.V.
Approved By:
Date: 5/24/95
Rev. Date: NA
Project No.: ASEV01

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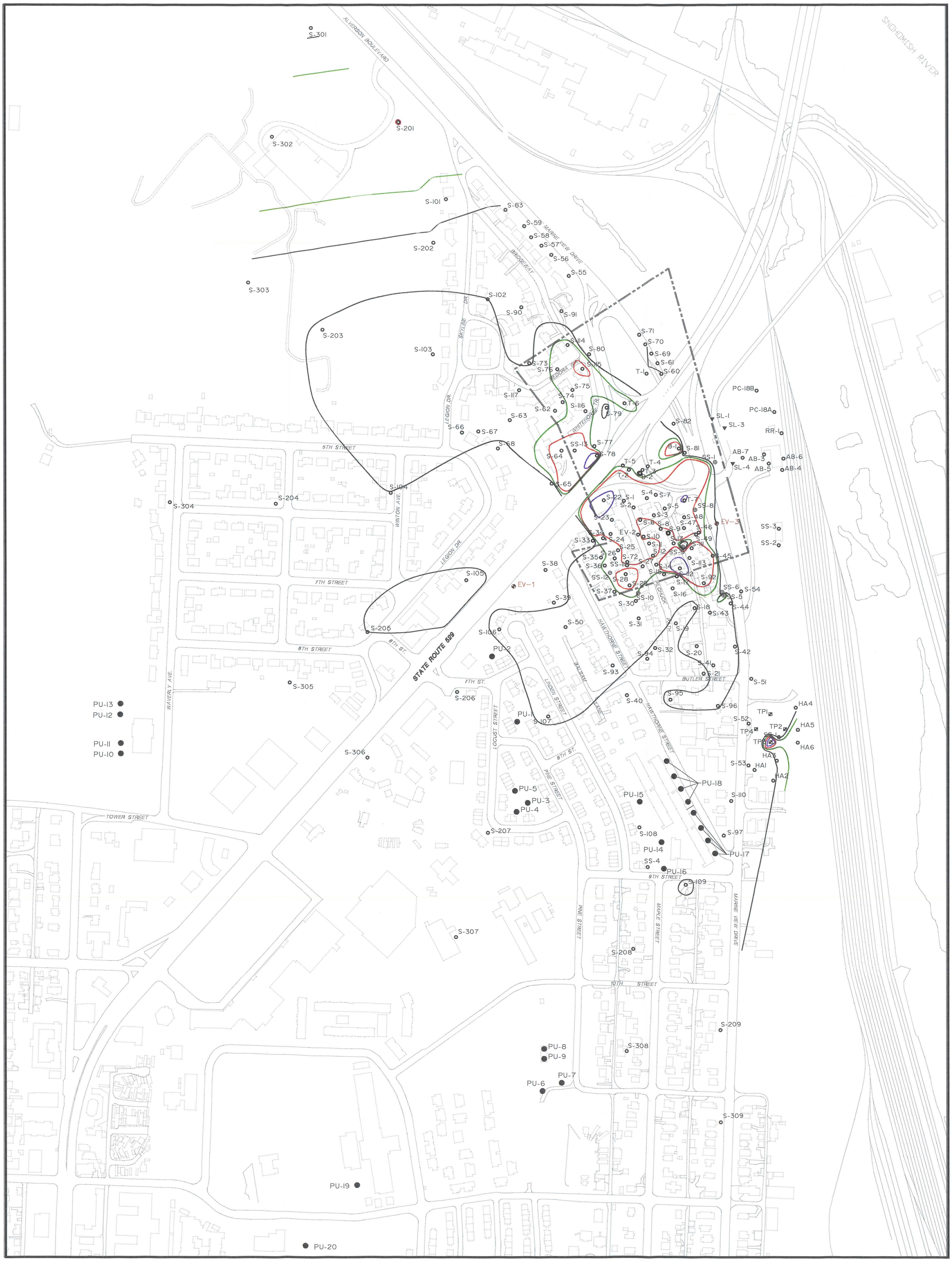
Consulting Scientists and Engineers
950 Pacific Ave, Seafirst Center, Suite 610
Tacoma, Washington 98402
(206) 572-5481

SHEET
3-7

SP0-03095S01



LEGEND

- HISTORIC PLANT BOUNDARY
- BUILDING
- SS-10 ⊕ SURFACE SOIL
- S-75 ○ SOIL BORING
- TP2 ▨ TESTPIT
- EV-1 ◕ MONITORING WELL
- PU-4 ● PUBLIC USE SOIL SAMPLE LOCATION

CADMIUM ISO-CONCENTRATION CONTOURS

- 2 ppm
- 5 ppm
- 10 ppm
- 100 ppm

MAXIMUM CADMIUM CONCENTRATION (ppm)

LOC.	Cd	LOC.	Cd	LOC.	Cd	LOC.	Cd	LOC.	Cd
B-1	23.0	HA5	9.4	S-33	1.4	S-72	22.0	S-203	2.6
B-2	0.5	HA6	5.9	S-34	6.6	S-73	1.7	S-204	1.2
EV-1	1.0	SS-1	0.5	S-35	3.1	S-74	4.9	S-205	2.0
EV-2	15.0	TP1	0.5	S-36	3.9	S-75	5.1	S-206	0.5
EV-3	2.0	TP2	1.64	S-37	4.3	S-76	6.3	S-207	0.5
AB-3	-	TP3	154.0	S-38	0.76	S-77	2.1	S-208	1.1
AB-4	-	TP4	0.5	S-39	1.2	S-78	137.0	S-209	0.5
AB-5	-	S-1	25.1	S-40	0.76	S-79	1.4	S-301	1.2
AB-6	-	S-2	62.1	S-41	4.1	S-80	1.1	S-302	9.7
AB-7	-	S-3	12.9	S-42	3.6	S-81	1.8	S-303	0.5
PC-18A	-	S-4	86.0	S-43	3.7	S-82	0.82	S-304	0.5
PC-18B	-	S-5	34.1	S-44	2.4	S-83	1.6	S-305	0.5
RR-1	-	S-6	5.3	S-45	10.0	S-90	0.5	S-306	0.5
SL-1	-	S-7	13.6	S-46	12.0	S-91	1.4	S-307	0.5
SL-3	-	S-8	9.0	S-47	21.0	S-92	14.0	S-308	0.5
SL-4	-	S-9	4.8	S-48	9.6	S-93	2.8	S-309	1.2
SS-1	2.0	S-10	7.3	S-49	5.3	S-94	1.6	PU-1	0.5
SS-2	-	S-11	13.9	S-50	4.8	S-95	2.7	PU-2	0.5
SS-3	-	S-12	11.0	S-51	0.5	S-96	2.1	PU-3	0.5
SS-4	0.32	S-13	8.0	S-52	0.5	S-97	0.5	PU-4	0.5
SS-5	6.1	S-14	6.2	S-53	0.79	S-101	3.0	PU-5	0.5
SS-6	0.51	S-15	4.7	S-54	0.5	S-102	2.0	PU-6	0.5
SS-8	8.3	S-16	5.5	S-55	1.3	S-103	3.0	PU-7	0.5
SS-9	0.71	S-17	2.9	S-56	0.5	S-104	2.0	PU-8	0.5
SS-10	4.7	S-18	1.7	S-57	0.5	S-105	3.0	PU-9	0.5
SS-11	6.2	S-19	1.6	S-58	0.5	S-106	3.0	PU-10	0.5
SS-12	5.2	S-20	3.8	S-59	0.5	S-107	3.0	PU-11	0.5
SS-13	17	S-21	0.5	S-60	1.7	S-108	2.0	PU-12	0.5
T-1	0.5	S-22	181.0	S-61	3.2	S-109	3.0	PU-13	0.5
T-2	6.2	S-23	23.8	S-62	2.7	S-110	1.0	PU-14	0.5
T-3	4.4	S-24	15.2	S-63	2.9	S-111	96.0	PU-15	0.5
T-4	4.0	S-25	5.4	S-64	14.3	S-112	230.0	PU-16	0.5
T-5	3.4	S-26	9.0	S-65	1.7	S-113	17.0	PU-17	0.5
T-6	6.3	S-27	6.0	S-66	2.7	S-114	8.0	PU-18	0.5
T-7	112.0	S-28	20.0	S-67	2.5	S-115	12.0	PU-19	0.5
HA1	0.5	S-29	12.0	S-68	1.3	S-116	8.0	PU-20	0.5
HA2	1.7	S-30	4.7	S-69	4.8	S-117	4.0		
HA3	2.2	S-31	4.8	S-70	0.82	S-201	10.0		
HA4	0.5	S-32	1.2	S-71	1.9	S-202	1.2		

NORTH

200' 0 200' 400'

Everett Smelter Site
Everett, Washington

Maximum Cadmium Concentrations in Soil

Designed: R.B.V.
Drawn By: G.J.F
Checked By: R.B.V.
Approved By:
Date: 5/24/95
Rev. Date: NA
Project No.: ASEV01

Hydrometrics, Inc.
Consulting Scientists and Engineers
950 Pacific Ave, Seafirst Center, Suite 610
Tacoma, Washington 98402
(206) 572-5481

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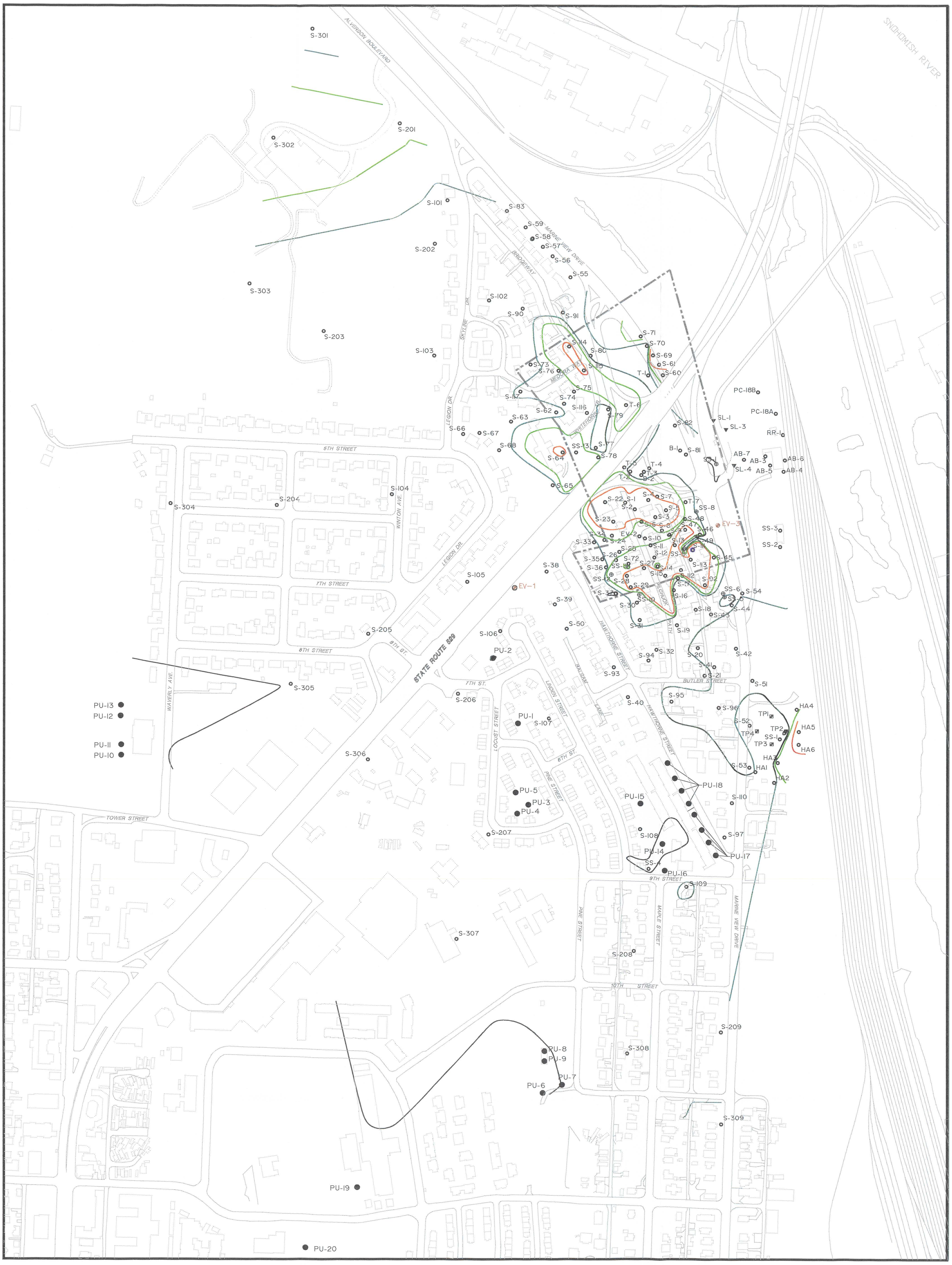
LAST UPDATE: 5/24/95 4:50 PM



LEGEND

- HISTORIC PLANT BOUNDARY
- BUILDING
- SS-10 ⊕ SURFACE SOIL
- S-75 ○ SOIL BORING
- TP2 ▨ TESTPIT
- EV-1 ⊕ MONITORING WELL
- PU-4 ● PUBLIC USE SOIL SAMPLE LOCATION

LEAD ISO-CONCENTRATION CONTOURS

- 24 ppm
- 250 ppm
- 500 ppm
- 1,000 ppm
- 10,000 ppm

MAXIMUM LEAD CONCENTRATION (ppm)

LOC.	Pb	LOC.	Pb	LOC.	Pb	LOC.	Pb	LOC.	Pb
B-1	40.0	HA5	1,500.0	S-33	96.1	S-72	630.0	S-203	238.0
B-2	30.0	HA6	1,910.0	S-34	344.0	S-73	65.8	S-204	102.0
EV-1	23.0	SS-1	2.5	S-35	199.0	S-74	323.0	S-205	130.0
EV-2	430.0	TP1	103.0	S-36	194.0	S-75	386.0	S-206	207.0
EV-3	66.0	TP2	18.0	S-37	15.3	S-76	419.0	S-207	109.0
AB-3	-	TP3	270.0	S-38	63.9	S-77	71.8	S-208	193.0
AB-4	-	TP4	31.0	S-39	72.6	S-78	827.0	S-209	44.0
AB-5	-	S-1	1,470.0	S-40	60.2	S-79	71.6	S-301	104.0
AB-6	-	S-2	2,330.0	S-41	305.0	S-80	152.0	S-302	851.0
AB-7	-	S-3	8,870.0	S-42	496.0	S-81	67.1	S-303	45.0
PC-18A	-	S-4	2,490.0	S-43	198.0	S-82	89.4	S-304	54.0
PC-18B	-	S-5	2,150.0	S-44	209.0	S-83	209.0	S-305	25.0
RR-1	-	S-6	284.0	S-45	581.0	S-90	62.0	S-306	122.0
SL-1	-	S-7	772.0	S-46	821.0	S-91	126.0	S-307	36.0
SL-3	-	S-8	644.0	S-47	1,640.0	S-92	1,098.0	S-308	108.0
SL-4	-	S-9	238.0	S-48	492.0	S-93	84.0	S-309	314.0
SS-1	29.3	S-10	348.0	S-49	233.0	S-94	221.0	PU-1	119.0
SS-2	-	S-11	500.0	S-50	198.0	S-95	335.0	PU-2	253.0
SS-3	-	S-12	635.0	S-51	261.0	S-96	333.0	PU-3	43.0
SS-4	13.2	S-13	1,190.0	S-52	131.0	S-97	74.0	PU-4	80.0
SS-5	480.0	S-14	384.0	S-53	306.0	S-101	140.0	PU-5	69.0
SS-6	34.3	S-15	632.0	S-54	242.0	S-102	130.0	PU-6	12.0
SS-8	209.0	S-16	220.0	S-55	132.0	S-103	140.0	PU-7	24.0
SS-9	87.3	S-17	256.0	S-56	103.0	S-104	87.0	PU-8	16.0
SS-10	257.0	S-18	190.0	S-57	167.0	S-105	170.0	PU-9	15.0
SS-11	425.0	S-19	122.0	S-58	253.0	S-106	170.0	PU-10	10.0
SS-12	864.0	S-20	346.0	S-59	179.0	S-107	122.0	PU-11	13.0
SS-13	688.0	S-21	159.0	S-60	666.0	S-108	74.0	PU-12	5.6
T-1	181.0	S-22	2,540.0	S-61	4,540.0	S-109	300.0	PU-13	15.0
T-2	77.0	S-23	1,500.0	S-62	150.0	S-110	70.0	PU-14	5.6
T-3	44.4	S-24	632.0	S-63	178.0	S-111	11,000.0	PU-15	102.0
T-4	48.7	S-25	446.0	S-64	1,160.0	S-112	2,061.0	PU-16	53.0
T-5	301.0	S-26	533.0	S-65	111.0	S-113	1,040.0	PU-17	34.0
T-6	834.0	S-27	1,063.0	S-66	129.0	S-114	1,220.0	PU-18	38.0
T-7	461.0	S-28	1,300.0	S-67	35.0	S-115	1,130.0	PU-19	22.0
HA1	97.2	S-29	1,220.0	S-68	90.4	S-116	487.0	PU-20	9.8
HA2	25.0	S-30	403.0	S-69	3,940.0	S-117	284.0		
HA3	889.0	S-31	381.0	S-70	217.0	S-201	598.0		
HA4	470.0	S-32	92.3	S-71	630.0	S-202	58.0		

Everett Smelter Site
Everett, Washington

Maximum Lead Concentrations in Soil

Designed: R.B.V.
Drawn By: G.J.F.
Checked By: R.B.V.
Approved By:
Date: 5/24/95
Rev. Date: NA
Project No.: ASEV01

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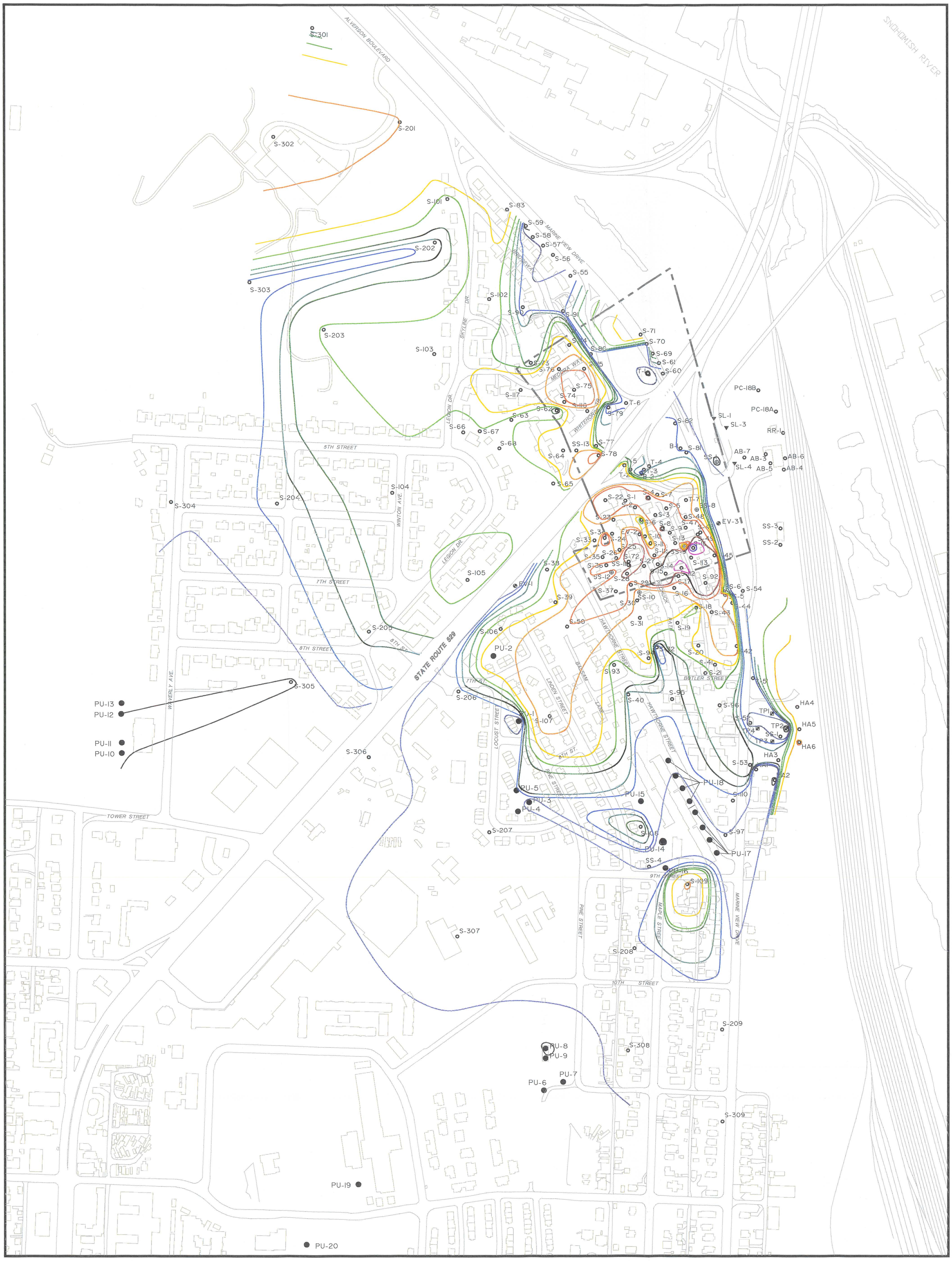

LEGEND

───	HISTORIC PLANT BOUNDARY
☐	BUILDING
SS-10 ⊕	SURFACE SOIL
S-75 ○	SOIL BORING
TP2 ▨	TESTPIT
EV-1 ⊗	MONITORING WELL
PU-4 ●	PUBLIC USE SOIL SAMPLE LOCATION

MTCA RISK CONTOURS

───	$4x10^{-6}$
───	$1x10^{-5}$
───	$3x10^{-5}$
───	$5x10^{-5}$
───	$6x10^{-5}$
───	$9x10^{-5}$
───	$2x10^{-4}$
───	$3x10^{-4}$
───	$6x10^{-4}$
───	$6x10^{-3}$
───	$6x10^{-2}$
───	$4x10^{-1}$

NORTH

200' 0 200' 400'

Everett Smelter Site
Everett, Washington

MTCA Risks for Arsenic in Soil

Designed: R.B.V.
Drawn By: S.T.R.
Checked By: R.B.V.
Approved By:
Date: 6/6/95
Rev. Date: 7/26/95
Project No.: ASEV01

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950 Pacific Ave, Seafirst Center, Suite 610
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SHEET
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TAC-03095T13

APPENDIX A

ANALYTICAL RESULTS

Sample Type: AIR

SITE CODE	HD-1	HD-1	HD-2	HD-2	HD-3
SAMPLE DATE	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93
SAMPLE TIME	10:20	10:16	11:00	11:05	11:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8386	93-8387	93-8388	93-8389	93-8390
REMARKS	WIPE	AIR FILTER	AIR FILTER	WIPE	WIPE
SAMPLE NUMBER	EVT-9308-900	EVT-9308-901	EVT-9308-902	EVT-9308-903	EVT-9308-905
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) (uG/100cm2) TOT	39.0			<2.5	<2.5
ARSENIC (AS) (ug/L) TOT		10.4	<0.1		
LEAD (PB) (uG/100cm2) TOT	4.2			<2.5	<2.5
LEAD (PB) (ug/L) TOT		<1.9	<0.1		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: AIR

SITE CODE	HD-3	HD-4	HD-4	HD-5	HD-5
SAMPLE DATE	08/23/93	08/23/93	08/23/93	08/23/93	08/23/93
SAMPLE TIME	11:30	13:35	13:30	16:50	16:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8391	93-8392	93-8393	93-8394	93-8395
REMARKS	AIR FILTER	WIPE	AIR FILTER	WIPE	AIR FILTER
SAMPLE NUMBER	EVT-9308-906	EVT-9308-907	EVT-9308-908	EVT-9308-909	EVT-9308-910
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) (uG/100cm2) TOT		<2.5		<2.5	
ARSENIC (AS) (ug/L) TOT	<0.125		<0.25		<0.25
LEAD (PB) (uG/100cm2) TOT		2.9		<2.5	
LEAD (PB) (ug/L) TOT	<0.125		<0.25		<0.25

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

```
          Sample Type: AIR

               SITE CODE       HD-6          HD-6
             SAMPLE DATE   09/01/93      09/01/93
             SAMPLE TIME      16:00         16:05
                     LAB    TSC-SLC       TSC-SLC
              LAB NUMBER    93-8457       93-8458
                 REMARKS AIR FILTER          WIPE
           SAMPLE NUMBER EVT-9309-915 EVT-9309-916

--- METALS & MINOR CONSTITUENTS ---
   ARSENIC (AS) (uG/100cm2) TOT                <2.5
       ARSENIC (AS) (ug/L) TOT    <0.125
     LEAD (PB) (uG/100cm2) TOT                 <2.5
          LEAD (PB) (ug/L) TOT    <0.125
```

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	DEC.WATER	DEC.WATER	DRILL.WATE	EV-1	EV-1
SAMPLE DATE	02/02/93	07/16/93	02/02/93	02/02/93	02/17/93
SAMPLE TIME		08:00		16:30	12:30
LAB	SAS	SAS	SAS	SAS	ASARCO-SLC
LAB NUMBER	30051-7	33509-1	30051-8	30051-1	93-7243
SAMPLE NUMBER	EVT-9302-906	DECON.WATER	EVT-9302-907	EVT-9302-900	EVT-9302-101
— PHYSICAL PARAMETERS —					
DEPTH TO WATER LEVEL (FEET)					2.29
OXYGEN (O) DIS					5.8
PH (FLD)					6.67
PH					6.7
SC (UMHOS/CM AT 25 C)					200.0
WATER TEMPERATURE (C) (FLD)					8.5
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS					14.0
MAGNESIUM (MG) DIS					11.0
SODIUM (NA) DIS					10.0
POTASSIUM (K) DIS					3.0
TOTAL ALKALINITY AS CACO3					66.0
TOTAL ACIDITY AS CACO3					<1.0
BICARBONATE ALKALINITY AS CACO3					66.0
CARBONATE ALKALINITY AS CACO3					<1.0
SULFATE (SO4)					16.0
CHLORIDE (CL)					8.0
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS					<0.002
ARSENIC (AS) TOT	17.0	2.2	<0.01	<0.01	0.0024
ARSENIC +3					<0.005
ARSENIC +5					<0.005
CADMIUM (CD) DIS					<0.005
CADMIUM (CD) TOT	0.082	0.018	<0.005	<0.005	<0.005
COPPER (CU) DIS					<0.005
COPPER (CU) TOT					0.0056
LEAD (PB) DIS					<0.005
LEAD (PB) TOT	2.8	0.08	0.004	0.01	<0.005
ZINC (ZN) DIS					0.048
ZINC (ZN) TOT					0.075

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-1	EV-1	EV-1	EV-3	EV-3	EV-3
SAMPLE DATE	04/21/93	06/16/93	09/15/93	02/04/93	02/17/93	04/21/93
SAMPLE TIME	15:00	10:55	17:35	16:45	13:40	12:10
LAB	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC	TSC-SLC
LAB NUMBER	93-7702	93-7950	93-8477	30051-6	93-7244	93-7700
SAMPLE NUMBER	EVT-9304-113	EVT-9306-133	EVT-9309-104	EVT-9302-905	EVT-9302-102	EVT-9304-111
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	0.5	1.26	5.05		47.78	47.7
OXYGEN (O) DIS	6.2	6.8	8.2		4.2	4.6
PH (FLD)	6.53	6.44	8.04		6.47	6.44
PH	7.92		7.5		6.4	7.45
SC (UMHOS/CM AT 25 C)	290.0		160.0		350.0	350.0
SC (UMHOS/CM AT 25 C) (FLD)	201.0	190.0	165.0			310.0
WATER TEMPERATURE (C) (FLD)	10.5	12.9	14.6		11.8	13.1
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	14.0	13.0	10.0		27.0	24.0
MAGNESIUM (MG) DIS	12.0	11.0	9.2		16.0	12.0
SODIUM (NA) DIS	8.6	9.0	7.5		16.0	13.0
POTASSIUM (K) DIS	2.5	2.8	<5.0		4.5	3.8
TOTAL ALKALINITY AS CACO3	74.0		56.0		61.0	50.0
TOTAL ACIDITY AS CACO3					<1.0	
BICARBONATE ALKALINITY AS CACO3	74.0	68.0			61.0	50.0
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0			<1.0	<1.0
SULFATE (SO4)	23.0	14.0	10.0		35.0	34.0
CHLORIDE (CL)	8.3	4.5	4.9		8.2	7.8
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	<0.005	<0.005	<0.005		0.0032	<0.005
ARSENIC (AS) TOT	0.012	<0.005	<0.005	<0.01	0.012	0.0052
ARSENIC +3					<0.005	
ARSENIC +5					<0.005	
CADMIUM (CD) DIS	<0.005	<0.005	<0.005		<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
COPPER (CU) DIS	<0.005		<0.005		<0.005	<0.005
COPPER (CU) TOT	0.066		<0.005		0.0082	0.0099
LEAD (PB) DIS	<0.005	<0.005	<0.005		<0.005	<0.005
LEAD (PB) TOT	0.016	<0.005	<0.005	0.009	<0.005	<0.005
ZINC (ZN) DIS	0.013 UJ1,J4		<0.005		0.041	0.015 UJ1,J4
ZINC (ZN) TOT	0.13 UJ1,J4		0.008		0.042 UJ1	0.02 UJ1,J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-3	EV-3	EV-3	EV-3	EV-4A	EV-4A
SAMPLE DATE	04/21/93	06/16/93	09/16/93	12/29/93	02/03/93	02/17/93
SAMPLE TIME	12:10	09:15	10:00	14:20	08:00	
LAB	ARI	TSC-SLC	TSC-SLC	TSC-SLC	SAS	HYDRO
LAB NUMBER	D612A	93-7948	93-8480	94-9929	30051-2	
REMARKS						NO SAMPLE
SAMPLE NUMBER	EVT-9304-111	EVT-9306-131	EVT-9309-110	EVT-9312-206	EVT-9302-901	EVT-9302-104
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	47.7	47.57	47.91	47.94		9.45
OXYGEN (O) DIS	4.6	5.2	7.7	4.2		
PH (FLD)	6.44	6.36	6.66	6.9		
PH			6.7			
SC (UMHOS/CM AT 25 C)			340.0			
SC (UMHOS/CM AT 25 C) (FLD)	310.0	333.0	362.0	392.0		
WATER TEMPERATURE (C) (FLD)	13.1	13.2	12.8	12.2		
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS		27.0	26.0		48.0	
MAGNESIUM (MG) DIS		16.0	15.0			
SODIUM (NA) DIS		15.0	14.0		16.0	
POTASSIUM (K) DIS		4.0	<5.0		6.8	
TOTAL ALKALINITY AS CACO3			59.0			
BICARBONATE ALKALINITY AS CACO3		54.0				
CARBONATE ALKALINITY AS CACO3		<1.0				
SULFATE (SO4)		36.0	36.0			
CHLORIDE (CL)		9.0	9.1		14.0	
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS		<0.005	<0.005	<0.005		
ARSENIC (AS) TOT		<0.005	<0.005	0.0058	0.38	
CADMIUM (CD) DIS		<0.005	<0.005	<0.005		
CADMIUM (CD) TOT		<0.005	<0.005	<0.005	0.015	
COPPER (CU) DIS			<0.005	<0.005		
COPPER (CU) TOT			<0.005	0.019		
LEAD (PB) DIS		<0.005	<0.005	<0.005		
LEAD (PB) TOT		<0.005	<0.005	0.0054	0.33	
ZINC (ZN) DIS			<0.005	0.01		
ZINC (ZN) TOT			0.006	0.033		
— VOLATILE ORGANICS —						
1,1,1-TRICHLOROETHANE	<.001					
1,1,2,2-TETRACHLOROETHANE	<.001					
1,1,2-TRICHLOROETHANE	<.001					
1,1,2-TRICHLOROTRIFLUOROETHANE	<.002					
1,1-DICHLOROETHANE	<.001					
1,1-DICHLOROETHENE	<.001					
1,2-DICHLOROETHANE	<.001					
1,2-DICHLOROPROPANE	<.001					
2,2'-OXYBIS(1-CHLOROPROPANE)	<.001					
2-BUTANONE (METHYL-ETHYL-KETONE)	<.005					
2-CHLOROETHYL VINYL ETHER	<.001					
2-HEXANONE	<.005					
4-METHYL-2-PENTANONE	<.005					
ACETONE	<.005					
BENZENE	<.001					
BROMODICHLOROMETHANE	<.001					
BROMOFORM	<.001					
BROMOMETHANE	<.002					
CARBON DISULFIDE	<.001					
CARBON TETRACHLORIDE	<.001					

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-3	EV-3	EV-3	EV-3	EV-4A	EV-4A
SAMPLE DATE	04/21/93	06/16/93	09/16/93	12/29/93	02/03/93	02/17/93
SAMPLE TIME	12:10	09:15	10:00	14:20	08:00	
LAB	ARI	TSC-SLC	TSC-SLC	TSC-SLC	SAS	HYDRO
LAB NUMBER	D612A	93-7948	93-8480	94-9929	30051-2	
REMARKS						NO SAMPLE
SAMPLE NUMBER	EVT-9304-111	EVT-9306-131	EVT-9309-110	EVT-9312-206	EVT-9302-901	EVT-9302-104
— VOLATILE ORGANICS —						
CHLOROBENZENE	<.001					
CHLOROETHANE	<.002					
CHLOROFORM	<.001					
CHLOROMETHANE	<.002					
CIS-1,2-DICHLOROETHENE	<.001					
CIS-1,3-DICHLOROPROPENE	<.001					
DIBROMOCHLOROMETHANE	<.001					
ETHYLBENZENE	<.001					
TOTAL XYLENE TOT	<.002					
METHYLENE CHLORIDE	<.002					
STYRENE	<.001					
TETRACHLOROETHENE	<.001					
TOLUENE	<.001					
TRANS-1,2-DICHLOROETHENE	<.001					
TRANS-1,3-DICHLOROPROPENE	<.001					
TRICHLOROETHENE	<.001					
TRICHLOROFLUOROMETHANE	<.002					
VINYL ACETATE	<.001					
VINYL CHLORIDE	<.002					
— SEMI-VOLATILE EXTRACTABLES —						
1,2,4-TRICHLOROBENZENE	<.001					
1,2-DICHLOROBENZENE	<.001					
1,3-DICHLOROBENZENE	<.001					
1,4-DICHLOROBENZENE	<.001					
2,4,5-TRICHLOROPHENOL	<.005					
2,4,6-TRICHLOROPHENOL	<.005					
2,4-DICHLOROPHENOL	<.003					
2,4-DIMETHYLPHENOL	<.002					
2,4-DINITROPHENOL	<.01					
2,4-DINITROTOLUENE	<.005					
2,6-DINITROTOLUENE	<.005					
2-CHLORONAPHTHALENE	<.001					
2-CHLOROPHENOL	<.001					
2-METHYLNAPHTHALENE	<.001					
2-METHYLPHENOL (O-CRESOL)	<.001					
2-NITROANILINE	<.005					
2-NITROPHENOL	<.005					
3,3-DICHLOROBENZIDINE	<.005					
3-NITROANILINE	<.005					
4,6-DINITRO-2-METHYLPHENOL	<.01					
4-BROMOPHENYL PHENYL ETHER	<.001					
4-CHLORO-3-METHYLPHENOL	<.002					
4-CHLOROANILINE	<.003					
4-CHLOROPHENYL PHENYL ETHER	<.001					
4-METHYLPHENOL (P-CRESOL)	<.001					
4-NITROANILINE	<.005					
4-NITROPHENOL	<.005					
ACENAPHTHENE	<.001					
ACENAPHTHYLENE	<.001					
ANTHRACENE	<.001					
BENZO (A) ANTHRACENE	<.001					

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-3	EV-3	EV-3	EV-3	EV-4A	EV-4A
SAMPLE DATE	04/21/93	06/16/93	09/16/93	12/29/93	02/03/93	02/17/93
SAMPLE TIME	12:10	09:15	10:00	14:20	08:00	
LAB	ARI	TSC-SLC	TSC-SLC	TSC-SLC	SAS	HYDRO
LAB NUMBER	D612A	93-7948	93-8480	94-9929	30051-2	
REMARKS						NO SAMPLE
SAMPLE NUMBER	EVT-9304-111	EVT-9306-131	EVT-9309-110	EVT-9312-206	EVT-9302-901	EVT-9302-104
— SEMI-VOLATILE EXTRACTABLES —						
BENZO (A) PYRENE	<.001					
BENZO (B) FLUORANTHENE	<.001					
BENZO (GHI) PERYLENE	<.001					
BENZO (K) FLUORANTHENE	<.001					
BENZOIC ACID	<.01					
BENZYL ALCOHOL	<.005					
BIS (2-CHLOROETHOXY) METHANE	<.001					
BIS (2-CHLOROETHYL) ETHER	<.001					
BIS (2-ETHYLHEXYL) PHTHALATE	.0011 J4					
BUTYL BENZYL PHTHALATE	<.001					
CARBAZOLE	<.001					
CHRYSENE	<.001					
DI-N-BUTYLPHTHALATE	.0013 J4					
DI-N-OCTYLPHTHALATE	<.001					
DIBENZO (A,H) ANTHRACENE	<.001					
DIBENZOFURAN	<.001					
DIETHYLPHTHALATE	<.001					
DIMETHYLPHTHALATE	<.001					
FLUORANTHENE	<.001					
FLUORENE	<.001					
HEXACHLOROBENZENE	<.001					
HEXACHLOROBUTADIENE	<.002					
HEXACHLOROCYCLOPENTADIENE	<.005					
HEXACHLOROETHANE	<.002					
INDENO (1,2,3-CD) PYRENE	<.001					
ISOPHORONE	<.001					
N-NITROSO-DI-N-PROPYLAMINE	<.001					
N-NITROSODIPHENYLAMINE	<.001					
NAPHTHALENE	<.001					
NITROBENZENE	<.001					
PENTACHLOROPHENOL	<.005					
PHENANTHRENE	<.001					
PHENOL	<.002					
PYRENE	<.001					

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TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-4A	EV-4A	EV-4A	EV-4A	EV-4B	EV-4B
SAMPLE DATE	04/22/93	06/16/93	09/15/93	12/28/93	02/04/93	02/17/93
SAMPLE TIME		11:20		18:00	08:30	14:50
LAB	HYDRO	TSC-SLC	HYDRO	TSC-SLC	SAS	TSC-SLC
LAB NUMBER		93-7960	HYDRO	94-9928	30051-4	93-7245
REMARKS	NO SAMPLE		NO SAMPLE			
SAMPLE NUMBER	EVT-9304-124	EVT-9306-134	EVT-9309-105	EVT-9312-205	EVT-9302-903	EVT-9302-103
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	8.79	9.01	DRY	9.85		51.68
OXYGEN (O) DIS		2.6		8.0		5.2
PH (FLD)		6.29		7.55		6.76
PH						6.7
SC (UMHOS/CM AT 25 C)						720.0
SC (UMHOS/CM AT 25 C) (FLD)		620.0		543.0		
WATER TEMPERATURE (C) (FLD)		14.0		13.1		12.3
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS						53.0
MAGNESIUM (MG) DIS						47.0
SODIUM (NA) DIS						33.0
POTASSIUM (K) DIS						5.7
TOTAL ALKALINITY AS CACO3						246.0
TOTAL ACIDITY AS CACO3						<1.0
BICARBONATE ALKALINITY AS CACO3						246.0
CARBONATE ALKALINITY AS CACO3						<1.0
SULFATE (SO4)						46.0
CHLORIDE (CL)						54.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS						0.014
ARSENIC (AS) TOT		0.935		0.453	0.028	0.015
ARSENIC +3						<0.005
ARSENIC +5						0.006
CADMIUM (CD) DIS						<0.005
CADMIUM (CD) TOT		<0.005		0.017	<0.005	<0.005
COPPER (CU) DIS						<0.005
COPPER (CU) TOT				0.082		<0.005
LEAD (PB) DIS						<0.005
LEAD (PB) TOT		0.139		0.281	0.009	<0.005
ZINC (ZN) DIS						0.039
ZINC (ZN) TOT				0.264		0.035

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Sample Type: Monitoring Wells

SITE CODE	EV-4B	EV-4B	EV-4B	EV-4B	EV-5	EV-5
SAMPLE DATE	04/21/93	06/16/93	09/16/93	12/28/93	02/03/93	02/17/93
SAMPLE TIME	13:45	09:50	08:05	17:30	14:00	16:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC
LAB NUMBER	93-7701	93-7949	93-8479	94-9927	30051-3	93-7246
SAMPLE NUMBER	EVT-9304-112	EVT-9306-132	EVT-9309-108	EVT-9312-204	EVT-9302-902	EVT-9302-105
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	51.7	51.69	51.91	51.79		6.35
OXYGEN (O) DIS	5.2	4.8		5.2		4.4
PH (FLD)	6.6	6.65		6.94		6.82
PH	8.28		6.7			6.6
SC (UMHOS/CM AT 25 C)	800.0		820.0			600.0
SC (UMHOS/CM AT 25 C) (FLD)	671.0	845.0		864.0		
WATER TEMPERATURE (C) (FLD)	13.3	13.9		11.9		10.7
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	54.0	63.0	57.0			21.0
MAGNESIUM (MG) DIS	43.0	55.0	49.0			28.0
SODIUM (NA) DIS	32.0	38.0	34.0			71.0
POTASSIUM (K) DIS	5.0	4.7	5.1			5.3
TOTAL ALKALINITY AS CACO3	263.0		276.0			216.0
TOTAL ACIDITY AS CACO3						<1.0
BICARBONATE ALKALINITY AS CACO3	263.0	278.0				216.0
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0				<1.0
SULFATE (SO4)	46.0	51.0	52.0			45.0
CHLORIDE (CL)	62.0	65.0	63.0			27.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.045	0.106	0.152	0.139		0.002
ARSENIC (AS) TOT	0.047	0.11	0.113	0.156	<0.01	<0.002
ARSENIC +3		<0.005				<0.005
ARSENIC +5		0.095				<0.005
CADMIUM (CD) DIS	<0.005	<0.005	<0.005	<0.005		<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	0.007 J4	0.012	<0.005
COPPER (CU) DIS	<0.005		<0.005	<0.005		<0.005
COPPER (CU) TOT	<0.005		<0.005	0.017 J4		<0.005
LEAD (PB) DIS	<0.005	<0.005	<0.005	<0.005		<0.005
LEAD (PB) TOT	<0.005	<0.005	<0.005	0.012 J4	0.023	<0.005
ZINC (ZN) DIS	0.038 UJ1,J4		0.083	0.093		0.03
ZINC (ZN) TOT	0.04 UJ1,J4		0.073	0.129		0.025 UJ1

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5
SAMPLE DATE	02/17/93	04/21/93	04/21/93	04/21/93	04/21/93	06/16/93	09/16/93
SAMPLE TIME	16:30	16:30	16:30	19:00	19:00	14:45	13:55
LAB	TSC-SLC	TSC-SLC	ARI	TSC-SLC	ARI	TSC-SLC	TSC-SLC
LAB NUMBER	93-7248	93-7703	D612B	93-7705	D612C	93-7958	93-8482
REMARKS	DUPLICATE			DUPLICATE	DUPLICATE		
SAMPLE NUMBER	EVT-9302-107	EVT-9304-114	EVT-9304-114	EVT-9304-116	EVT-9304-116	EVT-9306-142	EVT-9309-113
— PHYSICAL PARAMETERS —							
DEPTH TO WATER LEVEL (FEET)	6.35	7.99	7.99	7.99	7.99	8.14	8.27
OXYGEN (O) DIS	4.4	2.4	2.4	2.4	2.4	2.6	2.5
PH (FLD)	6.82	6.59	6.59	6.59	6.59	6.46	6.47
PH	6.6	7.89		7.91			6.7
SC (UMHOS/CM AT 25 C)	600.0	600.0		600.0			570.0
SC (UMHOS/CM AT 25 C) (FLD)		474.0	474.0	474.0	474.0	552.0	521.0
WATER TEMPERATURE (C) (FLD)	10.7	12.0	12.0	12.0	12.0	13.6	12.3
— MAJOR CONSTITUENTS —							
CALCIUM (CA) DIS	21.0	19.0		19.0		21.0	19.0
MAGNESIUM (MG) DIS	29.0	23.0		22.0		28.0	25.0
SODIUM (NA) DIS	70.0	59.0		57.0		71.0	67.0
POTASSIUM (K) DIS	5.1	4.0		4.3		4.5	5.0
TOTAL ALKALINITY AS CACO3	208.0	203.0		201.0			213.0
TOTAL ACIDITY AS CACO3	<1.0						
BICARBONATE ALKALINITY AS CACO3	208.0	203.0		201.0		216.0	
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0		<1.0		<1.0	
SULFATE (SO4)	46.0	45.0		46.0		48.0	46.0
CHLORIDE (CL)	27.0	26.0		26.0		27.0	27.0
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) DIS	0.0021	<0.005		<0.005		<0.005	<0.005
ARSENIC (AS) TOT	<0.002	<0.005		<0.005		<0.005	<0.005
ARSENIC +3	<0.005						
ARSENIC +5	<0.005						
CADMIUM (CD) DIS	<0.005	<0.005		<0.005		<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005		<0.005		<0.005	<0.005
COPPER (CU) DIS	<0.005	<0.005		<0.005			<0.005
COPPER (CU) TOT	<0.005	<0.005		<0.005			<0.005
LEAD (PB) DIS	<0.005	<0.005		<0.005		<0.005	<0.005
LEAD (PB) TOT	<0.005	<0.005		<0.005		<0.005	<0.005
ZINC (ZN) DIS	0.027	0.0083 UJ1,J4		0.0067			<0.005
ZINC (ZN) TOT	0.022	0.01 UJ1,J4		0.0067			<0.005
— VOLATILE ORGANICS —							
1,1,1-TRICHLOROETHANE			<.001		<.001		
1,1,2,2-TETRACHLOROETHANE			<.001		<.001		
1,1,2-TRICHLOROETHANE			<.001		<.001		
1,1,2-TRICHLOROTRIFLUOROETHANE			<.002		<.002		
1,1-DICHLOROETHANE			<.001		<.001		
1,1-DICHLOROETHENE			<.001		<.001		
1,2-DICHLOROETHANE			<.001		<.001		
1,2-DICHLOROPROPANE			<.001		<.001		
2,2'-OXYBIS(1-CHLOROPROPANE)			<.001		<.001		
2-BUTANONE (METHYL-ETHYL-KETONE)			<.005		<.005		
2-CHLOROETHYL VINYL ETHER			<.001		<.001		
2-HEXANONE			<.005		<.005		
4-METHYL-2-PENTANONE			<.005		<.005		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5
SAMPLE DATE	02/17/93	04/21/93	04/21/93	04/21/93	04/21/93	06/16/93	09/16/93
SAMPLE TIME	16:30	16:30	16:30	19:00	19:00	14:45	13:55
LAB	TSC-SLC	TSC-SLC	ARI	TSC-SLC	ARI	TSC-SLC	TSC-SLC
LAB NUMBER	93-7248	93-7703	D612B	93-7705	D612C	93-7958	93-8482
REMARKS	DUPLICATE			DUPLICATE	DUPLICATE		
SAMPLE NUMBER	EVT-9302-107	EVT-9304-114	EVT-9304-114	EVT-9304-116	EVT-9304-116	EVT-9306-142	EVT-9309-113
— VOLATILE ORGANICS —							
ACETONE			<.005		<.005		
BENZENE			<.001		<.001		
BROMODICHLOROMETHANE			<.001		<.001		
BROMOFORM			<.001		<.001		
BROMOMETHANE			<.002		<.002		
CARBON DISULFIDE			.0011		<.001		
CARBON TETRACHLORIDE			<.001		<.001		
CHLOROBENZENE			<.001		<.001		
CHLOROETHANE			<.002		<.002		
CHLOROFORM			<.001		<.001		
CHLOROMETHANE			<.002		<.002		
CIS-1,2-DICHLOROETHENE			<.001		<.001		
CIS-1,3-DICHLOROPROPENE			<.001		<.001		
DIBROMOCHLOROMETHANE			<.001		<.001		
ETHYLBENZENE			<.001		<.001		
TOTAL XYLENE TOT			<.002		<.002		
METHYLENE CHLORIDE			<.002		<.002		
STYRENE			<.001		<.001		
TETRACHLOROETHENE			<.001		<.001		
TOLUENE			<.001		<.001		
TRANS-1,2-DICHLOROETHENE			<.001		<.001		
TRANS-1,3-DICHLOROPROPENE			<.001		<.001		
TRICHLOROETHENE			<.001		<.001		
TRICHLOROFLUOROMETHANE			<.002		<.002		
VINYL ACETATE			<.001		<.001		
VINYL CHLORIDE			<.002		<.002		
— SEMI-VOLATILE EXTRACTABLES —							
1,2,4-TRICHLOROBENZENE			<.001		<.001		
1,2-DICHLOROBENZENE			<.001		<.001		
1,3-DICHLOROBENZENE			<.001		<.001		
1,4-DICHLOROBENZENE			<.001		<.001		
2,4,5-TRICHLOROPHENOL			<.005		<.005		
2,4,6-TRICHLOROPHENOL			<.005		<.005		
2,4-DICHLOROPHENOL			<.003		<.003		
2,4-DIMETHYLPHENOL			<.002		<.002		
2,4-DINITROPHENOL			<.01		<.01		
2,4-DINITROTOLUENE			<.005		<.005		
2,6-DINITROTOLUENE			<.005		<.005		
2-CHLORONAPHTHALENE			<.001		<.001		
2-CHLOROPHENOL			<.001		<.001		
2-METHYLNAPHTHALENE			<.001		<.001		
2-METHYLPHENOL (O-CRESOL)			<.001		<.001		
2-NITROANILINE			<.005		<.005		
2-NITROPHENOL			<.005		<.005		
3,3-DICHLOROBENZIDINE			<.005		<.005		
3-NITROANILINE			<.005		<.005		
4,6-DINITRO-2-METHYLPHENOL			<.01		<.01		
4-BROMOPHENYL PHENYL ETHER			<.001		<.001		
4-CHLORO-3-METHYLPHENOL			<.002		<.002		
4-CHLOROANILINE			<.003		<.003		
4-CHLOROPHENYL PHENYL ETHER			<.001		<.001		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5	EV-5
SAMPLE DATE	02/17/93	04/21/93	04/21/93	04/21/93	04/21/93	06/16/93	09/16/93
SAMPLE TIME	16:30	16:30	16:30	19:00	19:00	14:45	13:55
LAB	TSC-SLC	TSC-SLC	ARI	TSC-SLC	ARI	TSC-SLC	TSC-SLC
LAB NUMBER	93-7248	93-7703	D612B	93-7705	D612C	93-7958	93-8482
REMARKS	DUPLICATE			DUPLICATE	DUPLICATE		
SAMPLE NUMBER	EVT-9302-107	EVT-9304-114	EVT-9304-114	EVT-9304-116	EVT-9304-116	EVT-9306-142	EVT-9309-113
-- SEMI-VOLATILE EXTRACTABLES --							
4-METHYLPHENOL (P-CRESOL)			<.001		<.001		
4-NITROANILINE			<.005		<.005		
4-NITROPHENOL			<.005		<.005		
ACENAPHTHENE			<.001		<.001		
ACENAPHTHYLENE			<.001		<.001		
ANTHRACENE			<.001		<.001		
BENZO (A) ANTHRACENE			<.001		<.001		
BENZO (A) PYRENE			<.001		<.001		
BENZO (B) FLUORANTHENE			<.001		<.001		
BENZO (GHI) PERYLENE			<.001		<.001		
BENZO (K) FLUORANTHENE			<.001		<.001		
BENZOIC ACID			<.01		<.01		
BENZYL ALCOHOL			<.005		<.005		
BIS (2-CHLOROETHOXY) METHANE			<.001		<.001		
BIS (2-CHLOROETHYL) ETHER			<.001		<.001		
BIS (2-ETHYLHEXYL) PHTHALATE			.0084		.0021		
BUTYL BENZYL PHTHALATE			<.001		<.001		
CARBAZOLE			<.001		<.001		
CHRYSENE			<.001		<.001		
DI-N-BUTYLPHTHALATE			.0012		.0017		
DI-N-OCTYLPHTHALATE			.0011		<.001		
DIBENZO (A,H) ANTHRACENE			<.001		<.001		
DIBENZOFURAN			<.001		<.001		
DIETHYLPHTHALATE			<.001		<.001		
DIMETHYLPHTHALATE			<.001		<.001		
FLUORANTHENE			<.001		<.001		
FLUORENE			<.001		<.001		
HEXACHLOROBENZENE			<.001		<.001		
HEXACHLOROBUTADIENE			<.002		<.002		
HEXACHLOROCYCLOPENTADIENE			<.005		<.005		
HEXACHLOROETHANE			<.002		<.002		
INDENO (1,2,3-CD) PYRENE			<.001		<.001		
ISOPHORONE			<.001		<.001		
N-NITROSO-DI-N-PROPYLAMINE			<.001		<.001		
N-NITROSODIPHENYLAMINE			<.001		<.001		
NAPHTHALENE			<.001		<.001		
NITROBENZENE			<.001		<.001		
PENTACHLOROPHENOL			<.005		<.005		
PHENANTHRENE			<.001		<.001		
PHENOL			<.002		<.002		
PYRENE			<.001		<.001		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-5	EV-5	EV-6A	EV-6A	EV-6A
SAMPLE DATE	12/29/93	08/23/94	09/16/93	12/28/93	12/28/93
SAMPLE TIME	08:45	14:00	12:15	16:00	17:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-9930	94-1559006	93-8460	94-9924	94-9926
REMARKS					DUPLICATE
OTHER INFO		TOT 94-18536			
SAMPLE NUMBER	EVT-9312-207	EVT-9408-105	EVT-9309-112	EVT-9312-201	EVT-9312-203
— PHYSICAL PARAMETERS —					
DEPTH TO WATER LEVEL (FEET)	6.4	7.87	48.18	47.22	47.22
OXYGEN (O) DIS	4.8		1.3	4.6	4.6
PH (FLD)	6.54	6.55	6.83	6.87	6.87
PH		6.6	6.6		
SC (UMHOS/CM AT 25 C)		577.0	600.0		
SC (UMHOS/CM AT 25 C) (FLD)	676.0	495.0	570.0	553.0	553.0
WATER TEMPERATURE (C) (FLD)	11.2	13.9	13.2	11.2	11.2
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS		18.0	72.0	59.0	56.0
MAGNESIUM (MG) DIS		25.0	18.0	12.0	11.0
SODIUM (NA) DIS		69.0	20.0	17.0	16.0
POTASSIUM (K) DIS		4.4	17.0	16.0	14.0
TOTAL ALKALINITY AS CACO3		208.0	443.0		
TOTAL ACIDITY AS CACO3		13.0			
BICARBONATE ALKALINITY AS CACO3				211.0	208.0
BICARBONATE (HCO3)		253.8			
CARBONATE ALKALINITY AS CACO3				<1.0	<1.0
CARBONATE AS CO3		<1.0			
SULFATE (SO4)		45.0	49.0	53.0	53.0
CHLORIDE (CL)		28.0	11.0	8.2	8.3
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS	<0.005	<0.005 UJ4S	4.973	0.433	0.428
ARSENIC (AS) TOT	<0.005	<0.005 UJ4S	36.097	0.986	0.839
ARSENIC +3			3.516	0.132	0.132
ARSENIC +5			0.228	0.232	0.22
CADMIUM (CD) DIS	<0.005		<0.005	0.017	0.013
CADMIUM (CD) TOT	<0.005		0.558	0.027	0.02
CHROMIUM (CR) DIS		<0.005			
CHROMIUM (CR) TOT		<0.005			
COPPER (CU) DIS	<0.005	0.043 UJ1	0.0071	0.1	0.104
COPPER (CU) TOT	<0.005	0.009 UJ1,J4S	12.078	0.477 J4	0.355
LEAD (PB) DIS	<0.005	<0.005	0.028	0.213	0.2
LEAD (PB) TOT	<0.005	<0.005 UJ4S	51.1	1.389 J4	0.807
ZINC (ZN) DIS	<0.005		2.944	13.095	11.305
ZINC (ZN) TOT	0.008 UJ1/J4		219.333	17.017	15.02

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J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-6B	EV-6B	EV-7A	EV-7A	EV-7A
SAMPLE DATE	09/16/93	12/28/93	09/17/93	12/29/93	08/23/94
SAMPLE TIME	08:55	15:00	13:20	11:35	15:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8459	94-9923	93-8468	94-9938	94-1559010
OTHER INFO					TOT 94-185310
SAMPLE NUMBER	EVT-9309-109	EVT-9312-200	EVT-9309-121	EVT-9312-215	EVT-9408-109
— PHYSICAL PARAMETERS —					
DEPTH TO WATER LEVEL (FEET)	51.84	51.75	2.39	1.43	2.91
OXYGEN (O) DIS	1.86	5.8	3.2	3.8	
PH (FLD)	8.5	7.27	8.95	9.17	8.8
PH	8.7		8.8		8.5
SC (UMHOS/CM AT 25 C)	560.0		580.0		482.0
SC (UMHOS/CM AT 25 C) (FLD)	575.0	536.0	525.0	491.0	458.0
WATER TEMPERATURE (C) (FLD)	12.2	11.6	15.8	9.9	16.5
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS	21.0	21.0 UJ1	87.0	72.0 UJ1	78.0
MAGNESIUM (MG) DIS	46.0	47.0	11.0	9.1 UJ1	10.0
SODIUM (NA) DIS	21.0	22.0 UJ1	26.0	23.0 UJ1	16.0
POTASSIUM (K) DIS	7.5	7.6	20.0	18.0	17.0
TOTAL ALKALINITY AS CACO3	272.0		308.0		226.0
TOTAL ACIDITY AS CACO3					<1.0
BICARBONATE ALKALINITY AS CACO3		245.0		247.0	
BICARBONATE (HCO3)					275.7
CARBONATE ALKALINITY AS CACO3		<1.0		<1.0	
CARBONATE AS CO3					<1.0
SULFATE (SO4)	27.0	50.0	<2.0	15.0	14.0
CHLORIDE (CL)	25.0	22.0	14.0	9.5 UJ1	9.2
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS	<0.005	<0.005	3.329	1.793	2.4 J4S
ARSENIC (AS) TOT	0.12	0.0098	3.093	2.043	2.5 J4S
ARSENIC +3	<0.005	<0.005	2.666 J4	1.707	
ARSENIC +5	<0.005	<0.005	0.446 J4	0.28	
CADMIUM (CD) DIS	<0.005	<0.005	<0.005	<0.005	
CADMIUM (CD) TOT	<0.005	<0.005 J4	<0.005	<0.005	
CHROMIUM (CR) DIS					<0.005
CHROMIUM (CR) TOT					<0.005
COPPER (CU) DIS	<0.005	<0.005	<0.005	0.006	0.015 UJ1

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J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-6B	EV-6B	EV-7A	EV-7A	EV-7A
SAMPLE DATE	09/16/93	12/28/93	09/17/93	12/29/93	08/23/94
SAMPLE TIME	08:55	15:00	13:20	11:35	15:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8459	94-9923	93-8468	94-9938	94-1559010
OTHER INFO					TOT 94-185310
SAMPLE NUMBER	EVT-9309-109	EVT-9312-200	EVT-9309-121	EVT-9312-215	EVT-9408-109
— METALS & MINOR CONSTITUENTS —					
COPPER (CU) TOT	0.585	0.038 J4	0.175	0.041	0.019 UJ1,J4S
LEAD (PB) DIS	<0.005	<0.005	0.022	0.062	0.17
LEAD (PB) TOT	0.484	0.042 J4	2.092	0.513	0.18 J4S
ZINC (ZN) DIS	<0.005	<0.005	0.011	0.016	
ZINC (ZN) TOT	2.028	0.161	3.298	0.587 J4	

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-7B	EV-7B	EV-7B	EV-7B	EV-7B	EV-8A
SAMPLE DATE	09/17/93	09/17/93	12/29/93	08/23/94	08/23/94	09/16/93
SAMPLE TIME	11:45	12:45	11:15	14:30	14:45	14:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8467	93-8469	94-9937	94-1559007	94-1559009	93-8462
REMARKS		DUPLICATE			DUPLICATE	
OTHER INFO				TOT 94-18537	TOT 94-18539	
SAMPLE NUMBER	EVT-9309-120	EVT-9309-122	EVT-9312-214	EVT-9408-106	EVT-9408-108	EVT-9309-115
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	6.56	6.56	6.38	7.58	7.58	2.45
OXYGEN (O) DIS	7.8	7.8	4.8			2.4
PH (FLD)	7.1	7.1	6.65	6.62	6.62	8.52
PH	6.6	6.7		7.1	7.0	8.4
SC (UMHOS/CM AT 25 C)	342.0	348.0		367.0	368.0	570.0
SC (UMHOS/CM AT 25 C) (FLD)	328.0	328.0	368.0	338.0	338.0	558.0
WATER TEMPERATURE (C) (FLD)	12.8	12.8	10.8	14.1	14.1	16.1
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	31.0	30.0	28.0 UJ1	29.0	29.0	77.0
MAGNESIUM (MG) DIS	19.0	19.0	18.0 UJ1	20.0	19.0	12.0
SODIUM (NA) DIS	12.0	12.0	14.0 UJ1	14.0	14.0	26.0
POTASSIUM (K) DIS	<5.0	<5.0	<5.0	4.2	4.3	16.0
TOTAL ALKALINITY AS CACO3	96.0	98.0		100.0	100.0	295.0
TOTAL ACIDITY AS CACO3				<1.0	<1.0	
BICARBONATE ALKALINITY AS CACO3			105.0			
BICARBONATE (HCO3)				122.0	122.0	
CARBONATE ALKALINITY AS CACO3			<1.0			
CARBONATE AS CO3				<1.0	<1.0	
SULFATE (SO4)	41.0	42.0	41.0	41.0	41.0	<2.0
CHLORIDE (CL)	15.0	16.0	16.0	15.0	15.0	8.1
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	3.954	3.952	4.858	6.1 J4S	5.9	1.862
ARSENIC (AS) TOT	3.757	3.655	5.253	6.4 J4S	6.6	1.693
ARSENIC +3	<0.005 UJ4	3.058	<0.005			1.54
ARSENIC +5	3.856 J4	0.984	5.19			0.143
CADMIUM (CD) DIS	<0.005	<0.005	<0.005			<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005			<0.005
CHROMIUM (CR) DIS				<0.005	<0.005	
CHROMIUM (CR) TOT				<0.005	<0.005	
COPPER (CU) DIS	<0.005	<0.005	<0.005	0.012 UJ1	0.008	<0.005
COPPER (CU) TOT	0.0096	0.0084	0.006	0.008 UJ1,J4S	0.007	0.078

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-7B	EV-7B	EV-7B	EV-7B	EV-7B	EV-8A
SAMPLE DATE	09/17/93	09/17/93	12/29/93	08/23/94	08/23/94	09/16/93
SAMPLE TIME	11:45	12:45	11:15	14:30	14:45	14:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8467	93-8469	94-9937	94-1559007	94-1559009	93-8462
REMARKS		DUPLICATE			DUPLICATE	
OTHER INFO				TOT 94-18537	TOT 94-18539	
SAMPLE NUMBER	EVT-9309-120	EVT-9309-122	EVT-9312-214	EVT-9408-106	EVT-9408-108	EVT-9309-115
— METALS & MINOR CONSTITUENTS —						
LEAD (PB) DIS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
LEAD (PB) TOT	<0.005	<0.005	<0.005	<0.005 UJ4S	<0.005	0.578
ZINC (ZN) DIS	<0.005	<0.005	<0.005			<0.005
ZINC (ZN) TOT	0.014	0.018	0.0095 UJ1/J4			1.233

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-8A	EV-8A	EV-8B	EV-8B	EV-8B	EV-8B
SAMPLE DATE	12/29/93	08/24/94	09/16/93	09/16/93	12/29/93	12/29/93
SAMPLE TIME	09:45	09:00	14:25	15:00	09:15	10:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-9932	94-1559013	93-8461	93-8463	94-9931	94-9933
REMARKS				DUPLICATE		DUPLICATE
OTHER INFO		TOT 94-185313				
SAMPLE NUMBER	EVT-9312-209	EVT-9408-112	EVT-9309-114	EVT-9309-116	EVT-9312-208	EVT-9312-210
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	1.79	3.31	5.76	5.76	7.05	7.05
OXYGEN (O) DIS	1.8		4.2	4.2	6.0	6.0
PH (FLD)	8.81	8.05	6.95	6.95	7.06	7.06
PH		8.2	7.0	7.0		
SC (UMHOS/CM AT 25 C)		576.0	500.0	482.0		
SC (UMHOS/CM AT 25 C) (FLD)	515.0	577.0	465.0	465.0	463.0	463.0
WATER TEMPERATURE (C) (FLD)	9.6	17.1	12.7	12.7	10.9	10.9
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	64.0 UJ1	82.0	21.0	21.0	23.0 UJ1	23.0
MAGNESIUM (MG) DIS	8.3 UJ1	11.0	31.0	30.0	32.0	32.0
SODIUM (NA) DIS	15.0 UJ1	25.0	42.0	41.0	34.0 UJ1	39.0
POTASSIUM (K) DIS	9.2	15.0	5.6	5.7	5.7	5.9
TOTAL ALKALINITY AS CACO3		284.0	192.0	190.0		
TOTAL ACIDITY AS CACO3		<1.0				
BICARBONATE ALKALINITY AS CACO3	209.0 UJ1				200.0 UJ1	200.0
BICARBONATE (HCO3)		346.5				
CARBONATE ALKALINITY AS CACO3	<1.0				<1.0	<1.0
CARBONATE AS CO3		<1.0				
SULFATE (SO4)	19.0	6.3	32.0	36.0	24.0	26.0
CHLORIDE (CL)	4.4	9.9	31.0	29.0	35.0	34.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	1.375	1.9 J4S	16.02	16.43	9.448	8.92
ARSENIC (AS) TOT	1.875	2.1 J4S	14.637	14.665	9.85	9.018
ARSENIC +3	1.332		12.455	12.91	10.01	10.035
ARSENIC +5	0.13		2.368	2.137	1.279	1.37
CADMIUM (CD) DIS	<0.005		<0.005	<0.005	<0.005	<0.005
CADMIUM (CD) TOT	<0.005		<0.005	<0.005	<0.005	<0.005
CHROMIUM (CR) DIS		<0.005				
CHROMIUM (CR) TOT		<0.005				
COPPER (CU) DIS	<0.005	0.008 UJ1,J4D	<0.005	<0.005	<0.005	<0.005
COPPER (CU) TOT	0.29	0.027 UJ1,J4D,J4S	<0.005	<0.005	0.007	<0.005
LEAD (PB) DIS	<0.005	0.15	<0.005	<0.005	<0.005	<0.005
LEAD (PB) TOT	2.142	0.13 J4S	<0.005	<0.005	<0.005	<0.005

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-8A	EV-8A	EV-8B	EV-8B	EV-8B	EV-8B
SAMPLE DATE	12/29/93	08/24/94	09/16/93	09/16/93	12/29/93	12/29/93
SAMPLE TIME	09:45	09:00	14:25	15:00	09:15	10:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-9932	94-1559013	93-8461	93-8463	94-9931	94-9933
REMARKS				DUPLICATE		DUPLICATE
OTHER INFO		TOT 94-185313				
SAMPLE NUMBER	EVT-9312-209	EVT-9408-112	EVT-9309-114	EVT-9309-116	EVT-9312-208	EVT-9312-210
— METALS & MINOR CONSTITUENTS —						
ZINC (ZN) DIS	<0.005		<0.005	<0.005	<0.005	<0.005
ZINC (ZN) TOT	4.003		<0.005	<0.005	0.013	<0.005
	J4				UJ1/J4	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-8B	EV-8B	EV-9A	EV-9A	EV-9A
SAMPLE DATE	08/24/94	08/24/94	09/17/93	12/29/93	08/24/94
SAMPLE TIME	10:30	11:00	10:55	10:30	08:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-1559015	94-1559017	93-8465	94-9935	94-1559012
REMARKS		DUPLICATE			
OTHER INFO	TOT 94-185315	TOT 94-185317			TOT 94-185312
SAMPLE NUMBER	EVT-9408-114	EVT-9408-116	EVT-9309-118	EVT-9312-212	EVT-9408-111
— PHYSICAL PARAMETERS —					
DEPTH TO WATER LEVEL (FEET)	7.49	7.49	6.64	2.51	4.42
OXYGEN (O) DIS			5.4	2.6	
PH (FLD)	6.72	6.72	7.44	7.26	6.25
PH	7.3	7.4	7.0		7.1
SC (UMHOS/CM AT 25 C)	524.0	528.0	1330.0		1366.0
SC (UMHOS/CM AT 25 C) (FLD)	537.0	537.0	1477.0	1614.0	1298.0
WATER TEMPERATURE (C) (FLD)	14.3	14.3	15.9	13.1	14.7
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS	20.0	20.0	103.0	107.0	114.0
MAGNESIUM (MG) DIS	28.0	27.0	38.0	32.0	34.0
SODIUM (NA) DIS	46.0	45.0	111.0	100.0	106.0
POTASSIUM (K) DIS	5.6	5.5	50.0	45.0	51.0
TOTAL ALKALINITY AS CACO3	164.0	164.0	674.0		596.0
TOTAL ACIDITY AS CACO3	<1.0	<1.0			<1.0
BICARBONATE ALKALINITY AS CACO3				662.0	
BICARBONATE (HCO3)	200.1	200.1			727.1
CARBONATE ALKALINITY AS CACO3				<1.0	
CARBONATE AS CO3	<1.0	<1.0			<1.0
SULFATE (SO4)	42.0	42.0	<2.0	15.0	13.0
CHLORIDE (CL)	34.0	34.0	63.0	61.0	63.0
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS	3.3 J4S	3.4	2.262	1.875	2.2 J4S
ARSENIC (AS) TOT	3.6 J4S	3.6	2.083	5.27	2.4 J4S
ARSENIC +3			1.75	1.532	
ARSENIC +5			0.264	0.272	
CADMIUM (CD) DIS			<0.005	<0.005	
CADMIUM (CD) TOT			<0.005	0.013	
CHROMIUM (CR) DIS	<0.005	<0.005			<0.005
CHROMIUM (CR) TOT	<0.005 UJ4S	<0.005			0.006 J4S
COPPER (CU) DIS	0.015 UJ1,J4D	0.008	<0.005	<0.005	0.013 UJ1,J4D
COPPER (CU) TOT	0.014 UJ1,J4D,J4S	0.008	0.045	1.636	0.067 J4D,J4S
LEAD (PB) DIS	<0.005	<0.005	<0.005	<0.005	0.18
LEAD (PB) TOT	<0.005 UJ4S	<0.005	0.103	5.31	0.16 J4S
ZINC (ZN) DIS			0.168	0.117	
ZINC (ZN) TOT			0.503	13.468	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	EV-9B	EV-9B	EV-9B	MW-1	MW-1	MW-1
SAMPLE DATE	09/16/93	12/29/93	08/23/94	02/04/93	02/17/93	04/21/93
SAMPLE TIME	15:35	10:15	16:00	19:45	11:10	10:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC	TSC-SLC
LAB NUMBER	93-8464	94-9934	94-1559011	30051-5	93-7242	93-7699
OTHER INFO			TOT 94-185311			
SAMPLE NUMBER	EVT-9309-117	EVT-9312-211	EVT-9408-110	EVT-9302-904	EVT-9302-100	EVT-9304-110
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	8.29	7.21	8.48		9.96	8.93
OXYGEN (O) DIS	5.8	2.8			4.5	4.8
PH (FLD)	6.31	6.36	6.56		6.65	6.81
PH	6.6		7.1		6.6	7.72
SC (UMHOS/CM AT 25 C)	382.0		391.0		212.0	230.0
SC (UMHOS/CM AT 25 C) (FLD)	370.0	489.0	346.0			220.0
WATER TEMPERATURE (C) (FLD)	13.0	11.6	13.3		10.9	11.2
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	25.0	26.0 UJ1	25.0		17.0	15.0
MAGNESIUM (MG) DIS	24.0	24.0	23.0		8.7	7.1
SODIUM (NA) DIS	18.0	18.0 UJ1	18.0		12.0	15.0
POTASSIUM (K) DIS	<5.0	<5.0	2.6		2.0	1.8
TOTAL ALKALINITY AS CACO3	134.0		134.0		45.0	46.0
TOTAL ACIDITY AS CACO3			<1.0		<1.0	
BICARBONATE ALKALINITY AS CACO3		135.0			45.0	46.0
BICARBONATE (HCO3)			163.5			
CARBONATE ALKALINITY AS CACO3		<1.0			<1.0	<1.0
CARBONATE AS CO3			<1.0			
SULFATE (SO4)	26.0	27.0	27.0		30.0	33.0
CHLORIDE (CL)	20.0	18.0	19.0		7.8	6.7
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.533	0.916	0.89 J4S		<0.002	<0.005
ARSENIC (AS) TOT	0.495	1.058	0.93 J4S	<0.01	<0.002	<0.005
ARSENIC +3		<0.005			<0.005	
ARSENIC +5		0.932			<0.005	
CADMIUM (CD) DIS	<0.005	<0.005			<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005		<0.005	<0.005	<0.005
CHROMIUM (CR) DIS			<0.005			
CHROMIUM (CR) TOT			<0.005			
COPPER (CU) DIS	<0.005	<0.005	0.017 UJ1		<0.005	0.0079
COPPER (CU) TOT	<0.005	<0.005	0.013 UJ1,J4S		0.0051	0.014
LEAD (PB) DIS	<0.005	<0.005	<0.005		<0.005	<0.005
LEAD (PB) TOT	<0.005	<0.005	<0.005 UJ4S	0.007	<0.005	<0.005
ZINC (ZN) DIS	<0.005	<0.005			0.011	0.005
ZINC (ZN) TOT	<0.005	0.0057 UJ1/J4			0.055 UJ1	0.025 UJ1,J4

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
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Sample Type: Monitoring Wells

SITE CODE	MW-1	MW-1	MW-1	MW-2	MW-2	MW-2
SAMPLE DATE	06/16/93	09/16/93	08/23/94	04/14/93	04/22/93	06/16/93
SAMPLE TIME	08:25	10:45	11:45	16:45	13:00	12:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC	TSC-SLC
LAB NUMBER	93-7947	93-8481	94-1559005	31447-5	93-7708	93-7953
OTHER INFO			TOT 94-18535			
SAMPLE NUMBER	EVT-9306-130	EVT-9309-111	EVT-9408-104	EVT-9304-904	EVT-9304-119	EVT-9306-137
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	9.22	10.7	11.01	2.53	2.79	2.86
OXYGEN (O) DIS	6.8	7.6			1.7	2.6
PH (FLD)	6.54	6.79	6.59	7.4	7.66	7.45
PH		6.9	7.6		7.33	
SC (UMHOS/CM AT 25 C)		205.0	202.0		2300.0	
SC (UMHOS/CM AT 25 C) (FLD)	208.0	213.0	198.0	2000.0	2870.0	2240.0
WATER TEMPERATURE (C) (FLD)	11.0	11.8	13.0	10.8	10.2	13.8
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	16.0	16.0	15.0		425.0	386.0
MAGNESIUM (MG) DIS	8.2	8.0	8.1		42.0	44.0
SODIUM (NA) DIS	14.0	12.0	10.0		57.0	67.0
POTASSIUM (K) DIS	1.8	<5.0	1.8		25.0	30.0
TOTAL ALKALINITY AS CACO3		42.0	40.0		347.0	
TOTAL ACIDITY AS CACO3			<1.0			
BICARBONATE ALKALINITY AS CACO3	48.0				347.0	684.0
BICARBONATE (HCO3)			48.8			
CARBONATE ALKALINITY AS CACO3	<1.0				<1.0	<1.0
CARBONATE AS CO3			<1.0			
SULFATE (SO4)	33.0	32.0	32.0		709.0	663.0
CHLORIDE (CL)	6.7	7.3	7.0		63.0	51.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	<0.005	<0.005	<0.005 UJ4S		0.04	0.037
ARSENIC (AS) TOT	<0.005	<0.005	<0.005 UJ4S	<0.1	0.04	0.054
ARSENIC +3					0.026	0.029
ARSENIC +5					0.005	<0.005
CADMIUM (CD) DIS	<0.005	<0.005			<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005		<0.005	<0.005	<0.005
CHROMIUM (CR) DIS			<0.005			
CHROMIUM (CR) TOT			0.005			
COPPER (CU) DIS		<0.005	0.007		<0.005	
COPPER (CU) TOT		<0.005	0.007		0.027	
LEAD (PB) DIS	<0.005	<0.005	<0.005		<0.005	<0.005
LEAD (PB) TOT	<0.005	<0.005	<0.005 UJ4S	0.34	0.069	0.157
ZINC (ZN) DIS		0.0058			0.012	
ZINC (ZN) TOT		0.006			0.097	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
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Sample Type: Monitoring Wells

SITE CODE	MW-2	MW-2	MW-2	MW-3	MW-3	MW-3
SAMPLE DATE	09/15/93	08/23/94	08/23/94	04/14/93	04/22/93	06/16/93
SAMPLE TIME	15:20	10:15	10:15	10:40	12:35	12:20
LAB	TSC-SLC	EMCON	TSC-SLC	SAS	TSC-SLC	TSC-SLC
LAB NUMBER	93-8476	33750	94-1559002	31447-1	93-7707	93-7952
REMARKS		SPLIT				
OTHER INFO			TOT 94-18532			
SAMPLE NUMBER	EVT-9309-103	EVT-9408-101	EVT-9408-101	EVT-9304-900	EVT-9304-118	EVT-9306-136
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	4.0	5.0	5.0	0.13	0.32	0.42
OXYGEN (O) DIS	1.8				2.2	2.4
PH (FLD)	7.58	7.31	7.31	6.75	6.9	6.62
PH	7.1		7.7		7.69	
SC (UMHOS/CM AT 25 C)	2180.0		2310.0		400.0	
SC (UMHOS/CM AT 25 C) (FLD)	2220.0	2030.0	2030.0	306.0	479.0	509.0
WATER TEMPERATURE (C) (FLD)	15.8	17.6	17.6	11.7	10.7	15.3
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	358.0	394.0	379.0		49.0	65.0
MAGNESIUM (MG) DIS	43.0	48.1	47.0		9.9	13.0
SODIUM (NA) DIS	68.0	82.9	80.0		14.0	21.0
POTASSIUM (K) DIS	33.0	35.2	37.0		5.6	7.0
TOTAL ALKALINITY AS CACO3	707.0		732.0		169.0	
TOTAL ACIDITY AS CACO3			<1.0			
BICARBONATE ALKALINITY AS CACO3					169.0	224.0
BICARBONATE (HCO3)			893.0			
CARBONATE ALKALINITY AS CACO3					<1.0	<1.0
CARBONATE AS CO3			<1.0			
SULFATE (SO4)	600.0		538.0		21.0	9.0
CHLORIDE (CL)	52.0		56.0		6.5	11.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.052	0.0481	<0.005 UJ4S		<0.005	0.0059
ARSENIC (AS) TOT	0.038	0.048	0.049 J4S	<0.1	<0.005	0.0084
ARSENIC +3					0.007	
ARSENIC +5					<0.005	
CADMIUM (CD) DIS	<0.005				<0.005	<0.005
CADMIUM (CD) TOT	<0.005			<0.005	<0.005	<0.005
CHROMIUM (CR) DIS		0.00091	<0.005			
CHROMIUM (CR) TOT		0.0085	0.025			
COPPER (CU) DIS	0.0071	0.0011	0.01 UJ1		<0.005	
COPPER (CU) TOT	0.012	0.0112	0.012 UJ1,J4S		<0.005	
LEAD (PB) DIS	<0.025	0.0006	<0.005		<0.005	<0.005
LEAD (PB) TOT	0.0059	0.0137	0.026 J4S	<0.05	<0.005	<0.005
ZINC (ZN) DIS	<0.005				0.01	
ZINC (ZN) TOT	0.009				0.01	

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
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Sample Type: Monitoring Wells

SITE CODE	MW-3	MW-3	MW-3	MW-3	MW-4A	MW-4A
SAMPLE DATE	09/15/93	12/29/93	08/23/94	08/23/94	04/14/93	04/22/93
SAMPLE TIME	14:50	12:10	10:50	10:50	11:40	12:10
LAB	TSC-SLC	TSC-SLC	EMCON	TSC-SLC	SAS	TSC-SLC
LAB NUMBER	93-8474	94-9939	33752	94-1559003	31447-2	93-7706
REMARKS			SPLIT			
OTHER INFO				TOT 94-18533		
SAMPLE NUMBER	EVT-9309-101	EVT-9312-216	EVT-9408-102	EVT-9408-102	EVT-9304-901	EVT-9304-117
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	1.75	0.41	8.6	8.6	0.36	0.63
OXYGEN (O) DIS	1.6	2.4				2.5
PH (FLD)	6.89	6.62	6.65	6.65	6.58	6.75
PH	6.6			7.9		7.74
SC (UMHOS/CM AT 25 C)	460.0			536.0		340.0
SC (UMHOS/CM AT 25 C) (FLD)	502.0	473.0	549.0	549.0	283.0	422.0
WATER TEMPERATURE (C) (FLD)	17.6	8.2	20.4	20.4	12.1	10.4
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	58.0		56.0	66.0		28.0
MAGNESIUM (MG) DIS	13.0		13.0	15.0		11.0
SODIUM (NA) DIS	20.0		21.0	24.0		20.0
POTASSIUM (K) DIS	7.6		8.14	9.3		2.6
TOTAL ALKALINITY AS CACO3	230.0			252.0		154.0
TOTAL ACIDITY AS CACO3				<1.0		
BICARBONATE ALKALINITY AS CACO3						154.0
BICARBONATE (HCO3)				307.4		
CARBONATE ALKALINITY AS CACO3						<1.0
CARBONATE AS CO3				<1.0		
SULFATE (SO4)	<2.0			2.8		14.0
CHLORIDE (CL)	9.6			11.0		4.6
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.0091	<0.005	0.0078	0.005 J4S		<0.005
ARSENIC (AS) TOT	0.0084	0.013	0.0067	0.008 J4S	<0.1	<0.005
ARSENIC +3						0.006
ARSENIC +5						<0.005
CADMIUM (CD) DIS	<0.005	<0.005				<0.005
CADMIUM (CD) TOT	<0.005	<0.005			<0.005	<0.005
CHROMIUM (CR) DIS			0.00085	<0.005		
CHROMIUM (CR) TOT			0.0019	<0.005		
COPPER (CU) DIS	<0.005	<0.005	0.0011	0.01 UJ1		<0.005
COPPER (CU) TOT	<0.005	<0.005	0.0015	0.012 UJ1,J4S		0.0058
LEAD (PB) DIS	<0.005	<0.005	0.0006	<0.005		0.0058
LEAD (PB) TOT	<0.005	<0.005	0.00085	<0.005 UJ4S	<0.05	0.011
ZINC (ZN) DIS	<0.005	<0.005				0.0083
ZINC (ZN) TOT	<0.005	0.0082 UJ1/J4				0.012 UJ1,J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	MW-4A	MW-4A	MW-4A	MW-4A	MW-4B	MW-4B
SAMPLE DATE	06/16/93	09/17/93	12/29/93	08/23/94	04/14/93	04/21/93
SAMPLE TIME	13:20	15:30	12:30	11:15	13:55	18:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC
LAB NUMBER	93-7954	93-8483	94-9940	94-1559004	31447-3	93-7704
OTHER INFO				TOT 94-18534		
SAMPLE NUMBER	EVT-9306-138	EVT-9309-126	EVT-9312-217	EVT-9408-103	EVT-9304-902	EVT-9304-115
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	0.74	1.99	0.58	7.0	5.52	6.56
OXYGEN (O) DIS	2.6	2.8	2.8			2.2
PH (FLD)	6.57	6.79	6.9	6.56	6.8	6.85
PH		6.7		7.6		7.97
SC (UMHOS/CM AT 25 C)		370.0		387.0		1000.0
SC (UMHOS/CM AT 25 C) (FLD)	405.0	422.0	449.0	408.0	682.0	810.0
WATER TEMPERATURE (C) (FLD)	15.9	17.9	8.5	20.7	14.3	12.7
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	38.0	39.0		35.0		28.0
MAGNESIUM (MG) DIS	14.0	14.0		15.0		35.0
SODIUM (NA) DIS	22.0	20.0		25.0		115.0
POTASSIUM (K) DIS	3.4	<5.0		4.3		9.3
TOTAL ALKALINITY AS CACO3		184.0		156.0		336.0
TOTAL ACIDITY AS CACO3				<1.0		
BICARBONATE ALKALINITY AS CACO3	160.0					336.0
BICARBONATE (HCO3)				190.3		
CARBONATE ALKALINITY AS CACO3	<1.0					<1.0
CARBONATE AS CO3				<1.0		
SULFATE (SO4)	17.0	<2.0		21.0		13.0
CHLORIDE (CL)	5.2	7.4		6.8		101.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	<0.005	0.0058	<0.005	<0.005 UJ4S		2.62
ARSENIC (AS) TOT	<0.005	0.014	0.0073	0.005 J4S	<0.1	2.62
ARSENIC +3						1.87
ARSENIC +5						0.043
CADMIUM (CD) DIS	<0.005	<0.005	<0.005			<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005		<0.005	<0.005
CHROMIUM (CR) DIS				<0.005		
CHROMIUM (CR) TOT				<0.005		
COPPER (CU) DIS		<0.005	<0.005	0.01		<0.005
COPPER (CU) TOT		0.015	0.007	0.014		0.0052
LEAD (PB) DIS	<0.005	<0.005	<0.005	<0.005		<0.005
LEAD (PB) TOT	<0.005	0.034	0.017	<0.005 UJ4S	<0.05	<0.005
ZINC (ZN) DIS		<0.005	<0.005			0.013
ZINC (ZN) TOT		0.025	0.016			0.017

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	MW-4B	MW-4B	MW-4B	MW-4B	MW-4B	MW-5
SAMPLE DATE	06/16/93	06/16/93	06/16/93	07/16/93	09/17/93	04/14/93
SAMPLE TIME	13:50	14:10	14:10	08:00	15:00	15:00
LAB	TSC-SLC	SAS	TSC-SLC	SAS	TSC-SLC	SAS
LAB NUMBER	93-7955	33022	93-7957	33022-1	93-8472	31447-4
REMARKS		SPLIT	DUPLICATE			
SAMPLE NUMBER	EVT-9306-139	EVT-9306-141	EVT-9306-141	MW-4B	EVT-9309-125	EVT-9304-903
— PHYSICAL PARAMETERS —						
DEPTH TO WATER LEVEL (FEET)	7.59	7.59	7.59		7.0	0.85
OXYGEN (O) DIS	2.6		2.6		2.4	
PH (FLD)	6.97	6.97	6.97		7.12	6.75
PH					6.9	
SC (UMHOS/CM AT 25 C)					1150.0	
SC (UMHOS/CM AT 25 C) (FLD)	990.0	990.0	990.0		1140.0	264.0
WATER TEMPERATURE (C) (FLD)	13.7	13.7	13.7		13.4	10.0
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	26.0		26.0		27.0	
MAGNESIUM (MG) DIS	41.0		40.0		45.0	
SODIUM (NA) DIS	148.0		139.0		140.0	
POTASSIUM (K) DIS	9.3		9.1		10.0	
TOTAL ALKALINITY AS CACO3					387.0	
BICARBONATE ALKALINITY AS CACO3	358.0		342.0			
CARBONATE ALKALINITY AS CACO3	<1.0		<1.0			
SULFATE (SO4)	9.9		15.0		12.0	
CHLORIDE (CL)	109.0		103.0		119.0	
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	2.697		2.7		2.713	
ARSENIC (AS) TOT	2.704	2.5	2.726	2.5	2.775	<0.1
ARSENIC +3	1.039		1.074		0.613 J4	
ARSENIC +5	0.045		0.04		0.036 J4	
CADMIUM (CD) DIS	<0.005		<0.005		<0.005	
CADMIUM (CD) TOT	<0.005		<0.005		<0.005	<0.005
COPPER (CU) DIS					<0.005	
COPPER (CU) TOT					0.02	
LEAD (PB) DIS	<0.005		<0.005		<0.005	
LEAD (PB) TOT	<0.005	<0.05	<0.005	<0.05	0.0064	<0.05
ZINC (ZN) DIS					<0.005	
ZINC (ZN) TOT					0.022	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	MW-5	MW-5	MW-5	MW-5	MW-5	MW-5	MW-5
SAMPLE DATE	04/22/93	06/16/93	09/15/93	09/15/93	12/29/93	08/23/94	08/23/94
SAMPLE TIME	13:45	11:55	14:10	14:10	13:00	09:25	09:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	EMCON	TSC-SLC
LAB NUMBER	93-7709	93-7951	93-8473	93-8475	94-9941	33751	94-1559001
REMARKS				DUPLICATE		SPLIT	
OTHER INFO							TOT 94-18531
SAMPLE NUMBER	EVT-9304-120	EVT-9306-135	EVT-9309-100	EVT-9309-102	EVT-9312-218	EVT-9408-100	EVT-9408-100
— PHYSICAL PARAMETERS —							
DEPTH TO WATER LEVEL (FEET)	1.0	1.13	1.46	1.4	1.48	3.33	3.33
OXYGEN (O) DIS	1.7	2.6	2.0	2.0	2.4		
PH (FLD)	7.16	6.79	7.0	7.0	7.5	6.29	6.29
PH	7.62		6.6	6.6			8.1
SC (UMHOS/CM AT 25 C)	330.0		365.0	370.0			598.0
SC (UMHOS/CM AT 25 C) (FLD)	336.0	426.0	394.0	394.0	458.0	577.0	577.0
WATER TEMPERATURE (C) (FLD)	15.2	15.2	65.4	65.4	8.2	20.3	20.3
— MAJOR CONSTITUENTS —							
CALCIUM (CA) DIS	34.0	52.0	39.0	40.0		63.5	74.0
MAGNESIUM (MG) DIS	7.4	11.0	8.6	8.8		13.3	15.0
SODIUM (NA) DIS	18.0	23.0	21.0	23.0		22.5	24.0
POTASSIUM (K) DIS	6.5	8.8	9.0	9.3		11.3	12.0
TOTAL ALKALINITY AS CACO3	154.0		179.0	181.0			200.0
TOTAL ACIDITY AS CACO3							<1.0
BICARBONATE ALKALINITY AS CACO3	154.0	192.0					
BICARBONATE (HCO3)							244.0
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0					
CARBONATE AS CO3							<1.0
SULFATE (SO4)	11.0	14.0	6.4	8.1			87.0
CHLORIDE (CL)	8.4	11.0	6.1	6.8			9.6
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) DIS	<0.005	<0.005	<0.005	<0.005	<0.005	0.0039	<0.005 UJ4S
ARSENIC (AS) TOT	0.0088	<0.005	<0.005	<0.005	<0.005	0.0159	0.006 J4S
ARSENIC +3	0.005						
ARSENIC +5	<0.005						
CADMIUM (CD) DIS	<0.005	<0.005	<0.005	<0.005	<0.005		
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<0.005	<0.005		
CHROMIUM (CR) DIS						0.0011	<0.005
CHROMIUM (CR) TOT						0.0061	<0.005
COPPER (CU) DIS	<0.005		<0.005	<0.005	<0.005	0.0011	0.01 UJ1,J4S
COPPER (CU) TOT	0.0053		<0.005	<0.005	<0.005	0.0093	0.012 UJ1
LEAD (PB) DIS	<0.005	<0.005	<0.005	<0.005	<0.005	0.0006	<0.005
LEAD (PB) TOT	0.0079	<0.005	<0.005	<0.005	<0.005	0.0107	0.005 J4S
ZINC (ZN) DIS	0.01 UJ1,J4		<0.005	<0.005	<0.005		
ZINC (ZN) TOT	0.013 UJ1,J4		<0.005	<0.005	<0.005 J4		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	WP-1	WP-1	WP-1	WP-1	WP-1	WP-1	WP-1
SAMPLE DATE	02/17/93	04/22/93	04/22/93	06/16/93	09/17/93	12/29/93	08/24/94
SAMPLE TIME	18:10	15:00	15:30	15:05	14:00	10:45	09:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7247	93-7710	93-7711	93-7959	93-8470	94-9936	94-1559014
REMARKS			DUPLICATE				
OTHER INFO							TOT 94-185314
SAMPLE NUMBER	EVT-9302-106	EVT-9304-121	EVT-9304-122	EVT-9306-143	EVT-9309-123	EVT-9312-213	EVT-9408-113
— PHYSICAL PARAMETERS —							
DEPTH TO WATER LEVEL (FEET)	5.17	5.03	5.03	4.65	5.5	4.52	6.03
OXYGEN (O) DIS	2.8	2.0	2.0	3.4	3.5	2.4	
PH (FLD)	7.92	8.0	8.0	7.53	7.74	8.06	7.76
PH	7.4	7.82			7.3		7.4
SC (UMHOS/CM AT 25 C)	580.0	600.0			900.0		820.0
SC (UMHOS/CM AT 25 C) (FLD)		558.0	558.0	751.0	755.0	802.0	1433.0
WATER TEMPERATURE (C) (FLD)	10.1	14.9	14.9	14.0	15.8	12.2	16.6
— MAJOR CONSTITUENTS —							
CALCIUM (CA) DIS	61.0	52.0		93.0	98.0		85.0
MAGNESIUM (MG) DIS	12.0	8.5		16.0	18.0		15.0
SODIUM (NA) DIS	47.0	42.0		51.0	54.0		55.0
POTASSIUM (K) DIS	20.0	20.0		27.0	31.0		31.0
TOTAL ALKALINITY AS CACO3	284.0	264.0			462.0		388.0
TOTAL ACIDITY AS CACO3	<1.0						<1.0
BICARBONATE ALKALINITY AS CACO3	284.0	264.0		376.0			
BICARBONATE (HCO3)							473.4
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0		<1.0			
CARBONATE AS CO3							<1.0
SULFATE (SO4)	17.0	13.0		23.0	<2.0		6.3
CHLORIDE (CL)	14.0	12.0		19.0	21.0		17.0
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) DIS	0.768	0.65		0.895	0.848	0.91	1.1 J4S
ARSENIC (AS) TOT	1.227	0.7		0.919	1.221	0.991	1.2 J4S
ARSENIC +3	0.485	0.715	0.914	0.754	0.604 J4	0.73	
ARSENIC +5	0.093	0.106	0.126	0.107	0.166 J4	0.142	
CADMIUM (CD) DIS	<0.005	<0.005		<0.005	<0.005	<0.005	
CADMIUM (CD) TOT	<0.005	0.005		<0.005	<0.005	<0.005	
CHROMIUM (CR) DIS							<0.005
CHROMIUM (CR) TOT							<0.005
COPPER (CU) DIS	<0.005	<0.005			<0.005	<0.005	0.012 UJ1,J4D
COPPER (CU) TOT	0.0057	0.013			0.0084	<0.005	0.018 UJ1,J4D,J4S
LEAD (PB) DIS	0.006	0.0057		<0.005	<0.005	<0.005	0.03
LEAD (PB) TOT	0.026	0.013		0.012	0.046	0.014	0.045 J4S
ZINC (ZN) DIS	0.044	0.033 UJ1,J4			0.02	0.016	

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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Monitoring Wells

SITE CODE	WP-1	WP-1	WP-1	WP-1	WP-1	WP-1	WP-1
SAMPLE DATE	02/17/93	04/22/93	04/22/93	06/16/93	09/17/93	12/29/93	08/24/94
SAMPLE TIME	18:10	15:00	15:30	15:05	14:00	10:45	09:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7247	93-7710	93-7711	93-7959	93-8470	94-9936	94-1559014
REMARKS			DUPLICATE				
OTHER INFO							TOT 94-185314
SAMPLE NUMBER	EVT-9302-106	EVT-9304-121	EVT-9304-122	EVT-9306-143	EVT-9309-123	EVT-9312-213	EVT-9408-113
— METALS & MINOR CONSTITUENTS —							
ZINC (ZN) TOT	0.075 UJ1	0.045 UJ1,J4			0.191	0.073 J4	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Quality Control

SITE CODE	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK
SAMPLE DATE	02/17/93	03/18/93	03/22/93	03/23/93	04/22/93	09/15/93	09/16/93
SAMPLE TIME	19:00	12:00	18:20	08:20	16:00	18:20	15:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7249	93-7586	93-7602	93-7605	93-7712	93-8478	93-8466
REMARKS					BLANK	BLANK	BLANK
SAMPLE NUMBER	EVT-9302-108	EVT-9303-156	EVT-9303-175	EVT-9303-178	EVT-9304-123	EVT-9309-107	EVT-9309-119
— PHYSICAL PARAMETERS —							
PH	5.3	5.9			6.41	5.6	5.2
SC (UMHOS/CM AT 25 C)	<10.0	<10.0			<5.0	<10.0	<10.0
— MAJOR CONSTITUENTS —							
CALCIUM (CA) DIS	<.1	<4.0			<.1	<5.0	<5.0
MAGNESIUM (MG) DIS	<.1	<4.0			<.1	<5.0	<5.0
SODIUM (NA) DIS	<2.0	<4.0			<1.0	<5.0	<5.0
POTASSIUM (K) DIS	<2.0	<4.0			<1.0	<5.0	<5.0
TOTAL ALKALINITY AS CACO3	<1.0	<1.0			<1.0	<1.0	<1.0
TOTAL ACIDITY AS CACO3	2.3					<1.0	<1.0
BICARBONATE ALKALINITY AS CACO3	<1.0	<1.0			<1.0		
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0			<1.0		
SULFATE (SO4)	<2.0	<2.0			<2.0	<2.0	<2.0
CHLORIDE (CL)	<1.0	<2.0			<1.0	<2.0	<2.0
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) DIS	<0.002	<0.005			<0.005	<0.005	<0.005
ARSENIC (AS) TOT	<0.002	<0.005	0.0066	0.0079	<0.005	<0.005	<0.005
ARSENIC +3	<0.005				<0.005		<0.005
ARSENIC +5	<0.005				<0.005		<0.005
CADMIUM (CD) DIS	<0.005	<0.005			<0.005	<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
COPPER (CU) DIS	<0.005				<0.005	<0.005	<0.005
COPPER (CU) TOT	<0.005				<0.005	<0.005	<0.005
LEAD (PB) DIS	<0.005	<0.005			<0.005	<0.005	<0.005
LEAD (PB) TOT	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ZINC (ZN) DIS	<0.005				0.0067	<0.005	<0.005
ZINC (ZN) TOT	0.017				0.0067	<0.005	<0.005

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Quality Control

SITE CODE	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK	D.I.BLANK
SAMPLE DATE	09/17/93	12/10/93	12/28/93	12/29/93	01/23/94	08/23/94	08/24/94
SAMPLE TIME	14:30	13:15	16:30	15:00	12:50	14:45	10:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8471	93-9774	94-9925	94-9942	94-318	94-1559008	94-1559016
REMARKS	BLANK	BLANK			BLANK	BLANK	BLANK
OTHER INFO						TOT 94-18538	TOT 94-185316
SAMPLE NUMBER	EVT-9309-124	EVT-9312-113	EVT-9312-202	EVT-9312-219	EVT-9401-907	EVT-9408-107	EVT-9408-115
— PHYSICAL PARAMETERS —							
PH	5.7					5.5	5.1
SC (UMHOS/CM AT 25 C)	<10.0					<10.0	<10.0
— MAJOR CONSTITUENTS —							
CALCIUM (CA) DIS	<5.0		22.0	22.0		<0.1	<0.1
MAGNESIUM (MG) DIS	<5.0		4.9	4.8		<0.1	<0.1
SODIUM (NA) DIS	<5.0		11.0	11.0		<1.0	<1.0
POTASSIUM (K) DIS	<5.0		<5.0	<5.0		<1.0	<1.0
TOTAL ALKALINITY AS CACO3	<1.0					<2.0	<2.0
TOTAL ACIDITY AS CACO3	<1.0					2.0	<1.0
BICARBONATE ALKALINITY AS CACO3			81.0	80.0			
BICARBONATE (HCO3)						<2.0	<2.0
CARBONATE ALKALINITY AS CACO3			<1.0	<1.0			
CARBONATE AS CO3						<1.0	<1.0
SULFATE (SO4)	<2.0		<2.0	<2.0		<1.0	<1.0
CHLORIDE (CL)	<2.0		4.4	4.7		<1.0	1.3
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) DIS	<0.005	<.005	<0.005	<0.005	<0.005	<0.005	<0.005
ARSENIC (AS) TOT	<0.005	<.005	<0.005	<0.005	<0.005	<0.005	<0.005
ARSENIC +3	<0.005		<0.005	<0.005			
ARSENIC +5	<0.005		<0.005	<0.005			
CADMIUM (CD) DIS	<0.005	<.003	<0.005	<0.005	<0.005		
CADMIUM (CD) TOT	<0.005	<.003	<0.005	<0.005	<0.005		
CHROMIUM (CR) DIS						<0.005	<0.005
CHROMIUM (CR) TOT						<0.005	<0.005
COPPER (CU) DIS	<0.005		<0.005	<0.005		0.027	0.012
COPPER (CU) TOT	<0.005		<0.005	<0.005		0.038	0.013
LEAD (PB) DIS	<0.005	<.005	<0.005	<0.005	<0.005	<0.005	<0.005
LEAD (PB) TOT	<0.005	<.005	<0.005	<0.005	<0.005	<0.005	<0.005
ZINC (ZN) DIS	<0.005		<0.005	<0.005			
ZINC (ZN) TOT	<0.005		<0.005	0.0057			

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Quality Control

SITE CODE	RINSBLANK	RINSBLANK	STANDARD
SAMPLE DATE	05/19/93	06/16/93	01/10/94
SAMPLE TIME	12:00		13:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7875	93-7956	94-121
REMARKS	BLANK		STANDARD
SAMPLE NUMBER	EVT-9305-164	EVT-9306-140	EVT-9401-204
— PHYSICAL PARAMETERS —			
PH	5.4		
SC (UMHOS/CM AT 25 C)	<5.0		
— MAJOR CONSTITUENTS —			
CALCIUM (CA) DIS	.27	<.1	
MAGNESIUM (MG) DIS	<.1	<.1	
SODIUM (NA) DIS	<1.0	<1.0	
POTASSIUM (K) DIS	<1.0	<1.0	
TOTAL ALKALINITY AS CACO3	<1.0		
BICARBONATE ALKALINITY AS CACO3	<1.0	1.0	
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0	
SULFATE (SO4)	<2.0	<2.0	
CHLORIDE (CL)	<1.0	<1.0	
— METALS & MINOR CONSTITUENTS —			
ARSENIC (AS) DIS	<0.005	<0.005	
ARSENIC (AS) TOT	<0.005	<0.005	146.0
ARSENIC +3		<0.005	
ARSENIC +5		<0.005	
CADMIUM (CD) DIS	<0.005	<0.005	
CADMIUM (CD) TOT	<0.005	<0.005	102.0
LEAD (PB) DIS	<0.005	<0.005	
LEAD (PB) TOT	<0.005	<0.005	84.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	ALLEYWAY	B-1	B-1	B-1	B-1	B-1
SAMPLE DATE	10/06/92	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93
SAMPLE TIME		08:00	08:05	08:10	08:15	08:20
LAB	SAS	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	27632-3	93-7457	93-7458	93-7459	93-7460	93-7461
DEPTH	0-2"	0-1'	2-3'	4-5'	6-7'	8-9'
SAMPLE NUMBER	ASEV-9210-3	EVT-9302-700	EVT-9302-701	EVT-9302-702	EVT-9302-703	EVT-9302-704
— METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) TOT	1300.0	16.0 J4	10.0 J4	7.0 J4	3.0 J4	2.0 J4
CADMIUM (CD) TOT	2.0	<1.0	4.0	21.0	23.0	18.0
LEAD (PB) TOT	58.0 J4	30.0	16.0	4.0	4.0	5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	B-1	B-1	B-1	B-1	B-1	B-2
SAMPLE DATE	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	02/02/93
SAMPLE TIME	08:25	08:30	08:35	08:40	08:45	16:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7462	93-7463	93-7464	93-7465	93-7466	93-7485
REMARKS				DUPLICATE		
DEPTH	10-11'	12-13'	14-14.5'	0-1'	20-21'	0-1'
SAMPLE NUMBER	EVT-9302-705	EVT-9302-706	EVT-9302-707	EVT-9302-708	EVT-9302-709	EVT-9302-720
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	6.0 J4	6.0 J4	3.0 J4	24.0	4.0 J4	34.0
CADMIUM (CD) TOT	15.0	11.0	11.0	<1.0	13.0	<1.0
LEAD (PB) TOT	7.0	7.0	5.0	40.0	4.0	30.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	B-2	B-2	B-2	B-2	B-2	B-2	B-2
SAMPLE DATE	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93
SAMPLE TIME	16:05	16:10	16:15	16:20	16:25	16:30	16:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7486	93-7487	93-7488	93-7489	93-7490	93-7491	93-7492
DEPTH	2'- 3'	4'- 5'	6'- 7'	8'- 9'	10'- 11'	12'- 13'	14'- 15'
SAMPLE NUMBER	EVT-9302-721	EVT-9302-722	EVT-9302-723	EVT-9302-724	EVT-9302-725	EVT-9302-726	EVT-9302-727
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	29.0	37.0	10.0	4.0	5.0	4.0	4.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	14.0	26.0	3.0	4.0	4.0	3.0	4.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	B-2	DRIVEWAY	EV-1S	EV-1S	EV-1S
SAMPLE DATE	02/02/93	10/06/92	01/19/93	01/19/93	01/19/93
SAMPLE TIME	16:40	15:30	08:45	08:50	09:00
LAB	TSC-SLC	SAS	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7493	27632-4	93-7401	93-7402	93-7403
REMARKS	DUPLICATE				
DEPTH	0'-1'	0.3'	0 - 1.5' S-1	2 - 2.5' S-2	4 - 5.5' S-3
SAMPLE NUMBER	EVT-9302-728	ASEV-9210-4	EVT-9301-100	EVT-9301-100	EVT-9301-100
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	32.0	14.0	10.0	2.0	4.0
CADMIUM (CD) TOT	<1.0	0.82	1.0	1.0	1.0
LEAD (PB) TOT	22.0	6.3	23.0	3.0	7.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-1S	EV-1S	EV-2A-S	EV-2A-S	EV-2A-S	EV-2A-S
SAMPLE DATE	01/19/93	01/19/93	01/26/93	01/26/93	01/26/93	01/26/93
SAMPLE TIME	09:30	10:05	16:20	17:00	17:10	17:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7404	93-7405	93-7367	93-7368	93-7369	93-7370
DEPTH	10-11.5' S-6	14.5-16' S-9	0-1'	1.5-3'	4.5-6'	9-10.5'
SAMPLE NUMBER	EVT-9301-100	EVT-9301-100	EVT-9302-200	EVT-9302-201	EVT-9302-204	EVT-9302-207
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	2.0	3.0	660.0	1090.0	228.0	7.0
	J4	J4	J4	J4	J4	J4
CADMIUM (CD) TOT	1.0	<1.0	10.0	13.0	3.0	<1.0
LEAD (PB) TOT	3.0	4.0	400.0	430.0	62.0	4.0
			J4	J4	J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-2A-S	EV-2A-S	EV-2A-S	EV-2A-S	EV-2A-S	EV-2A-S	EV-2A-S
SAMPLE DATE	01/26/93	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93
SAMPLE TIME	17:20			11:45		11:55	
LAB	TSC-SLC	SAS	TSC-SLC	SAS	TSC-SLC	SAS	TSC-SLC
LAB NUMBER	93-7371	35793-1	93-9136	35793-2	93-9137	32511	93-9138
REMARKS		SPLIT		SPLIT		SPLIT	
DEPTH	13.5-15'	6.0'-7.5'	6.0'-7.5'	12.0'-13.5'	12.0'-13.5'	18.5'- 20'	18.5'-20.0'
SAMPLE NUMBER	EVT-9302-210	EVT-9302-205	EVT-9302-205	EVT-9302-209	EVT-9302-209	EVT-9302-211	EVT-9302-211
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	5.0 J4	2.6	<10.0	3.1	<10.0	<2.4	<10.0
CADMIUM (CD) TOT	2.0	<0.11	<1.0	<0.11	<1.0	<0.12	<1.0
LEAD (PB) TOT	11.0 J4	2.2	5.8 J4	1.8	<5.0 UJ4	<1.2	<5.0 UJ4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-2B-S	EV-2B-S	EV-2B-S	EV-2B-S	EV-2B-S	EV-2B-S	EV-2B-S
SAMPLE DATE	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93
SAMPLE TIME	15:50	16:00	16:05	16:10	16:15	16:20	16:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8361	93-8362	93-8363	93-8364	93-8365	93-8366	93-8367
DEPTH	0-1.5' S-1	2-3.5' S-2	4-5.5' S-3	6-7.5' S-4	8-9.5' S-5	10-11.5' S-6	12-13.5' S-7
SAMPLE NUMBER	EVT-9308-139	EVT-9308-140	EVT-9308-141	EVT-9308-142	EVT-9308-143	EVT-9308-144	EVT-9308-145
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	117.0	1687.0	27.0	11.0	8.2	7.2	9.0
CADMIUM (CD) TOT	1.2	15.0	1.0	1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	50.0	430.0	7.4	<5.0	<5.0	5.4	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-2B-S	EV-2B-S	EV-2B-S	EV-2B-S		EV-3-S	EV-3-S
SAMPLE DATE	08/17/93	08/17/93	08/17/93	08/17/93		01/22/93	01/22/93
SAMPLE TIME	16:30	16:35	16:40	17:00		12:00	12:02
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC		TSC-SLC	TSC-SLC
LAB NUMBER	93-8368	93-8369	93-8370	93-8371		93-7406	93-7407
DEPTH	14-15.5' S-8	16-17.5' S-9	18-19.5' S-10	20-21.5' S-11		1-2.5' S-1A	1-2.5' S-1B
SAMPLE NUMBER	EVT-9308-146	EVT-9308-147	EVT-9308-148	EVT-9308-149		EVT-9301-102	EVT-9301-102
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	<5.0	<5.0	6.8	7.4		288.0	166.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0		2.0	1.0
LEAD (PB) TOT	<5.3	<5.0	<5.0	6.6		66.0	13.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-3-S	EV-3-S	EV-3-S	EV-3-S	EV-3-S	EV-3-S	EV-3-S
SAMPLE DATE	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93
SAMPLE TIME	12:10	12:30	12:45	12:25	12:55	13:07	13:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7408	93-7409	93-7410	93-7494	93-7495	93-7496	93-7497
DEPTH	4-5.5' S-3	10-11.5' S-7	14.5-16.9S-10	8.5-10' S-6	24-25.5' S-12	34-35.5'S-14B	44-45.5' S-17
SAMPLE NUMBER	EVT-9301-102	EVT-9301-102	EVT-9301-102	EVT-9301-102	EVT-9301-102	EVT-9301-102	EVT-9301-102
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	248.0	34.0	83.0	212.0	66.0	14.0	5.0
	J4	J4	J4	J4	J4	J4	J4
CADMIUM (CD) TOT	1.0	1.0	1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	44.0	4.0	7.0	4.0	4.0	6.0	3.0
	J4	J4	J4	J4	J4	J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-3-S	EV-3-S	EV-4B-S	EV-4B-S	EV-4B-S	EV-4B-S
SAMPLE DATE	01/22/93	01/22/93	01/20/93	01/20/93	01/20/93	01/20/93
SAMPLE TIME	13:25	13:30	08:05	08:10	08:30	08:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7498	93-7499	93-7411	93-7412	93-7413	93-7414
REMARKS		DUPLICATE				
DEPTH	49-50.5' S-18	49-50.5' S-19	0-1.5' S-1	1.5-3' S-2	4.5-6' S-4	9-10.5' S-7A
SAMPLE NUMBER	EVT-9301-102	EVT-9301-102	EVT-9301-101	EVT-9301-101	EVT-9301-101	EVT-9301-101
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	3.0 J4	12.0	16.0 J4	7.0 J4	3.0 J4	14.0 J4
CADMIUM (CD) TOT	<1.0	<1.0	1.0	1.0	1.0	1.0
LEAD (PB) TOT	2.0 J4	6.0	12.0	11.0	4.0	8.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-4B-S	EV-4B-S	EV-4B-S	EV-4B-S	EV-4B-S	EV-5-S
SAMPLE DATE	01/20/93	01/20/93	01/20/93	01/20/93	01/20/93	01/26/93
SAMPLE TIME	08:45	09:40	09:55	12:15	08:35	17:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7415	93-7416	93-7417	93-7418	93-7500	93-7372
REMARKS					DUPLICATE	
DEPTH	15-17' S-9	24-25.5' S-13	39-40.5' S-15	55.5-57.5S-19	9-10.5' S-7A	0-1'
SAMPLE NUMBER	EVT-9301-101	EVT-9301-101	EVT-9301-101	EVT-9301-101	EVT-9301-101	EVT-9302-212
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	138.0 J4	5.0 J4	4.0 J4	5.0 J4	21.0	20.0 J4
CADMIUM (CD) TOT	2.0	1.0	1.0	1.0	<1.0	7.0
LEAD (PB) TOT	140.0	7.0	4.0	<1.0	7.0	1300.0 J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-5-S	EV-5-S	EV-5-S	EV-5-S	EV-5-S	EV-5-S
SAMPLE DATE	01/27/93	02/01/93	02/01/93	02/01/93	02/01/93	02/02/93
SAMPLE TIME	08:50	15:05	15:10	15:20	15:35	08:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7377	93-7473	93-7474	93-7475	93-7476	93-7478
REMARKS			DUPLICATE			
DEPTH	13.5-15'	1.5-3'	1.5-3	4.5-6'	9-10.5'	25-26.5'
SAMPLE NUMBER	EVT-9302-222	EVT-9302-213	EVT-9302-214	EVT-9302-216	EVT-9302-219	EVT-9302-226
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	19.0	7.0	5.0	19.0	131.0	8.0
CADMIUM (CD) TOT	2.0	<1.0	<1.0	<1.0	1.0	<1.0
LEAD (PB) TOT	11.0	53.0	11.0	23.0	66.0	6.0
		J4		J4	J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-6A-S	EV-6A-S	EV-6A-S	EV-6A-S	EV-6A-S	EV-6A-S	EV-6A-S
SAMPLE DATE	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93	08/17/93
SAMPLE TIME	09:30	09:35	09:35	09:40	09:45	09:55	10:10
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8351	93-8352	93-8353	93-8354	93-8355	93-8356	93-8357
REMARKS			DUPLICATE				
DEPTH	0-1.5' S-1	2-3.5' S-2	2-3.5' S-2	5' S-3	10-11.5' S-4	15-16.5' S-5	25-26.5' S-7
SAMPLE NUMBER	EVT-9308-125	EVT-9308-126	EVT-9308-127	EVT-9308-128	EVT-9308-129	EVT-9308-130	EVT-9308-132
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	<5.0	12.0	17.0	18.0	37.0	87.0	138.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	1.2	4.3	<1.0
LEAD (PB) TOT	5.4	32.0	40.0	70.0	64.0	359.0	131.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-6A-S	EV-6A-S	EV-6A-S	EV-6B-S	EV-6B-S	EV-6B-S
SAMPLE DATE	08/17/93	08/17/93	08/17/93	08/24/93	08/25/93	08/25/93
SAMPLE TIME	10:15	10:50	11:00	15:15	09:20	09:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8358	93-8359	93-8360	93-8381	93-8382	93-8383
REMARKS						DUPLICATE
DEPTH	30-31.5' S-8	45-46.5' S-11	50-51.5' S-12	54-55.5'	60-61.5'	60-61.5'
SAMPLE NUMBER	EVT-9308-133	EVT-9308-136	EVT-9308-137	EVT-9308-164	EVT-9308-165	EVT-9308-166
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	423.0	484.0	418.0	350.0	22.0	27.0
CADMIUM (CD) TOT	7.3	4.3	17.0	5.2	<1.0	<1.0
LEAD (PB) TOT	24010.0	24230.0	12.0	12140.0	133.0	378.0
				J4	J4	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-6B-S	EV-6B-S	EV-7A-S	EV-7A-S	EV-7A-S	EV-7A-S
SAMPLE DATE	08/25/93	08/25/93	08/16/93	08/16/93	08/16/93	08/16/93
SAMPLE TIME	11:40	11:55	11:15	11:25	11:35	12:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8384	93-8385	93-8340	93-8341	93-8342	93-8343
DEPTH	67.5-68'	68-68.5'	0-1.5' S-1	2-3.5' S-2	4-5.5' S-3	10-11.5' S-6
SAMPLE NUMBER	EVT-9308-168	EVT-9308-169	EVT-9308-107	EVT-9308-108	EVT-9308-109	EVT-9308-112
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	7.5	<5.0	100.0	359.0	428.0	385.0
CADMIUM (CD) TOT	<1.0	<1.0	1.6	3.0	3.0	13.0
LEAD (PB) TOT	29.0 J4	12.0 J4	1875.0	8708.0	11000.0	14440.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-7A-S	EV-7B-S	EV-7B-S	EV-8A-S	EV-8A-S
SAMPLE DATE	08/16/93	08/20/93	08/20/93	08/16/93	08/16/93
SAMPLE TIME	12:20	12:20	14:15	09:15	09:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	ASARCO-SLC	TSC-SLC
LAB NUMBER	93-8344	93-8375	93-8376	93-8335	93-8336
DEPTH	14-15.5' S-8	17-18.5' S-10	28-29.5' S-12	0-1.5' S-1	2-3.5' S-2
SAMPLE NUMBER	EVT-9308-114	EVT-9308-156	EVT-9308-158	EVT-9308-100	EVT-9308-101
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	24.0	79.0	30.0	21.0	338.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	13.0	<1.0
LEAD (PB) TOT	65.0	1941.0	<5.0	457.0	3048.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-8A-S	EV-8A-S	EV-8A-S	EV-8B-S	EV-8B-S	EV-8B-S
SAMPLE DATE	08/16/93	08/16/93	08/16/93	08/18/93	08/18/93	08/19/93
SAMPLE TIME	09:30	09:35	10:00	12:05	12:05	10:05
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8337	93-8338	93-8339	93-8372	93-8373	93-8374
REMARKS	DUPLICATE				DUPLICATE	
DEPTH	2-3.5' S-2	4-5.5' S-3	10-11.5' S-6	15-16.5' S-7	15-16.5' S-7	22-23.5' S-9
SAMPLE NUMBER	EVT-9308-102	EVT-9308-103	EVT-9308-106	EVT-9308-150	EVT-9308-151	EVT-9308-153
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	308.0	207.0	169.0	34.0	31.0	14.0
CADMIUM (CD) TOT	<1.0	5.4	1.2	<1.0	<1.0	<1.0
LEAD (PB) TOT	3032.0	15630.0	1584.0	23.0 J4	48.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-9A-S	EV-9A-S	EV-9A-S	EV-9A-S	EV-9A-S	EV-9A-S
SAMPLE DATE	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93	08/16/93
SAMPLE TIME	15:50	16:05	16:10	16:25	16:43	16:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8345	93-8346	93-8347	93-8348	93-8349	93-8350
DEPTH	0-1.5' S-1	2-3.5' S-2	4-5.5' S-3	8-9.5' S-5	14-15.5' S-8	16-17.5' S-9B
SAMPLE NUMBER	EVT-9308-115	EVT-9308-116	EVT-9308-117	EVT-9308-119	EVT-9308-122	EVT-9308-124
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	46.0	34.0	540.0	1344.0	1394.0	119.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	605.0	60.0	2979.0	4415.0	4643.0	337.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	EV-9B-S	EV-9B-S	EV-9B-S	EV-9B-S	MW-1-S	MW-1-S
SAMPLE DATE	08/23/93	08/23/93	08/23/93	08/23/93	02/03/93	02/03/93
SAMPLE TIME	10:25	10:30	11:25	12:00	08:00	08:05
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8377	93-8378	93-8379	93-8380	93-7479	93-7480
REMARKS		DUPLICATE				
DEPTH	18-19.5' S-10	18-19.5' S-10	23-24.5'S-11B	28-29.5' S-12	0-1' S-1	1.5-3' S-2
SAMPLE NUMBER	EVT-9308-159	EVT-9308-160	EVT-9308-162	EVT-9308-163	EVT-9302-227	EVT-9302-228
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	12.0	13.0	9.5	14.0	32.0	10.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	2.0	<1.0
LEAD (PB) TOT	14.0	7.2	<5.0	5.7	118.0	3.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	MW-1-S	MW-1-S	MW-1-S	MW-1-S	MW-2-S	MW-2-S
SAMPLE DATE	02/03/93	02/03/93	02/03/93	02/03/93	04/13/93	04/13/93
SAMPLE TIME	08:15	08:30	08:45	09:10	08:45	08:50
LAB	TSC-SLC	ASARCO-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7481	93-7482	93-7483	93-7484	93-7669	93-7670
DEPTH	4.5'-6' S-4	9-10.5' S-7	13.5-15' S-10	19.5-21' S-14	0-.5' S-1	1-2.5' S-2
SAMPLE NUMBER	EVT-9302-230	EVT-9302-233	EVT-9302-236	EVT-9302-241	EVT-9304-267	EVT-9304-268
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	3.0	6.0	3.0	5.0	23.0	22.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	1.0	3.0
LEAD (PB) TOT	4.0	3.0	3.0	3.0	120.0	330.0
	J4	J4	J4	J4	J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	MW-2-S	MW-2-S	MW-3-S	MW-3-S	MW-3-S	MW-3-S
SAMPLE DATE	04/13/93	04/13/93	04/12/93	04/12/93	04/12/93	04/12/93
SAMPLE TIME	09:00	09:15	15:15	15:25	15:35	15:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7671	93-7672	93-7662	93-7663	93-7664	93-7665
DEPTH	4-5.5' S-4	8.5-10' S-7	0-2" S-1	1-2.5' S-2	4-5.5' S-4	8.5-9' S-7A
SAMPLE NUMBER	EVT-9304-270	EVT-9304-273	EVT-9304-259	EVT-9304-260	EVT-9304-262	EVT-9304-263
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	64.0	74.0	13.0	5.3	4.5	10.0
CADMIUM (CD) TOT	6.0	2.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	470.0 J4	490.0 J4	20.0	3.4	4.1	10.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	MW-3-S	MW-3-S	MW-3-S	MW-4B-S	MW-4B-S	MW-4B-S
SAMPLE DATE	04/12/93	04/12/93	04/12/93	04/12/93	04/12/93	04/12/93
SAMPLE TIME	15:55	16:00	16:05	09:00	09:05	09:10
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7666	93-7667	93-7668	93-7658	93-7659	93-7660
REMARKS			DUPLICATE			
DEPTH	9-9.5' S-7B	10-11.5' S-8	10-11.5 S-8	0-2" S-1	1-2.5' S-2	4-5.5' S-3
SAMPLE NUMBER	EVT-9304-264	EVT-9304-265	EVT-9304-266	EVT-9304-250	EVT-9304-251	EVT-9304-252
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	25.0 J4	21.0 J4	14.0	36.0 J4	7.3 J4	5.9 J4
CADMIUM (CD) TOT	1.0	<1.0	<1.0	1.0	<1.0	<1.0
LEAD (PB) TOT	15.0	10.0	10.0	180.0	10.0	5.2

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	MW-4B-S	MW-4B-S	MW-4B-S	MW-4B-S	MW-5-S	MW-5-S
SAMPLE DATE	04/12/93	04/13/93	04/13/93	04/13/93	04/13/93	04/13/93
SAMPLE TIME	09:45	12:50	12:55	13:00	10:45	10:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7661	93-7677	93-7678	93-7679	93-7673	93-7674
REMARKS				DUPLICATE		
DEPTH	8.5-10' S-6	15-16.5 S-10	20-21.5' S-11	20-21.5' S-11	0-.5' S-1	1-2.5' S-2
SAMPLE NUMBER	EVT-9304-255	EVT-9304-283	EVT-9304-284	EVT-9304-285	EVT-9304-275	EVT-9304-276
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	25.0 J4	15.0	27.0	29.0	5.3	6.9
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	1.0	<1.0
LEAD (PB) TOT	10.0	10.0 J4	3.4 J4	5.0	10.0 J4	4.4 J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	MW-5-S	MW-5-S	PU-1	PU-1	PU-1	PU-1
SAMPLE DATE	04/13/93	04/13/93	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	11:00	11:15	09:40	09:45	09:50	09:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7675	93-7676	94-935	94-936	94-937	94-938
DEPTH	4-5.5' S-4	8.5-10.0' S-7	0.0FT	0.5FT	1.0FT	2.0FT
SAMPLE NUMBER	EVT-9304-278	EVT-9304-281	EVT-9404-200	EVT-9404-201	EVT-9404-202	EVT-9404-203
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	6.7	18.0	12.0	10.0	9.5	<5.0
			J4D	J4D	J4D	UJ4D
CADMIUM (CD) TOT	<1.0	<1.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	5.0	10.0	119.0	61.0	35.0	70.0
	J4	J4				

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-2	PU-2	PU-2	PU-2	PU-3	PU-3
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	10:05	10:10	10:15	10:20	10:25	10:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-939	94-940	94-941	94-942	94-943	94-944
DEPTH	0.5FT	1.0FT	2.0FT	0.0FT	0.0FT	0.5FT
SAMPLE NUMBER	EVT-9404-205	EVT-9404-206	EVT-9404-207	EVT-9404-208	EVT-9404-209	EVT-9404-210
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	122.0 J4D	181.0 J4D	334.0 J4D	94.0 J4D	9.6 J4D	8.1 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	155.0	138.0	253.0	119.0	43.0	21.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-3	PU-3	PU-4	PU-4	PU-4	PU-4
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	10:35	10:40	10:45	10:50	10:55	11:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-945	94-946	94-947	94-948	94-949	94-950
DEPTH	1.0FT	2.0FT	0.0FT	0.5FT	1.0FT	2.0FT
SAMPLE NUMBER	EVT-9404-211	EVT-9404-212	EVT-9404-213	EVT-9404-214	EVT-9404-215	EVT-9404-216
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	12.0	17.0	10.0	7.7	36.0
	UJ4D	J4D	J4D	J4D	J4D	J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	8.0	33.0	80.0	22.0	27.0	54.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-5	PU-5	PU-5	PU-5	PU-6	PU-6
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	11:05	11:10	11:15	11:20	11:25	11:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-951	94-952	94-953	94-954	94-955	94-956
DEPTH	0.0FT	0.5FT	1.0FT	2.0FT	0.0FT	0.5FT
SAMPLE NUMBER	EVT-9404-217	EVT-9404-218	EVT-9404-219	EVT-9404-220	EVT-9404-221	EVT-9404-222
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0 UJ4D	44.0 J4D	16.0 J4D	48.0 J4D	<5.0 UJ4D	7.1 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	31.0	69.0	20.0	47.0	6.1	12.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-6	PU-6	PU-7	PU-7	PU-7	PU-7
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	11:35	11:40	11:45	11:50	11:55	12:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-957	94-958	94-959	94-960	94-961	94-962
DEPTH	1.0FT	2.0FT	0.0FT	0.5FT	1.0FT	2.0FT
SAMPLE NUMBER	EVT-9404-223	EVT-9404-224	EVT-9404-225	EVT-9404-226	EVT-9404-227	EVT-9404-228
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	9.8 J4D	5.2 J4D	12.0 J4D	<5.0 UJ4D	17.0 J4D	<5.0 UJ4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	12.0	12.0	21.0	14.0	24.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-7	PU-8	PU-8	PU-8	PU-8
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	12:05	12:10	12:15	12:20	12:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-963	94-964	94-965	94-966	94-967
REMARKS	DUPLICATE				
DEPTH	0.0FT	0.0FT	0.5FT	1.0FT	2.0FT
SAMPLE NUMBER	EVT-9404-229	EVT-9404-230	EVT-9404-231	EVT-9404-232	EVT-9404-233
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	11.0	<5.0	<5.0	<5.0	<5.0
		UJ4D	UJ4D	UJ4D	UJ4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	21.0	5.9	6.0	16.0	5.5

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-9	PU-9	PU-9	PU-9	PU-10	PU-10
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	12:30	12:35	12:40	12:45	12:50	12:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-968	94-969	94-970	94-971	94-972	94-973
DEPTH	0.0FT	0.5FT	1.0FT	2.0FT	0.0FT	0.5FT
SAMPLE NUMBER	EVT-9404-234	EVT-9404-235	EVT-9404-236	EVT-9404-237	EVT-9404-238	EVT-9404-239
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0 UJ4D	<5.0 UJ4D	7.4 J4D	9.0 J4D	<5.0 UJ4D	6.6 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	<5.0	<5.0	15.0	10.0	<5.0	10.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-10	PU-11	PU-11	PU-11	PU-11
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	13:00	13:10	13:15	13:20	13:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-974	94-975	94-976	94-977	94-978
DEPTH	1.0FT	0.0FT	0.5FT	1.0FT	2.0FT
SAMPLE NUMBER	EVT-9404-240	EVT-9404-242	EVT-9404-243	EVT-9404-244	EVT-9404-245
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	<5.0 UJ4D	<5.0 UJ4D	6.5 J4D	5.5 J4D	<5.0 UJ4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	6.7	<5.0	9.5	9.2	13.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-12	PU-12	PU-12	PU-13	PU-13	PU-13
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	13:30	13:35	13:40	13:50	13:55	14:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-979	94-980	94-981	94-982	94-983	94-984
DEPTH	0.0FT	0.5FT	1.0FT	0.0FT	0.5FT	1.0FT
SAMPLE NUMBER	EVT-9404-246	EVT-9404-247	EVT-9404-248	EVT-9404-250	EVT-9404-251	EVT-9404-252
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	6.7	<5.0	12.0	13.0	17.0
	UJ4D	J4D	UJ4D	J4D	J4D	J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	5.5	5.3	5.6	8.2	9.0	9.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-13	PU-14	PU-14	PU-14	PU-15
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	14:05	14:10	14:15	14:20	14:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-985	94-986	94-987	94-988	94-989
DEPTH	2.0FT	0.0FT	0.5FT	1.0FT	0.0FT
SAMPLE NUMBER	EVT-9404-253	EVT-9404-254	EVT-9404-255	EVT-9404-256	EVT-9404-258
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	<5.0 UJ4D	6.0 J4D	6.6 J4D	<5.0 UJ4D	19.0 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	15.0	5.4	5.6	5.6	102.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-15	PU-15	PU-15	PU-16	PU-16	PU-16
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	14:35	14:40	14:45	14:50	14:55	15:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-990	94-991	94-992	94-993	94-994	94-995
DEPTH	0.5FT	1.0FT	2.0FT	0.0FT	0.5FT	1.0FT
SAMPLE NUMBER	EVT-9404-259	EVT-9404-260	EVT-9404-261	EVT-9404-262	EVT-9404-263	EVT-9404-264
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	28.0 J4D	20.0 J4D	11.0 J4D	17.0 J4D	29.0 J4D	11.0 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	70.0	34.0	11.0	31.0	53.0	37.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-16	PU-17	PU-17	PU-18
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	15:05	15:15	15:25	15:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-996	94-997	94-999	94-998
REMARKS			DUPLICATE	
DEPTH	2.0FT	0.0FT	0.0FT	0.0FT
SAMPLE NUMBER	EVT-9404-265	EVT-9404-266	EVT-9404-268	EVT-9404-267
— METALS & MINOR CONSTITUENTS —				
ARSENIC (AS) TOT	28.0 J4D	5.8 J4D	11.0	17.0 J4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	34.0	28.0	34.0	38.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-19	PU-19	PU-19	PU-19	PU-20	PU-20
SAMPLE DATE	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94	04/19/94
SAMPLE TIME	15:30	15:35	15:40	15:45	15:50	15:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-1000	94-1001	94-1002	94-1003	94-1004	94-1005
DEPTH	0.0FT	0.5FT	1.0FT	2.0FT	0.0FT	0.5FT
SAMPLE NUMBER	EVT-9404-269	EVT-9404-270	EVT-9404-271	EVT-9404-272	EVT-9404-273	EVT-9404-274
— METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) TOT	<5.0 UJ4D	<5.0 UJ4D	<5.0 UJ4D	<5.0 UJ4D	<5.0 UJ4D	<5.0 UJ4D
CADMIUM (CD) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
LEAD (PB) TOT	19.0	11.0	22.0	<5.0	<5.0	9.8

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	PU-20	PU-20	S-4	S-4	S-4	S-4
SAMPLE DATE	04/19/94	04/19/94	01/27/93	01/27/93	01/27/93	01/27/93
SAMPLE TIME	16:00	16:05	09:30	09:35	09:40	09:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-1006	94-1007	93-7380	93-7381	93-7382	93-7383
DEPTH	1.0FT	2.0	0-2"	6-9"	1'	2'
SAMPLE NUMBER	EVT-9404-275	EVT-9404-276	EVT-9301-616	EVT-9301-617	EVT-9301-618	EVT-9301-619
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0 UJ4D	<5.0 UJ4D	1340.0	2460.0	4290.0	1330.0
CADMIUM (CD) TOT	<5.0	<5.0	13.0	27.0	43.0	14.0
LEAD (PB) TOT	<5.0	<5.0	610.0	940.0	2280.0	610.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-4	S-4	S-4	S-4	S-4	S-4	S-4
SAMPLE DATE	01/27/93	01/27/93	01/27/93	07/13/93	07/13/93	07/13/93	07/13/93
SAMPLE TIME	09:50	09:55	10:00	08:30	08:45	09:30	10:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7384	93-7385	93-7386	93-8132	93-8133	93-8134	93-8135
REMARKS					DUPLICATE		
DEPTH	3'	4'	6'	7'-7.3'	7'-7.3'	9'-9.2'	10'-10.2'
SAMPLE NUMBER	EVT-9301-620	EVT-9301-621	EVT-9301-622	EVT-9307-700	EVT-9307-701	EVT-9307-702	EVT-9307-703
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	2720.0	4840.0	270.0	136.0	184.0	11.0	<5.0
CADMIUM (CD) TOT	86.0	65.0	12.0	4.0	4.3	18.0	<1.0
LEAD (PB) TOT	1560.0	1850.0	51.0	29.0	23.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-4	S-4	S-8	S-8	S-8	S-8
SAMPLE DATE	07/13/93	07/13/93	01/20/93	01/20/93	01/20/93	01/20/93
SAMPLE TIME	11:30	11:30	15:00	15:05	15:10	15:15
LAB	SAS	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	33402-1	93-8136	93-7274	93-7275	93-7276	93-7277
REMARKS	SPLIT					DUPLICATE
DEPTH	11.8'-12'	11.8'-12'	0-2"	6-9"	1'	1'
SAMPLE NUMBER	EVT-9307-704	EVT-9307-704	EVT-9301-507	EVT-9301-508	EVT-9301-509	EVT-9301-510
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	2.3	<5.0	10800.0	6700.0	5300.0	4300.0
CADMIUM (CD) TOT		1.5	9.0	3.0	1.0	1.0
LEAD (PB) TOT	1.4	<5.0	562.0	158.0	30.0	39.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-8	S-8	S-8	S-8	S-8	S-8	S-8
SAMPLE DATE	01/20/93	01/20/93	01/20/93	01/20/93	07/13/93	07/13/93	07/14/93
SAMPLE TIME	15:20	15:25	15:30	15:35	14:15	16:00	08:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7278	93-7279	93-7280	93-7281	93-8137	93-8138	93-8139
DEPTH	2'	3'	4'	6'	7'-7.2'	10'-10.2'	11'-11.2'
SAMPLE NUMBER	EVT-9301-511	EVT-9301-512	EVT-9301-513	EVT-9301-514	EVT-9307-705	EVT-9307-706	EVT-9307-707
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	18000.0	1500.0	1400.0	1000.0	129.0	123.0	64.0 J4
CADMIUM (CD) TOT	2.0	1.0	1.0	1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	14.0	10.0	10.0	4.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-8	S-8	S-13	S-13	S-13	S-13
SAMPLE DATE	07/14/93	07/14/93	01/21/93	01/21/93	01/21/93	01/21/93
SAMPLE TIME	08:30	08:45	10:30	10:35	10:40	10:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8140	93-8141	93-7294	93-7295	93-7296	93-7297
DEPTH	13'-13.2'	15'-15.2'	0-2"	6-9"	1'	2'
SAMPLE NUMBER	EVT-9307-708	EVT-9307-709	EVT-9301-528	EVT-9301-529	EVT-9301-530	EVT-9301-531
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	123.0 J4	75.0 J4	1400.0	1600.0	14000.0	4500.0
CADMIUM (CD) TOT	1.2	<1.0	5.0	5.0	8.0	1.0
LEAD (PB) TOT	<5.0	<5.0	556.0	533.0	662.0	96.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-13	S-13	S-13	S-13	S-13	S-13	S-13
SAMPLE DATE	01/21/93	01/21/93	01/21/93	07/14/93	07/14/93	07/20/93	07/20/93
SAMPLE TIME	10:50	10:55	10:00	14:30	14:30	10:45	11:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7298	93-7299	93-7300	33468-1	93-8145	93-8181	93-8182
REMARKS				SPLIT			
DEPTH	3'	4'	6'	4.25'-4.5'	4.25'-4.5'	7'-7.2'	9'-9.2'
SAMPLE NUMBER	EVT-9301-532	EVT-9301-533	EVT-9301-534	EVT-9307-713	EVT-9307-713	EVT-9307-747	EVT-9307-748
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	11200.0	6500.0	1100.0	560.0	147.0 J4	214.0	717.0
CADMIUM (CD) TOT	1.0	1.0	1.0	1.2	<1.0	<1.0	<1.0
LEAD (PB) TOT	25.0	13.0	56.0	1.3	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-13	S-13	S-13	S-13	S-15	S-15
SAMPLE DATE	07/20/93	07/20/93	07/20/93	07/20/93	01/26/93	01/26/93
SAMPLE TIME	11:45	12:05	12:20	12:35	15:50	15:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8183	93-8184	93-8185	93-8186	93-7361	93-7362
DEPTH	11'-11.2'	13'-13.2'	15'-15.2'	16.8'-17'	0-2"	6-9"
SAMPLE NUMBER	EVT-9307-749	EVT-9307-750	EVT-9307-751	EVT-9307-752	EVT-9301-595	EVT-9301-596
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	313.0	409.0	490.0	189.0	103.0	230.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	2.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	<5.0	36.0	110.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-15	S-15	S-15	S-15	S-15	S-15	S-15
SAMPLE DATE	01/26/93	01/26/93	01/26/93	01/26/93	02/01/93	07/20/93	07/20/93
SAMPLE TIME	16:00	16:05	16:10	16:15	11:00	13:45	14:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7363	93-7364	93-7365	93-7366	93-7467	93-8187	93-8188
DEPTH	1'	2'	3'	4'	6'	7-7.2'	9-9.2'
SAMPLE NUMBER	EVT-9301-597	EVT-9301-598	EVT-9301-599	EVT-9301-600	EVT-9301-601	EVT-9307-753	EVT-9307-754
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	870.0	1670.0	1780.0	650.0	3040.0	1074.0	293.0
	J4	J4	J4	J4			
CADMIUM (CD) TOT	3.0	4.0	2.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	150.0	230.0	95.0	19.0	34.0	<5.0	<5.0
	J4	J4	J4	J4	J4		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-15	S-15	S-15	S-22	S-22	S-22
SAMPLE DATE	07/20/93	07/20/93	07/20/93	07/22/93	07/22/93	07/22/93
SAMPLE TIME	14:20	14:40	14:55	11:45	12:00	12:05
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8189	93-8190	93-8191	93-8213	93-8214	93-8215
DEPTH	11-11.2'	13-13.2'	14.8-15'	4'-4.2'	6'-6.2'	7'-7.2'
SAMPLE NUMBER	EVT-9307-755	EVT-9307-756	EVT-9307-757	EVT-9307-782	EVT-9307-783	EVT-9307-784
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	526.0	123.0	258.0	18.0	450.0	236.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	181.0	112.0	64.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-22	S-22	S-22	S-22	S-27	S-27
SAMPLE DATE	07/22/93	07/22/93	07/22/93	07/22/93	01/28/93	01/28/93
SAMPLE TIME	12:10	12:15	12:50	13:00	10:55	11:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8216	93-8217	93-8218	93-8219	93-7387	93-7388
DEPTH	9'-9.2'	11'-11.2	13.3-13.5'	15'-15.2'	0-2"	6-9"
SAMPLE NUMBER	EVT-9307-785	EVT-9307-786	EVT-9307-787	EVT-9307-788	EVT-9301-623	EVT-9301-624
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	233.0	58.0	19.0	18.0	390.0	3510.0
CADMIUM (CD) TOT	77.0	116.0	6.8	<1.0	4.0	5.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	<5.0	210.0	180.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-27	S-27	S-27	S-27	S-27	S-27	S-27
SAMPLE DATE	01/28/93	01/28/93	01/28/93	01/28/93	01/28/93	01/28/93	01/28/93
SAMPLE TIME	11:05	11:10	11:10	11:15	11:20	11:25	11:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7389	93-7266	93-7259	93-7390	93-7391	93-7392	93-7393
REMARKS							DUPLICATE
TYPE		TOTAL	TCLP				
DEPTH	1'	2'	2'	3'	4'	6'	3'
SAMPLE NUMBER	EVT-9301-625	EVT-9301-626	EVT-9301-626T	EVT-9301-627	EVT-9301-628	EVT-9301-629	EVT-9301-630
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	4620.0	5306.0	12.0	660.0	2530.0	2480.0	720.0
BARIUM (BA) TOT		150.0	0.5				
CADMIUM (CD) TOT	3.0	6.0	<0.1	2.0	2.0	1.0	1.0
CHROMIUM (CR) TOT		37.0	<0.1				
COPPER (CU) TOT		95.0	<0.1				
LEAD (PB) TOT	81.0	1063.0	0.2	32.0	15.0	10.0	24.0
MERCURY (HG) TOT		100.0	<0.001				
SELENIUM (SE) TOT		11.0	<0.1				
SILVER (AG) TOT		6.8	<0.1				
ZINC (ZN) TOT		140.0	0.5				

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-27A	S-27B	S-27B	S-27B	S-28
SAMPLE DATE	07/16/93	07/16/93	07/16/93	07/16/93	01/28/93
SAMPLE TIME	09:20	09:50	10:20	10:45	11:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8154	93-8155	93-8156	93-8157	93-7394
DEPTH	7'-7.2'	7.2'-7.5'	9'-9.3'	10'-10.4'	0-2"
SAMPLE NUMBER	EVT-9307-721	EVT-9307-722	EVT-9307-723	EVT-9307-724	EVT-9301-631
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	1773.0	2328.0	1355.0	451.0	3010.0
CADMIUM (CD) TOT	2.5	<1.0	1.0	1.0	5.0
LEAD (PB) TOT	30.0	<5.0	<5.0	<5.0	250.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-28	S-28	S-28	S-28	S-28	S-28
SAMPLE DATE	01/28/93	01/28/93	01/28/93	01/28/93	01/28/93	01/28/93
SAMPLE TIME	11:55	12:00	12:05	12:10	12:15	12:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7395	93-7396	93-7397	93-7398	93-7399	93-7400
DEPTH	6-9"	1'	2'	3'	4'	5.5'
SAMPLE NUMBER	EVT-9301-632	EVT-9301-633	EVT-9301-634	EVT-9301-635	EVT-9301-636	EVT-9301-637
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	5620.0	14740.0	16840.0	7030.0	7480.0	6240.0
CADMIUM (CD) TOT	11.0	20.0	13.0	2.0	3.0	5.0
LEAD (PB) TOT	550.0	750.0	480.0	81.0	110.0	130.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-28B	S-34	S-34	S-34	S-34	S-34
SAMPLE DATE	07/16/93	07/19/93	07/19/93	07/19/93	07/19/93	07/19/93
SAMPLE TIME	13:40	16:45	16:50	17:05	17:10	17:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8158	93-8168	93-8169	93-8170	93-8171	93-8172
DEPTH	7'-7.2'	5'-5.2'	6.3'-6.5'	7'-7.2'	7.3'-7.5'	9'-9.2'
SAMPLE NUMBER	EVT-9307-725A	EVT-9307-734	EVT-9307-735	EVT-9307-736	EVT-9307-737	EVT-9307-738
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	304.0	89.0	119.0	53.0	16.0	12.0
		J4	J4	J4	J4	J4
CADMIUM (CD) TOT	1.0	1.6	1.2	<1.0	<1.0	<1.0
LEAD (PB) TOT	5.3	11.0	23.0	12.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-34	S-36	S-36	S-36	S-36	S-36
SAMPLE DATE	07/19/93	07/19/93	07/19/93	07/19/93	07/19/93	07/19/93
SAMPLE TIME	18:00	13:15	13:40	13:45	14:20	14:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8173	93-8163	93-8164	93-8165	93-8166	93-8167
DEPTH	11.5'-11.7'	4'-4.2'	6'-6.2'	7'-7.2'	9'-9.2'	10'-10.2'
SAMPLE NUMBER	EVT-9307-739	EVT-9307-729	EVT-9307-730	EVT-9307-731	EVT-9307-732	EVT-9307-733
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	11.0 J4	3260.0 J4	775.0 J4	499.0 J4	159.0 J4	118.0 J4
CADMIUM (CD) TOT	<1.0	1.5	1.1	1.1	<1.0	<1.0
LEAD (PB) TOT	<5.0	6.3	<5.0	<5.0	19.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-37	S-37	S-37	S-37	S-39	S-39
SAMPLE DATE	07/19/93	07/19/93	07/19/93	07/19/93	07/22/93	07/22/93
SAMPLE TIME	10:45	10:30	11:00	11:30	08:25	08:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8159	93-8160	93-8161	93-8162	93-8205	93-8206
REMARKS		DUPLICATE				
DEPTH	4.5'-5'	4.5'-5'	6.3'-6.5'	7'-7.2'	4'-4.2'	6'-6.2'
SAMPLE NUMBER	EVT-9307-725B	EVT-9307-726	EVT-9307-727	EVT-9307-728	EVT-9307-771	EVT-9307-772
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	18.0	<5.0	<5.0	<5.0	13.0	13.0
	J4		UJ4	UJ4		
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-39	S-39	S-39	S-39	S-39	S-39
SAMPLE DATE	07/22/93	07/22/93	07/22/93	07/22/93	07/22/93	07/22/93
SAMPLE TIME	08:40	08:45	09:10	09:35	10:10	10:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8207	93-8208	93-8209	93-8210	93-8211	93-8212
REMARKS	DUPLICATE					
DEPTH	6'-6.2'	6.8'-7'	9'-9.2'	11'-11.2'	13'-13.2'	15'-15.2'
SAMPLE NUMBER	EVT-9307-773	EVT-9307-774	EVT-9307-778	EVT-9307-779	EVT-9307-780	EVT-9307-781
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	15.0	15.0	17.0	19.0	10.0	15.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-46	S-46	S-46	S-46	S-46	S-46	S-46
SAMPLE DATE	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93
SAMPLE TIME	09:30	09:35	09:40	09:45	09:50	09:55	10:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7282	93-7283	93-7284	93-7285	93-7286	93-7287	93-7288
DEPTH	0-2"	6-9"	1'	2'	3'	4'	6'
SAMPLE NUMBER	EVT-9301-515	EVT-9301-516	EVT-9301-517	EVT-9301-518	EVT-9301-519	EVT-9301-520	EVT-9301-521
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	1600.0	1600.0	2100.0	3400.0	3300.0	900.0	900.0
CADMIUM (CD) TOT	7.0	7.0	8.0	11.0	12.0	11.0	2.0
LEAD (PB) TOT	376.0	407.0	442.0	712.0	821.0	552.0	86.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-46	S-46	S-46	S-46	S-46	S-46	S-46
SAMPLE DATE	07/21/93	07/21/93	07/21/93	07/21/93	07/21/93	07/21/93	07/21/93
SAMPLE TIME	09:00	09:05	09:10	09:15	09:30	09:50	10:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8192	93-8193	93-8194	93-8195	93-8196	93-8197	93-8198
REMARKS			DUPLICATE				
DEPTH	6'-6.2'	7'-7.2'	7'-7.2'	9'-9.2'	11'-11.2'	13'-13.2'	14.8'-15'
SAMPLE NUMBER	EVT-9307-758	EVT-9307-759	EVT-9307-760	EVT-9307-761	EVT-9307-762	EVT-9307-763	EVT-9307-764
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	2006.0	603.0	838.0	1052.0	512.0	134.0	133.0
CADMIUM (CD) TOT	1.3	1.2	1.2	1.4	1.3	<1.0	<1.0
LEAD (PB) TOT	5.8	13.0	<5.0	<5.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-46	S-47	S-47	S-47	S-47	S-47
SAMPLE DATE	07/21/93	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93
SAMPLE TIME	11:00	11:30	11:35	11:40	11:45	11:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8199	93-7333	93-7334	93-7335	93-7336	93-7337
DEPTH	16.5'-16.7'	0-2"	6-9"	1'	2'	3'
SAMPLE NUMBER	EVT-9307-765	EVT-9301-567	EVT-9301-568	EVT-9301-569	EVT-9301-570	EVT-9301-571
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	86.0	2580.0	3420.0	4980.0	2890.0	1660.0
CADMIUM (CD) TOT	<1.0	12.0	18.0	20.0	21.0	14.0
LEAD (PB) TOT	5.2	1200.0	1560.0	1550.0	48.0	38.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-47	S-47	S-47	S-47	S-47	S-47
SAMPLE DATE	01/22/93	01/22/93	01/22/93	07/14/93	07/14/93	07/14/93
SAMPLE TIME	11:55	12:00	12:05	11:00	12:15	13:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7338	93-7339	93-7340	93-8142	93-8143	93-8144
REMARKS			DUPLICATE			
DEPTH	4'	6'	2'	7'-7.2'	9'-9.2'	11'-11.2'
SAMPLE NUMBER	EVT-9301-572	EVT-9301-573	EVT-9301-574	EVT-9307-710	EVT-9307-711	EVT-9307-712
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	1630.0	1670.0	2720.0	466.0 J4	223.0 J4	642.0 J4
CADMIUM (CD) TOT	2.0	3.0	19.0	1.4	1.0	1.0
LEAD (PB) TOT	12.0	51.0	47.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-50	S-50	S-50	S-50	S-50	S-72
SAMPLE DATE	07/21/93	07/21/93	07/21/93	07/21/93	07/21/93	01/20/93
SAMPLE TIME	13:30	14:00	14:05	15:45	16:05	13:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8200	93-8201	93-8202	93-8203	93-8204	93-7267
DEPTH	4'-4.2'	6'-6.2'	7'-7.2'	9'-9.2'	9.6'-9.7'	0-2"
SAMPLE NUMBER	EVT-9307-766	EVT-9307-767	EVT-9307-768	EVT-9307-769	EVT-9307-770	EVT-9301-500
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	299.0	11.0	10.0	<5.0	11.0	295.0
CADMIUM (CD) TOT	4.8	<1.0	<1.0	<1.0	<1.0	2.0
LEAD (PB) TOT	121.0	5.6	<5.0	5.5	<5.0	59.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-72	S-72	S-72	S-72	S-72	S-72	S-72
SAMPLE DATE	01/20/93	01/20/93	01/20/93	01/20/93	01/20/93	01/20/93	07/15/93
SAMPLE TIME	13:09	13:55	14:00	14:05	14:10	14:15	15:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7268	93-7269	93-7270	93-7271	93-7272	93-7273	93-8151
DEPTH	6-9"	1'	2'	3'	4'	6'	7'-7.3'
SAMPLE NUMBER	EVT-9301-501	EVT-9301-502	EVT-9301-503	EVT-9301-504	EVT-9301-505	EVT-9301-506	EVT-9307-718
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	380.0	1300.0	8000.0	21200.0	5400.0	1700.0	489.0
CADMIUM (CD) TOT	2.0	5.0	18.0	6.0	1.0	2.0	<1.0
LEAD (PB) TOT	58.0	341.0	506.0	115.0	10.0	50.0	<5.0
							UJ4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-72	S-72	S-74	S-74	S-74	S-74
SAMPLE DATE	07/15/93	07/15/93	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	16:00	15:35	13:35	13:40	13:45	13:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8152	93-8153	94-185	94-186	94-187	94-188
REMARKS	DUPLICATE					
DEPTH	7'-7.3'	9'-9.3'	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9307-719	EVT-9307-720	EVT-9401-268	EVT-9401-269	EVT-9401-270	EVT-9401-271
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	432.0	263.0	183.0	231.0	230.0	13.0
CADMIUM (CD) TOT	<1.0	<1.0	2.9	4.2	2.6	<1.0
LEAD (PB) TOT	<5.0	<5.0 UJ4	242.0	284.0	236.0	10.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-74	S-74	S-83	S-83	S-83	S-83
SAMPLE DATE	01/11/94	01/11/94	01/13/94	01/13/94	01/13/94	01/13/94
SAMPLE TIME	13:55	14:00	09:05	09:10	09:15	09:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-189	94-190	94-221	94-222	94-223	94-224
DEPTH	36.0"	48.0"	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9401-272	EVT-9401-273	EVT-9401-304	EVT-9401-305	EVT-9401-306	EVT-9401-307
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	59.0	58.0	47.0	34.0
CADMIUM (CD) TOT	<1.0	<1.0	1.3	1.4	1.1	1.0
LEAD (PB) TOT	6.7	5.1	209.0	140.0	150.0	161.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-83	S-83	S-90	S-90	S-90	S-90
SAMPLE DATE	01/13/94	01/13/94	01/12/94	01/12/94	01/12/94	01/12/94
SAMPLE TIME	09:25	09:30	08:30	08:35	08:40	08:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-225	94-226	94-191	94-192	94-193	94-194
DEPTH	36.0"	48.0"	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9401-308	EVT-9401-309	EVT-9401-274	EVT-9401-275	EVT-9401-276	EVT-9401-277
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	34.0	71.0	22.0	25.0	30.0	<5.0
CADMIUM (CD) TOT	1.1	1.7	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	299.0	148.0	62.0	39.0	38.0	5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are Laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-90	S-90	S-90	S-91	S-91	S-91
SAMPLE DATE	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94
SAMPLE TIME	08:50	08:55	09:00	09:05	09:10	09:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-195	94-196	94-197	94-198	94-199	94-200
REMARKS			DUPLICATE			
DEPTH	36.0"	48.0"	24.0"	0-2"	6.0"	12.0"
SAMPLE NUMBER	EVT-9401-278	EVT-9401-279	EVT-9401-280	EVT-9401-281	EVT-9401-282	EVT-9401-283
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	<5.0	24.0	48.0	5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	1.4	<1.0
LEAD (PB) TOT	<5.0	<5.0	<5.0	65.0	126.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-91	S-91	S-91	S-92	S-92	S-92
SAMPLE DATE	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94
SAMPLE TIME	09:20	09:25	09:30	09:35	09:40	09:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-201	94-202	94-203	94-204	94-205	94-206
DEPTH	24.0"	36.0"	48.0"	0-2"	6.0"	12.0"
SAMPLE NUMBER	EVT-9401-284	EVT-9401-285	EVT-9401-286	EVT-9401-287	EVT-9401-288	EVT-9401-289
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	<5.0	2569.0	29000.0	7534.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	6.0	14.0	2.6
LEAD (PB) TOT	<5.0	<5.0	<5.0	415.0	1098.0	663.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-92	S-92	S-92	S-92	S-92	S-92	S-92
SAMPLE DATE	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94	01/12/94
SAMPLE TIME	09:50	09:55	10:00	10:05	10:10	10:15	10:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-207	94-208	94-209	94-210	94-211	94-212	94-213
DEPTH	24.0"	36.0"	48.0"	6.0'	7.0'	9.0'	11.0'
SAMPLE NUMBER	EVT-9401-290	EVT-9401-291	EVT-9401-292	EVT-9401-293	EVT-9401-294	EVT-9401-295	EVT-9401-296
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	3215.0	3681.0	1780.0	753.0	435.0	253.0	106.0
CADMIUM (CD) TOT	12.0	2.6	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	5.4	122.0	<5.0	<5.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-92	S-92	S-93	S-93	S-93	S-93
SAMPLE DATE	01/12/94	01/12/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	10:25	10:30	10:45	10:50	10:55	11:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-214	94-215	94-166	94-167	94-168	94-169
DEPTH	13.0'	14.0'	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9401-297	EVT-9401-298	EVT-9401-249	EVT-9401-250	EVT-9401-251	EVT-9401-252
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	94.0	70.0	34.0	65.0	132.0	38.0
CADMIUM (CD) TOT	<1.0	<1.0	2.8	1.1	1.8	1.0
LEAD (PB) TOT	<5.0	<5.0	84.0	46.0	64.0	21.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-93	S-93	S-94	S-94	S-94	S-94
SAMPLE DATE	01/11/94	01/11/94	01/13/94	01/13/94	01/13/94	01/13/94
SAMPLE TIME	11:05	11:10	09:35	09:40	09:45	09:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-170	94-171	94-227	94-228	94-229	94-230
DEPTH	36.0"	48.0"	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9401-253	EVT-9401-254	EVT-9401-310	EVT-9401-311	EVT-9401-312	EVT-9401-313
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	7.0	<5.0	54.0	68.0	65.0	245.0
CADMIUM (CD) TOT	<1.0	<1.0	1.5	1.6	<1.0	<1.0
LEAD (PB) TOT	6.7	<5.0	221.0	215.0	37.0	39.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-94	S-94	S-94	S-95	S-95	S-95
SAMPLE DATE	01/13/94	01/13/94	01/13/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	09:55	10:00	10:05	11:15	11:20	11:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-231	94-232	94-233	94-172	94-173	94-174
REMARKS			DUPLICATE			
DEPTH	36.0"	48.0"	36.0"	0-2"	6.0"	12.0"
SAMPLE NUMBER	EVT-9401-314	EVT-9401-315	EVT-9401-316	EVT-9401-255	EVT-9401-256	EVT-9401-257
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	9.5	8.5	9.0	38.0	57.0	<5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	1.4	2.7	<1.0
LEAD (PB) TOT	8.8	5.6	11.0	283.0	335.0	8.7

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-95	S-95	S-95	S-96	S-96	S-96
SAMPLE DATE	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	11:30	11:35	11:40	13:00	13:05	13:10
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-175	94-176	94-177	94-178	94-179	94-180
DEPTH	24.0"	36.0"	48.0"	0-2"	6.0"	12.0"
SAMPLE NUMBER	EVT-9401-258	EVT-9401-259	EVT-9401-260	EVT-9401-261	EVT-9401-262	EVT-9401-263
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	<5.0	102.0	141.0	<5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	2.1	2.0	<1.0
LEAD (PB) TOT	6.0	<5.0	<5.0	333.0	269.0	6.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-96	S-96	S-96	S-96	S-97	S-97
SAMPLE DATE	01/11/94	01/11/94	01/11/94	01/11/94	01/13/94	01/13/94
SAMPLE TIME	13:15	13:20	13:25	13:30	10:10	10:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-181	94-182	94-183	94-184	94-234	94-235
REMARKS				DUPLICATE		
DEPTH	24.0"	36.0"	48.0"	24.0"	0-2"	6.0"
SAMPLE NUMBER	EVT-9401-264	EVT-9401-265	EVT-9401-266	EVT-9401-267	EVT-9401-317	EVT-9401-318
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	<5.0	<5.0	20.0	9.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	5.8	<5.0	<5.0	<5.0	74.0	22.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-97	S-97	S-97	S-97	S-97	S-101
SAMPLE DATE	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94	01/21/93
SAMPLE TIME	10:20	10:25	10:30	10:35	10:40	14:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-236	94-237	94-238	94-239	94-240	93-7314
REMARKS					DUPLICATE	
DEPTH	12.0"	24.0"	36.0"	48.0"	12.0"	0-2"
SAMPLE NUMBER	EVT-9401-319	EVT-9401-320	EVT-9401-321	EVT-9401-322	EVT-9401-323	EVT-9301-548
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	<5.0	<5.0	<5.0	<5.0	<5.0	60.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	3.0
LEAD (PB) TOT	12.0	5.7	<5.0	5.3	11.0	90.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-101	S-101	S-101	S-101	S-101	S-101
SAMPLE DATE	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93
SAMPLE TIME	14:05	14:10	14:15	14:20	14:25	14:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7315	93-7316	93-7317	93-7318	93-7319	93-7320
REMARKS						DUPLICATE
DEPTH	6-9"	1'	2'	3'	4'	6-9"
SAMPLE NUMBER	EVT-9301-549	EVT-9301-550	EVT-9301-551	EVT-9301-552	EVT-9301-553	EVT-9301-554
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	70.0	120.0	50.0	9.0	25.0	70.0
CADMIUM (CD) TOT	2.0	3.0	1.0	1.0	1.0	2.0
LEAD (PB) TOT	90.0	140.0	13.0	7.0	7.0	90.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-102	S-102	S-102	S-102	S-102	S-102	S-102
SAMPLE DATE	01/26/93	01/26/93	01/26/93	01/26/93	01/26/93	01/26/93	01/26/93
SAMPLE TIME	14:00	14:05	14:10	14:15	14:20	14:25	14:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7348	93-7349	93-7350	93-7351	93-7352	93-7353	93-7354
REMARKS				DUPLICATE			
DEPTH	0-2"	6-9"	1'	1'	2'	3'	4'
SAMPLE NUMBER	EVT-9301-582	EVT-9301-583	EVT-9301-584	EVT-9301-585	EVT-9301-586	EVT-9301-587	EVT-9301-588
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	200.0	106.0	52.0	56.0	5.0	6.0	4.0
CADMIUM (CD) TOT	2.0	2.0	1.0	1.0	1.0	<1.0	<1.0
LEAD (PB) TOT	130.0	44.0	22.0	22.0	6.0	5.0	4.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-103	S-103	S-103	S-103	S-103	S-103	S-103
SAMPLE DATE	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93
SAMPLE TIME	12:20	12:25	12:30	12:35	12:40	12:45	12:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7419	93-7420	93-7421	93-7422	93-7423	93-7424	93-7425
REMARKS							DUPLICATE
DEPTH	0-2"	6-9"	1'	2'	3'	4'	2'
SAMPLE NUMBER	EVT-9301-638	EVT-9301-639	EVT-9301-640	EVT-9301-641	EVT-9301-642	EVT-9301-643	EVT-9301-644
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	84.0	106.0	155.0	163.0	26.0	87.0	192.0
CADMIUM (CD) TOT	2.0	2.0	2.0	3.0	<1.0	1.0	3.0
LEAD (PB) TOT	55.0	55.0	77.0	140.0	20.0	57.0	140.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-104	S-104	S-104	S-104	S-104	S-105
SAMPLE DATE	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	01/21/93
SAMPLE TIME	13:30	13:35	13:40	13:45	13:50	13:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7426	93-7427	93-7428	93-7429	93-7430	93-7308
DEPTH	0-2"	6-9"	1'	2'	3'	0-2"
SAMPLE NUMBER	EVT-9301-645	EVT-9301-646	EVT-9301-647	EVT-9301-648	EVT-9301-649	EVT-9301-542
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	132.0	131.0	40.0	16.0	70.0	163.0
CADMIUM (CD) TOT	2.0	2.0	<1.0	<1.0	<1.0	3.0
LEAD (PB) TOT	87.0	70.0	22.0	5.0	29.0	170.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-105	S-105	S-105	S-105	S-105	S-106
SAMPLE DATE	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/22/93
SAMPLE TIME	13:05	13:10	13:45	13:20	13:25	09:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7309	93-7310	93-7311	93-7312	93-7313	93-7321
DEPTH	6-9"	1'	2'	3'	4'	0-2"
SAMPLE NUMBER	EVT-9301-543	EVT-9301-544	EVT-9301-545	EVT-9301-546	EVT-9301-547	EVT-9301-555
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	140.0	205.0	39.0	30.0	15.0	145.0
CADMIUM (CD) TOT	3.0	2.0	<1.0	1.0	1.0	3.0
LEAD (PB) TOT	170.0	80.0	20.0	7.0	13.0	170.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-106	S-106	S-106	S-106	S-106	S-107
SAMPLE DATE	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93	02/02/93
SAMPLE TIME	09:05	09:10	09:15	09:20	09:25	10:15
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7322	93-7323	93-7324	93-7325	93-7326	93-7444
DEPTH	6-9"	1'	2'	3'	3.5'	0-2"
SAMPLE NUMBER	EVT-9301-556	EVT-9301-557	EVT-9301-558	EVT-9301-559	EVT-9301-560	EVT-9301-664
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	180.0	35.0	10.0	20.0	45.0	145.0 J4
CADMIUM (CD) TOT	2.0	1.0	<1.0	<1.0	1.0	2.0
LEAD (PB) TOT	100.0	11.0	10.0	20.0	44.0	122.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-107	S-107	S-107	S-107	S-107	S-108
SAMPLE DATE	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93
SAMPLE TIME	10:20	10:25	10:30	10:35	10:45	10:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7445	93-7446	93-7447	93-7448	93-7450	93-7451
REMARKS					DUPLICATE	
DEPTH	6-9"	1'	2'	3'	2'	0-2"
SAMPLE NUMBER	EVT-9301-665	EVT-9301-666	EVT-9301-667	EVT-9301-668	EVT-9301-670	EVT-9301-671
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	95.0	76.0	730.0	39.0	56.0	48.0
	J4	J4	J4	J4		J4
CADMIUM (CD) TOT	2.0	1.0	3.0	1.0	1.0	2.0
LEAD (PB) TOT	82.0	55.0	104.0	26.0	37.0	74.0
	J4	J4	J4	J4		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-108	S-108	S-108	S-108	S-108	S-109
SAMPLE DATE	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93	01/22/93
SAMPLE TIME	10:55	11:00	11:05	11:10	11:15	10:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7452	93-7453	93-7454	93-7455	93-7456	93-7327
DEPTH	6-9"	1'	2'	3'	4'	0-2"
SAMPLE NUMBER	EVT-9301-672	EVT-9301-673	EVT-9301-674	EVT-9301-675	EVT-9301-676	EVT-9301-561
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	31.0 J4	12.0 J4	3.0 J4	80.0 J4	130.0 J4	525.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	3.0
LEAD (PB) TOT	34.0	15.0	3.0	36.0	5.0	140.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-109	S-109	S-109	S-109	S-109	S-110
SAMPLE DATE	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93	02/02/93
SAMPLE TIME	10:50	10:55	11:00	11:05	11:10	08:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7328	93-7329	93-7330	93-7331	93-7332	93-7437
DEPTH	6-9"	1'	2'	3'	4'	0-2"
SAMPLE NUMBER	EVT-9301-562	EVT-9301-563	EVT-9301-564	EVT-9301-565	EVT-9301-566	EVT-9301-657
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	125.0	20.0	5.0	10.0	2.0	44.0 J4
CADMIUM (CD) TOT	2.0	1.0	1.0	1.0	<1.0	1.0
LEAD (PB) TOT	300.0	41.0	9.0	4.0	5.0	70.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-110	S-110	S-110	S-110	S-110	S-110
SAMPLE DATE	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93	02/02/93
SAMPLE TIME	08:25	08:30	08:35	08:40	08:45	08:50
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7438	93-7439	93-7440	93-7441	93-7442	93-7443
REMARKS						DUPLICATE
DEPTH	6-9"	1'	2'	3'	4'	4'
SAMPLE NUMBER	EVT-9301-658	EVT-9301-659	EVT-9301-660	EVT-9301-661	EVT-9301-662	EVT-9301-663
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	26.0 J4	26.0 J4	48.0 J4	19.0 J4	8.0 J4	19.0
CADMIUM (CD) TOT	<1.0	<1.0	1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	33.0	44.0	50.0	16.0	15.0	18.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-111	S-111	S-111	S-111	S-111	S-111	S-111
SAMPLE DATE	10/06/92	10/06/92	10/06/92	10/06/92	10/06/92	01/21/93	01/21/93
SAMPLE TIME	13:00	13:00	13:00	13:00	13:10	08:25	08:30
LAB	SAS	TSC-SLC	TSC-SLC	TSC-SLC	SAS	TSC-SLC	TSC-SLC
LAB NUMBER	27632-1	L931232-1	L931232-2	L931232-3	27632-2	93-7289	93-7290
REMARKS		SPLIT					
TYPE		TOTAL	TCLP	SPLP			
DEPTH	1'	1'	1'	1'	1' - 1.25'	0-2"	6-9"
SAMPLE NUMBER	ASEV-9210-1	ASEV-9210-1	ASEV-9210-1	ASEV-9210-1	ASEV-9210-2	EVT-9301-522	EVT-9301-523
— METALS & MINOR CONSTITUENTS —							
ANTIMONY (SB) TOT	1700.0 J4	3100.0			15000.0		
ARSENIC (AS) TOT	510000.0	727000.0	8519.0	9309.0	350000.0	205.0	4100.0
BARIUM (BA) TOT		<5.0	<0.1	<0.1			
BERYLLIUM (BE) TOT	<0.08				<0.16		
CADMIUM (CD) TOT	3.9	<5.0	<0.05	<0.05	84.0	1.0	11.0
CHROMIUM (CR) TOT	3.7	<5.0	<0.1	<0.1	17.0		
COPPER (CU) TOT	3.3	<5.0	.11	.12	460.0		
LEAD (PB) TOT	92.0 J4	26.0	.12	<0.1	11000.0 J4	33.0	264.0
MERCURY (HG) TOT	1.1	0.5	<0.5	<0.5	380.0		
NICKEL (NI) TOT	<0.62				21.0		
SELENIUM (SE) TOT	<1.6	<5.0	.12	<0.1	140.0		
SILVER (AG) TOT	0.32	<5.0	<0.05	<0.05	53.0		
THALLIUM (TL) TOT	15.0				200.0		
ZINC (ZN) TOT	4.1	<5.0	.065	<0.05	310.0		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-111	S-111	S-111	S-111	S-111	S-111	S-111
SAMPLE DATE	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	02/02/93	07/15/93
SAMPLE TIME	08:35	08:40	08:45		08:50	10:40	09:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7291	93-7292	93-7263	93-7256	93-7293	93-7449	93-8146
TYPE			TOTAL	TCLP			
DEPTH	1'	2'	3'	3'	4'	4'	5'-6'
SAMPLE NUMBER	EVT-9301-524	EVT-9301-525	EVT-9301-526	EVT-9301-526T	EVT-9301-527	EVT-9301-669	EVT-9307-714A
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	70000.0	430000.0	622500.0	4048.0	150000.0	20.0 J4	36000.0
BARIUM (BA) TOT			1704.0	0.5			
CADMIUM (CD) TOT	75.0	96.0	18.0	<0.1	17.0	<1.0	9.3
CHROMIUM (CR) TOT			8.2	<0.1			
COPPER (CU) TOT			167.0	<0.1			
LEAD (PB) TOT	1480.0	2910.0	2804.0	<0.1	388.0	14.0 J4	90.0 J4
MERCURY (HG) TOT			135.0	<0.001			
SELENIUM (SE) TOT			34.0	<0.1			
SILVER (AG) TOT			21.0	<0.1			
ZINC (ZN) TOT			87.0	0.2			

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-111	S-111	S-111	S-111	S-111	S-111	S-111
SAMPLE DATE	07/15/93	07/15/93	07/15/93	07/15/93	07/15/93	07/15/93	07/15/93
SAMPLE TIME	15:50	09:35	10:55	10:55	11:35	11:35	11:45
LAB	SAS	TSC-SLC	SAS	TSC-SLC	SAS	TSC-SLC	SAS
LAB NUMBER	33468-2	93-8147	33468-3	93-8148	33468-4	93-8149	33468-5
REMARKS	SPLIT		SPLIT		SPLIT		SPLIT
DEPTH	6.25'-7.25'	6.25'-7.25'	8'-8.5'	8'-8.5'	9'-9.2'	9'-9.2'	10.8'-11.3'
SAMPLE NUMBER	EVT-9307-714B	EVT-9307-714B	EVT-9307-715	EVT-9307-715	EVT-9307-716	EVT-9307-716	EVT-9307-717
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	17000.0	19140.0	15000.0	15680.0	14000.0	11950.0	1800.0
CADMIUM (CD) TOT	1.9	1.5	2.4	1.6	2.2	1.4	0.94
LEAD (PB) TOT	3.4	<5.0	1.4	<5.0	180.0	<5.0	2.0
		UJ4		UJ4		UJ4	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-111	S-112	S-112	S-112	S-112	S-112
SAMPLE DATE	07/15/93	01/26/93	01/26/93	01/26/93	01/26/93	01/26/93
SAMPLE TIME	11:45	11:05	17:05	17:05	11:20	11:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8150	93-7468	93-7264	93-7257	93-7469	93-7470
TYPE			TOTAL	TCLP		
DEPTH	10.8'-11.3'	0-2"	6-9"	6-9"	1'	2'
SAMPLE NUMBER	EVT-9307-717	EVT-9301-602	EVT-9301-603	EVT-9301-603T	EVT-9301-604	EVT-9301-605
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	1800.0	1510.0	143600.0	111.0	143500.0	83600.0
BARIUM (BA) TOT			113.0	<0.1		
CADMIUM (CD) TOT	<1.0	3.0	230.0	<0.1	17.0	19.0
CHROMIUM (CR) TOT			34.0	<0.1		
COPPER (CU) TOT			99.0	<0.1		
LEAD (PB) TOT	<5.0	303.0	2061.0	<0.1	1820.0	1130.0
	UJ4	J4	J4		J4	J4
MERCURY (HG) TOT			1250.0	6.6		
SELENIUM (SE) TOT			208.0	<0.1		
SILVER (AG) TOT			7.4	<0.1		
ZINC (ZN) TOT			75.0	<0.1		

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-112	S-112	S-112	S-113	S-113	S-113
SAMPLE DATE	01/26/93	01/26/93	01/26/93	01/27/93	01/27/93	01/27/93
SAMPLE TIME	11:50	15:00	17:30	08:30	08:35	08:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7471	93-7472	93-7373	93-7374	93-7375	93-7376
REMARKS			DUPLICATE			
DEPTH	3'	4'	3'	0-2"	6-9"	1'
SAMPLE NUMBER	EVT-9301-606	EVT-9301-607	EVT-9301-608	EVT-9301-609	EVT-9301-610	EVT-9301-611
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	34950.0	20550.0	37600.0	26550.0	38650.0	30150.0
CADMIUM (CD) TOT	5.0	11.0	6.0	9.0	17.0	12.0
LEAD (PB) TOT	328.0 J4	1370.0 J4	350.0	860.0	850.0	610.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-113	S-113	S-113	S-113	S-113	S-113	S-113
SAMPLE DATE	01/27/93	01/27/93	01/27/93	01/27/93	02/01/93	07/20/93	07/20/93
SAMPLE TIME	08:45	08:45	08:55	09:00	15:50	08:50	08:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7265	93-7258	93-7378	93-7379	93-7477	93-8174	93-8175
REMARKS				DUPLICATE			
TYPE	TOTAL	TCLP		TOTAL			
DEPTH	2'	2'	4'	2'	3'	6'-6.2'	7'-7.2'
SAMPLE NUMBER	EVT-9301-612	EVT-9301-612T	EVT-9301-614	EVT-9301-615	EVT-9301-613	EVT-9307-740	EVT-9307-741
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	25540.0	51.0	2620.0	32900.0	9060.0	13030.0	4795.0
BARIUM (BA) TOT	147.0	0.2					
CADMIUM (CD) TOT	9.0	<0.1	3.0	10.0	6.0	4.1	<1.0
CHROMIUM (CR) TOT	54.0	<0.1					
COPPER (CU) TOT	112.0	<0.1					
LEAD (PB) TOT	983.0	<0.1	14.0	1040.0	666.0 J4	201.0	5.3
MERCURY (HG) TOT	225.0	0.0015					
SELENIUM (SE) TOT	38.0	<0.1					
SILVER (AG) TOT	6.1	<0.1					
ZINC (ZN) TOT	89.0	0.3					

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-113	S-113	S-113	S-113	S-113	S-114
SAMPLE DATE	07/20/93	07/20/93	07/20/93	07/20/93	07/20/93	01/26/93
SAMPLE TIME	10:05	09:10	09:15	09:30	10:00	15:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-8176	93-8177	93-8178	93-8179	93-8180	93-7355
REMARKS	DUPLICATE					
DEPTH	7'-7.2'	9'-9.2'	11'-11.2'	12.8'-13'	14.8'-15'	0-2"
SAMPLE NUMBER	EVT-9307-742	EVT-9307-743	EVT-9307-744	EVT-9307-745	EVT-9307-746	EVT-9301-589
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	4649.0	864.0	389.0	346.0	282.0	375.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	8.0
LEAD (PB) TOT	5.4	<5.0	<5.0	<5.0	<5.0	1220.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-114	S-114	S-114	S-114	S-114	S-115
SAMPLE DATE	01/26/93	01/26/93	01/26/93	01/26/93	01/26/93	01/22/93
SAMPLE TIME	15:05	15:10	15:15	15:20	15:25	13:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7356	93-7357	93-7358	93-7359	93-7360	93-7341
DEPTH	6-9"	1'	2'	3'	4'	0-2"
SAMPLE NUMBER	EVT-9301-590	EVT-9301-591	EVT-9301-592	EVT-9301-593	EVT-9301-594	EVT-9301-575
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	290.0	55.0	36.0	5.0	7.0	675.0
CADMIUM (CD) TOT	5.0	1.0	2.0	<1.0	<1.0	11.0
LEAD (PB) TOT	180.0	55.0	19.0	4.0	7.0	1090.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-115	S-115	S-115	S-115	S-115	S-115
SAMPLE DATE	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93	01/22/93
SAMPLE TIME	13:05	13:10	13:15	13:20	13:25	13:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7342	93-7343	93-7344	93-7345	93-7346	93-7347
REMARKS						DUPLICATE
DEPTH	6-9"	1'	2'	3'	4'	1'
SAMPLE NUMBER	EVT-9301-576	EVT-9301-577	EVT-9301-578	EVT-9301-579	EVT-9301-580	EVT-9301-581
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	725.0 J4	350.0 J4	8.0 J4	6.0 J4	8.0 J4	125.0
CADMIUM (CD) TOT	12.0	3.0	<1.0	<1.0	<1.0	2.0
LEAD (PB) TOT	1130.0 J4	58.0 J4	7.0 J4	7.0 J4	10.0 J4	89.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-116	S-116	S-116	S-116	S-116	S-116
SAMPLE DATE	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93	02/01/93
SAMPLE TIME	16:22	16:25	16:30	16:35	16:40	16:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7431	93-7432	93-7433	93-7434	93-7435	93-7436
DEPTH	0-2"	6-9"	1'	2'	3'	4'
SAMPLE NUMBER	EVT-9301-651	EVT-9301-652	EVT-9301-653	EVT-9301-654	EVT-9301-655	EVT-9301-656
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	350.0	185.0	76.0	69.0	98.0	400.0
CADMIUM (CD) TOT	8.0	6.0	3.0	5.0	5.0	6.0
LEAD (PB) TOT	383.0	18.0	84.0	70.0	115.0	487.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-117	S-117	S-117	S-117	S-117	S-117	S-117
SAMPLE DATE	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93	01/21/93
SAMPLE TIME	11:05	11:10	11:15	11:20	11:25	11:30	11:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7301	93-7302	93-7303	93-7304	93-7305	93-7306	93-7307
REMARKS							DUPLICATE
DEPTH	0-2"	6-9"	1'	2'	3'	4'	1'
SAMPLE NUMBER	EVT-9301-535	EVT-9301-536	EVT-9301-537	EVT-9301-538	EVT-9301-539	EVT-9301-540	EVT-9301-541
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	108.0	40.0	48.0	413.0	18.0	5.0	50.0
CADMIUM (CD) TOT	1.0	1.0	<1.0	4.0	<1.0	<1.0	1.0
LEAD (PB) TOT	54.0	69.0	55.0	284.0	21.0	11.0	45.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-201	S-201	S-201	S-201	S-201	S-201
SAMPLE DATE	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94
SAMPLE TIME	14:00	14:05	14:10	14:15	14:20	14:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-488	94-489	94-490	94-491	94-492	94-493
DEPTH	0-1"		12"	24"	36"	48"
SAMPLE NUMBER	EVT-9402-340	EVT-9402-341	EVT-9402-342	EVT-9402-343	EVT-9402-344	EVT-9402-345
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	189.0	500.0	10.0	12.0	7.5	9.0
CADMIUM (CD) TOT	6.2	10.0	<1.0	<1.0	<1.0	<2.0
LEAD (PB) TOT	434.0	598.0	12.0	17.0	24.0	17.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-202	S-202	S-202	S-202	S-202	S-202
SAMPLE DATE	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94
SAMPLE TIME	16:10	16:15	16:20	16:25	16:30	16:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-512	94-513	94-514	94-515	94-516	94-517
DEPTH	0-1"	6"	12"	24"	36"	48"
SAMPLE NUMBER	EVT-9402-366	EVT-9402-367	EVT-9402-368	EVT-9402-369	EVT-9402-370	EVT-9402-371
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	17.0	18.0	26.0	16.0	<5.0	52.0
CADMIUM (CD) TOT	1.2	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	26.0	23.0	32.0	17.0	9.8	58.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-203	S-203	S-203	S-203	S-203		S-204
SAMPLE DATE	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94		01/11/94
SAMPLE TIME	15:35	15:40	15:45	15:50	16:05		09:05
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC		TSC-SLC
LAB NUMBER	94-507	94-508	94-509	94-510	94-511		94-146
REMARKS					DUPLICATE		
DEPTH	0.1	6"	12"	24"	24"		0-2"
SAMPLE NUMBER	EVT-9402-359	EVT-9402-360	EVT-9402-361	EVT-9402-362	EVT-9402-365		EVT-9401-229
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	96.0	159.0	<5.0	<5.0	<5.0		20.0
CADMIUM (CD) TOT	1.7	2.6	<1.0	<1.0	<1.0		<1.0
LEAD (PB) TOT	105.0	238.0	8.6	8.4	7.6		44.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-204	S-204	S-204	S-204	S-204	S-204
SAMPLE DATE	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	09:10	09:15	09:20	09:25	09:30	09:35
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-147	94-148	94-149	94-150	94-151	94-152
REMARKS						DUPLICATE
DEPTH	6.0"	12.0"	24.0"	36.0"	48.0"	36.0"
SAMPLE NUMBER	EVT-9401-230	EVT-9401-231	EVT-9401-232	EVT-9401-233	EVT-9401-234	EVT-9401-235
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	12.0	58.0	6.5	<5.0	<5.0	<5.0
CADMIUM (CD) TOT	<1.0	1.2	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	20.0	102.0	6.8	7.2	<5.0	7.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-205	S-205	S-205	S-205	S-205	S-205
SAMPLE DATE	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	09:40	09:45	09:50	09:55	10:00	10:05
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-153	94-154	94-155	94-156	94-157	94-158
DEPTH	0-2"	6.0"	12.0"	24.0"	36.0"	48.0"
SAMPLE NUMBER	EVT-9401-236	EVT-9401-237	EVT-9401-238	EVT-9401-239	EVT-9401-240	EVT-9401-241
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	52.0	42.0	87.0	<5.0	<5.0	<5.0
CADMIUM (CD) TOT	1.2	1.2	2.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	90.0	104.0	130.0	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-206	S-206	S-206	S-206	S-206	S-206	S-206
SAMPLE DATE	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	10:10	10:15	10:20	10:25	10:30	10:35	10:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-159	94-160	94-161	94-162	94-163	94-164	94-165
REMARKS							DUPLICATE
DEPTH	0-2"	6.0"	12.0"	24.0"	36.0"	48.0"	12.0"
SAMPLE NUMBER	EVT-9401-242	EVT-9401-243	EVT-9401-244	EVT-9401-245	EVT-9401-246	EVT-9401-247	EVT-9401-248
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	5.5	22.0	32.0	<5.0	<5.0	<5.0	23.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	132.0	49.0	207.0	<5.0	<5.0	<5.0	114.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-207	S-207	S-207	S-207	S-207	S-207	S-207
SAMPLE DATE	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94
SAMPLE TIME	14:50	14:55	15:00	15:05	15:10	15:15	15:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-135	94-136	94-137	94-138	94-139	94-140	94-141
REMARKS							DUPLICATE
DEPTH	0-2"	6.0"	12.0"	24.0"	36.0"	48.0"	48.0"
SAMPLE NUMBER	EVT-9401-218	EVT-9401-219	EVT-9401-220	EVT-9401-221	EVT-9401-222	EVT-9401-223	EVT-9401-224
— METALS & MINOR CONSTITUENTS —							
ARSENIC (AS) TOT	22.0	23.0	14.0	26.0	<5.0	<5.0	<5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	109.0	53.0	13.0	29.0	5.1	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are Laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-208	S-208	S-208	S-208	S-208	S-208
SAMPLE DATE	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94
SAMPLE TIME	13:00	13:05	13:10	13:15	13:20	13:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-241	94-242	94-243	94-244	94-245	94-246
DEPTH	0-2"	6.0"	12.0"	24.0"	36.0"	48.0"
SAMPLE NUMBER	EVT-9401-324	EVT-9401-325	EVT-9401-326	EVT-9401-327	EVT-9401-328	EVT-9401-329
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	27.0	44.0	<5.0	<5.0	<5.0	<5.0
CADMIUM (CD) TOT	1.1	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	193.0	95.0	6.9	5.9	6.8	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-209	S-209	S-209	S-209	S-209	S-209
SAMPLE DATE	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94
SAMPLE TIME	13:30	13:35	13:40	13:45	13:50	13:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-247	94-248	94-249	94-250	94-251	94-252
DEPTH	0-2"	6.0"	12.0"	24.0"	36.0"	48.0"
SAMPLE NUMBER	EVT-9401-330	EVT-9401-331	EVT-9401-332	EVT-9401-333	EVT-9401-334	EVT-9401-335
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	20.0	22.0	16.0	14.0	15.0	<5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	44.0	41.0	34.0	27.0	28.0	5.4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-301	S-301	S-301	S-301	S-301	S-302
SAMPLE DATE	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94
SAMPLE TIME	14:30	14:35	04:40	14:45	14:50	14:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-494	94-495	94-496	94-497	94-498	94-499
REMARKS					DUPLICATE	
DEPTH	0-1"	6"	12"	24"	12"	0-1"
SAMPLE NUMBER	EVT-9402-346	EVT-9402-347	EVT-9402-348	EVT-9402-349	EVT-9402-350	EVT-9402-351
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	41.0	52.0	34.0	36.0	40.0	97.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	1.2	<1.0	2.2
LEAD (PB) TOT	82.0	64.0	58.0	104.0	65.0	129.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-302	S-302	S-302	S-303	S-303	S-303
SAMPLE DATE	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94	02/16/94
SAMPLE TIME	15:00	15:05	15:10	15:15	15:20	15:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-500	94-501	94-502	94-503	94-504	94-505
DEPTH	6"	12"	24"	0-1"	6"	12"
SAMPLE NUMBER	EVT-9402-352	EVT-9402-353	EVT-9402-354	EVT-9402-355	EVT-9402-356	EVT-9402-357
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	150.0	771.0	7.3	38.0	25.0	<5.0
CADMIUM (CD) TOT	2.3	9.7	<2.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	131.0	851.0	26.0	45.0	30.0	8.5

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-303	S-304	S-304	S-304	S-304
SAMPLE DATE	02/16/94	01/11/94	01/11/94	01/11/94	01/11/94
SAMPLE TIME	15:30	08:45	08:50	08:55	09:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-506	94-142	94-143	94-144	94-145
DEPTH	24"	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9402-358	EVT-9401-225	EVT-9401-226	EVT-9401-227	EVT-9401-228
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	<5.0	19.0	20.0	21.0	<5.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	12.0	54.0	30.0	48.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-305	S-305	S-305	S-305	S-305	S-306
SAMPLE DATE	01/13/94	01/13/94	01/13/94	01/13/94	01/13/94	01/10/94
SAMPLE TIME	08:40	08:45	08:50	08:55	09:00	13:20
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-216	94-217	94-218	94-219	94-220	94-117
REMARKS					DUPLICATE	
DEPTH	0-2"	6.0"	12.0"	24.0"	24.0"	0-2"
SAMPLE NUMBER	EVT-9401-299	EVT-9401-300	EVT-9401-301	EVT-9401-302	EVT-9401-303	EVT-9401-200
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	5.3	6.8	<5.0	<5.0	<5.0	13.0
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	16.0	25.0	6.0	5.0	5.5	122.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-306	S-306	S-306	S-307	S-307	S-307
SAMPLE DATE	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94
SAMPLE TIME	13:25	13:30	13:35	13:45	13:50	13:55
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-118	94-119	94-120	94-122	94-123	94-124
DEPTH	12.0"	24.0"	6.0"	0-2"	6.0"	12.0"
SAMPLE NUMBER	EVT-9401-201	EVT-9401-202	EVT-9401-203	EVT-9401-205	EVT-9401-206	EVT-9401-207
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	8.1	<5.0	13.0	22.0	20.0	12.0
	J4	J4	J4	J4	J4	J4
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	44.0	6.6	79.0	32.0	36.0	19.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-307	S-307	S-308	S-308	S-308	S-308
SAMPLE DATE	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94	01/10/94
SAMPLE TIME	14:00	14:05	14:10	14:15	14:20	14:25
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-125	94-126	94-127	94-128	94-129	94-130
REMARKS		DUPLICATE				
DEPTH	24.0"	6.0"	0-2"	6.0"	12.0"	24.0"
SAMPLE NUMBER	EVT-9401-208	EVT-9401-209	EVT-9401-210	EVT-9401-211	EVT-9401-212	EVT-9401-213
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	9.0 J4	32.0	23.0 J4	25.0 J4	<5.0 J4	<5.0 J4
CADMIUM (CD) TOT	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
LEAD (PB) TOT	15.0	36.0	108.0	101.0	7.1	7.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	S-309	S-309	S-309	S-309	SAIC-S1	SAIC-S1
SAMPLE DATE	01/10/94	01/10/94	01/10/94	01/10/94	05/01/91	05/01/91
SAMPLE TIME	14:30	14:35	14:40	14:45		
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC		
LAB NUMBER	94-131	94-132	94-133	94-134		
REMARKS					SAIC	SAIC
DEPTH	0-2"	6.0"	12.0"	24.0"	0-2"	6.0"
SAMPLE NUMBER	EVT-9401-214	EVT-9401-215	EVT-9401-216	EVT-9401-217	HYD-9105-800	HYD-9105-801
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	31.0 J4	28.0 J4	<5.0 J4	<5.0 J4	319.0	215.0
CADMIUM (CD) TOT	1.2	<1.0	<1.0	<1.0	25.1	19.3
LEAD (PB) TOT	247.0	314.0	30.0	5.4	489.0	657.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S1	SAIC-S1	SAIC-S1	SAIC-S2	SAIC-S2	SAIC-S2
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-802	HYD-9105-803	HYD-9105-804	HYD-9105-805	HYD-9105-806	HYD-9105-807
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	438.0	1010.0	333.0	309.0	142.0	112.0
CADMIUM (CD) TOT	24.2	15.8	6.6	5.3	4.6	52.7
LEAD (PB) TOT	1290.0	1470.0	494.0	188.0	98.9	2330.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S2	SAIC-S2	SAIC-S3	SAIC-S3	SAIC-S3	SAIC-S3
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	6.0"	1.0'	2.0'
SAMPLE NUMBER	HYD-9105-808	HYD-9105-809	HYD-9105-810	HYD-9105-811	HYD-9105-812	HYD-9105-813
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	952.0	865.0	286.0	257.0	915.0	4700.0
CADMIUM (CD) TOT	62.1	27.0	12.9	6.5	12.9	9.0
LEAD (PB) TOT	541.0	68.9	448.0	240.0	805.0	8870.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S3	SAIC-S4	SAIC-S4	SAIC-S4	SAIC-S4	SAIC-S4
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3.0'	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-814	HYD-9105-815	HYD-9105-816	HYD-9105-817	HYD-9105-818	HYD-9105-819
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	2340.0	4860.0	2380.0	2860.0	5820.0	10500.0
CADMIUM (CD) TOT	6.6	81.2	35.0	36.8	53.2	67.6
LEAD (PB) TOT	8500.0	1570.0	1690.0	1610.0	2490.0	618.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S5	SAIC-S6	SAIC-S7	SAIC-S8
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91
LAB				
LAB NUMBER				
REMARKS	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-820	HYD-9105-821	HYD-9105-822	HYD-9105-823
— METALS & MINOR CONSTITUENTS —				
ARSENIC (AS) TOT	6890.0	138.0	480.0	917.0
CADMIUM (CD) TOT	34.1	5.3	13.6	4.0
LEAD (PB) TOT	2150.0	284.0	772.0	644.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S9	SAIC-S9	SAIC-S9	SAIC-S9	SAIC-S9	SAIC-S10
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-824	HYD-9105-825	HYD-9105-826	HYD-9105-827	HYD-9105-828	HYD-9105-829
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	1030.0	7210.0	6170.0	3300.0	1080.0	194.0
CADMIUM (CD) TOT	3.3	4.8	2.4	1.2	1.1	5.5
LEAD (PB) TOT	238.0	213.0	57.8	19.3	<5.0	226.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S10	SAIC-S10	SAIC-S10	SAIC-S10	SAIC-S11	SAIC-S11
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-830	HYD-9105-831	HYD-9105-832	HYD-9105-833	HYD-9105-834	HYD-9105-835
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	32.2	34.1	147.0	24.9	114.0	130.0
CADMIUM (CD) TOT	7.3	5.0	5.6	1.7	4.8	13.0
LEAD (PB) TOT	195.0	224.0	348.0	7.2	285.0	433.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S11	SAIC-S11	SAIC-S11	SAIC-S12	SAIC-S12	SAIC-S12
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-836	HYD-9105-837	HYD-9105-838	HYD-9105-839	HYD-9105-840	HYD-9105-841
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	355.0	192.0	336.0	38.1	412.0	266.0
CADMIUM (CD) TOT	13.9	12.6	7.7	2.9	5.8	11.0
LEAD (PB) TOT	350.0	500.0	341.0	285.0	378.0	635.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S12	SAIC-S12	SAIC-S13	SAIC-S13	SAIC-S13	SAIC-S13
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	6.0"	1.0'	2.0'
SAMPLE NUMBER	HYD-9105-842	HYD-9105-843	HYD-9105-844	HYD-9105-845	HYD-9105-846	HYD-9105-847
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	255.0	758.0	1350.0	1500.0	9150.0	6100.0
CADMIUM (CD) TOT	9.9	4.9	3.7	3.8	4.3	1.2
LEAD (PB) TOT	266.0	303.0	1190.0	488.0	732.0	671.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S13	SAIC-S14	SAIC-S14	SAIC-S14	SAIC-S14	SAIC-S14
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3.0'	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-848	HYD-9105-849	HYD-9105-850	HYD-9105-851	HYD-9105-852	HYD-9105-853
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	2620.0	833.0	2190.0	3330.0	6490.0	2410.0
CADMIUM (CD) TOT	2.6	2.0	5.3	3.8	6.2	<0.5
LEAD (PB) TOT	28.6	197.0	384.0	218.0	216.0	16.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S15	SAIC-S15	SAIC-S15	SAIC-S15	SAIC-S15	SAIC-S16
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-854	HYD-9105-855	HYD-9105-856	HYD-9105-857	HYD-9105-858	HYD-9105-859
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	50.6	313.0	577.0	2650.0	44700.0	732.0
CADMIUM (CD) TOT	<0.5	0.75	2.2	4.7	4.7	5.5
LEAD (PB) TOT	87.3	85.0	205.0	241.0	632.0	220.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S17	SAIC-S17	SAIC-S17	SAIC-S17	SAIC-S17	SAIC-S18
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3'	0-2"	6.0"	1.0'	2.0'	0-2"
SAMPLE NUMBER	HYD-9105-663	HYD-9105-860	HYD-9105-861	HYD-9105-862	HYD-9105-863	HYD-9105-864
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	1190.0	235.0	241.0	366.0	976.0	131.0
CADMIUM (CD) TOT	<0.5	1.7	1.3	2.9	0.98	1.7
LEAD (PB) TOT	<5.0	222.0	169.0	256.0	79.3	190.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S19	SAIC-S19	SAIC-S19	SAIC-S19	SAIC-S19	SAIC-S20
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-865	HYD-9105-866	HYD-9105-867	HYD-9105-868	HYD-9105-869	HYD-9105-870
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	14.0	24.0	159.0	48.1	25.3	74.3
CADMIUM (CD) TOT	<0.5	<0.5	1.6	0.89	<0.5	3.3
LEAD (PB) TOT	56.9	29.3	122.0	69.6	12.0	200.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S20	SAIC-S20	SAIC-S20	SAIC-S20	SAIC-S21
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-871	HYD-9105-872	HYD-9105-873	HYD-9105-874	HYD-9105-875
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	167.0	282.0	46.8	69.9	132.0
CADMIUM (CD) TOT	2.7	3.8	<0.5	<0.5	<0.5
LEAD (PB) TOT	179.0	346.0	12.0	<5.0	159.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S22	SAIC-S22	SAIC-S22	SAIC-S22	SAIC-S22	SAIC-S23
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-876	HYD-9105-877	HYD-9105-878	HYD-9105-879	HYD-9105-880	HYD-9105-881
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	1490.0	4230.0	3590.0	1710.0	455.0	475.0
CADMIUM (CD) TOT	112.0	51.3	24.4	22.0	14.8	23.8
LEAD (PB) TOT	2540.0	1240.0	96.2	122.0	<5.0	1500.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S24	SAIC-S24	SAIC-S24	SAIC-S24	SAIC-S24	SAIC-S25
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-882	HYD-9105-883	HYD-9105-884	HYD-9105-885	HYD-9105-886	HYD-9105-887
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	395.0	456.0	152.0	47.6	3.2	311.0
CADMIUM (CD) TOT	12.0	15.2	6.5	<0.5	<0.5	5.4
LEAD (PB) TOT	632.0	443.0	278.0	<5.0	<5.0	446.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S25	SAIC-S25	SAIC-S25	SAIC-S25	SAIC-S26	SAIC-S26
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-888	HYD-9105-889	HYD-9105-890	HYD-9105-891	HYD-9105-892	HYD-9105-893
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	146.0	272.0	80.0	4.5	421.0	800.0
CADMIUM (CD) TOT	1.7	2.1	<0.5	<0.5	5.7	6.8
LEAD (PB) TOT	117.0	97.5	33.3	<5.0	513.0	533.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S26	SAIC-S26	SAIC-S26	SAIC-S27	SAIC-S27	SAIC-S27
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-894	HYD-9105-895	HYD-9105-896	HYD-9105-700	HYD-9105-701	HYD-9105-897
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	642.0	80.5	61.7	2600.0	2090.0	3010.0
CADMIUM (CD) TOT	9.0	<0.5	<0.5	3.4	<0.5	<0.5
LEAD (PB) TOT	86.4	17.1	<5.0	301.0	19.8	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S27	SAIC-S27	SAIC-S28	SAIC-S28	SAIC-S28	SAIC-S28
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	6.0"	1.0'	2.0'
SAMPLE NUMBER	HYD-9105-898	HYD-9105-899	HYD-9105-702	HYD-9105-703	HYD-9105-704	HYD-9105-705
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	930.0	1880.0	1190.0	1800.0	4810.0	6230.0
CADMIUM (CD) TOT	<0.5	<0.5	4.3	5.3	8.1	4.0
LEAD (PB) TOT	<5.0	5.9	388.0	500.0	1300.0	90.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S28	SAIC-S29	SAIC-S29	SAIC-S29	SAIC-S29	SAIC-S29
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3.0'	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-706	HYD-9105-707	HYD-9105-708	HYD-9105-709	HYD-9105-710	HYD-9105-711
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	6020.0	484.0	935.0	737.0	488.0	188.0
CADMIUM (CD) TOT	<0.5	4.5	10.0	12.0	<0.5	0.59
LEAD (PB) TOT	7.2	563.0	1220.0	27.6	9.8	21.2

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S30	SAIC-S30	SAIC-S30	SAIC-S30	SAIC-S30	SAIC-S31
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-712	HYD-9105-713	HYD-9105-714	HYD-9105-715	HYD-9105-716	HYD-9105-717
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	432.0	203.0	319.0	338.0	42.9	333.0
CADMIUM (CD) TOT	3.2	2.2	4.7	2.3	<0.5	4.8
LEAD (PB) TOT	284.0	127.0	403.0	41.3	<5.0	381.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S31	SAIC-S31	SAIC-S31	SAIC-S31	SAIC-S32	SAIC-S32
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-718	HYD-9105-719	HYD-9105-720	HYD-9105-721	HYD-9105-722	HYD-9105-723
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	276.0	36.5	13.0	8.1	47.4	19.0
CADMIUM (CD) TOT	3.4	<0.5	<0.5	<0.5	1.2	<0.5
LEAD (PB) TOT	184.0	11.0	9.1	<5.0	92.3	17.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Commission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S32	SAIC-S32	SAIC-S32	SAIC-S33	SAIC-S34
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	FAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-724	HYD-9105-725	HYD-9105-726	HYD-9105-727	HYD-9105-728
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	42.5	15.1	2.5	240.0	276.0
CADMIUM (CD) TOT	0.63	<0.5	<0.5	1.4	3.2
LEAD (PB) TOT	42.5	5.8	<5.0	96.1	191.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S34	SAIC-S34	SAIC-S34	SAIC-S34	SAIC-S35	SAIC-S35
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-729	HYD-9105-730	HYD-9105-731	HYD-9105-732	HYD-9105-733	HYD-9105-734
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	312.0	415.0	1550.0	1160.0	298.0	435.0
CADMIUM (CD) TOT	2.6	4.3	6.6	5.7	1.3	1.2
LEAD (PB) TOT	181.0	223.0	342.0	344.0	72.0	52.1

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S35	SAIC-S35	SAIC-S35	SAIC-S36	SAIC-S36	SAIC-S36
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-735	HYD-9105-736	HYD-9105-737	HYD-9105-738	HYD-9105-739	HYD-9105-740
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	239.0	727.0	717.0	764.0	1100.0	994.0
CADMIUM (CD) TOT	<0.5	2.7	3.1	6.9	4.3	4.7
LEAD (PB) TOT	8.6	199.0	99.3	194.0	119.0	52.6

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S36	SAIC-S36	SAIC-S37	SAIC-S37	SAIC-S37	SAIC-S37
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	6.0"	1.0'	2.0'
SAMPLE NUMBER	HYD-9105-741	HYD-9105-742	HYD-9105-743	HYD-9105-744	HYD-9105-745	HYD-9105-746
-- METALS & MINOR CONSTITUENTS --						
ARSENIC (AS) TOT	1420.0	849.0	857.0	1900.0	1550.0	328.0
CADMIUM (CD) TOT	3.8	0.96	3.8	4.3	3.5	<0.5
LEAD (PB) TOT	86.4	17.9	405.0	15.3	9.8	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S37	SAIC-S38	SAIC-S39	SAIC-S39	SAIC-S39
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3.0'	0-2"	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-747	HYD-9105-748	HYD-9105-749	HYD-9105-750	HYD-9105-751
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	99.4	130.0	147.0	118.0	203.0
CADMIUM (CD) TOT	<0.5	0.76	1.2	0.72	1.2
LEAD (PB) TOT	7.3	63.9	58.0	49.0	72.6

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S39	SAIC-S39	SAIC-S40	SAIC-S40	SAIC-S40	SAIC-S40
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	6.0"	1.0'	2.0'
SAMPLE NUMBER	HYD-9105-752	HYD-9105-753	HYD-9105-754	HYD-9105-755	HYD-9105-756	HYD-9105-757
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	71.9	272.0	18.6	39.2	35.9	68.4
CADMIUM (CD) TOT	<0.5	1.2	<0.5	0.76	<0.5	0.73
LEAD (PB) TOT	22.3	66.2	60.2	42.1	39.9	48.4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S40	SAIC-S41	SAIC-S41	SAIC-S41	SAIC-S41	SAIC-S41
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	3.0'	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-758	HYD-9105-759	HYD-9105-760	HYD-9105-761	HYD-9105-762	HYD-9105-763
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	47.5	124.0	145.0	222.0	78.9	6.3
CADMIUM (CD) TOT	0.73	2.0	2.7	4.1	1.2	<0.5
LEAD (PB) TOT	37.5	201.0	305.0	209.0	64.6	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S42	SAIC-S42	SAIC-S42	SAIC-S42	SAIC-S42	SAIC-S43
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-764	HYD-9105-765	HYD-9105-766	HYD-9105-767	HYD-9105-768	HYD-9105-769
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	178.0	212.0	858.0	55.9	18.7	239.0
CADMIUM (CD) TOT	1.9	2.0	3.6	<0.5	<0.5	2.0
LEAD (PB) TOT	233.0	200.0	496.0	11.0	<5.0	143.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S43	SAIC-S43	SAIC-S43	SAIC-S43	SAIC-S44
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-770	HYD-9105-771	HYD-9105-772	HYD-9105-773	HYD-9105-774
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	231.0	528.0	104.0	13.0	341.0
CADMIUM (CD) TOT	2.9	3.7	<0.5	<0.5	2.4
LEAD (PB) TOT	184.0	198.0	22.6	6.6	209.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S45	SAIC-S45	SAIC-S45	SAIC-S45	SAIC-S45	SAIC-S46
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-775	HYD-9105-776	HYD-9105-777	HYD-9105-778	HYD-9105-779	HYD-9105-780
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	7450.0	7740.0	13700.0	4730.0	1940.0	1860.0
CADMIUM (CD) TOT	7.7	7.1	10.0	3.9	2.1	4.8
LEAD (PB) TOT	452.0	396.0	581.0	447.0	26.9	268.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S46	SAIC-S46	SAIC-S46	SAIC-S46	SAIC-S47	SAIC-S47
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-781	HYD-9105-782	HYD-9105-783	HYD-9105-784	HYD-9105-785	HYD-9105-786
--- METALS & MINOR CONSTITUENTS ---						
ARSENIC (AS) TOT	2590.0	3170.0	3120.0	2440.0	3880.0	4080.0
CADMIUM (CD) TOT	6.3	6.5	5.7	8.7	6.3	12.0
LEAD (PB) TOT	383.0	361.0	410.0	568.0	626.0	1130.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S47	SAIC-S47	SAIC-S47	SAIC-S48	SAIC-S48	SAIC-S48
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-787	HYD-9105-788	HYD-9105-789	HYD-9105-790	HYD-9105-791	HYD-9105-792
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	5380.0	5130.0	2150.0	791.0	584.0	780.0
CADMIUM (CD) TOT	14.8	12.4	6.1	6.2	9.6	9.2
LEAD (PB) TOT	1390.0	1640.0	15.9	492.0	376.0	338.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S48	SAIC-S48	SAIC-S49	SAIC-S50	SAIC-S50
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-793	HYD-9105-794	HYD-9105-795	HYD-9105-600	HYD-9105-796
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	48.8	96.7	2010.0	264.0	298.0
CADMIUM (CD) TOT	<0.5	<0.5	5.3	1.1	1.2
LEAD (PB) TOT	13.5	12.0	233.0	82.6	90.4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S50	SAIC-S50	SAIC-S50	SAIC-S51	SAIC-S52
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-797	HYD-9105-798	HYD-9105-799	HYD-9105-601	HYD-9105-602
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	374.0	994.0	62.1	49.3	9.6
CADMIUM (CD) TOT	0.95	2.8	<0.5	<0.5	<0.5
LEAD (PB) TOT	68.2	198.0	44.7	261.0	131.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S53	SAIC-S54	SAIC-S55	SAIC-S56
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91
LAB				
LAB NUMBER				
REMARKS	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-603	HYD-9105-604	HYD-9105-605	HYD-9105-606
--- METALS & MINOR CONSTITUENTS ---				
ARSENIC (AS) TOT	145.0	34.8	24.0	10.0
CADMIUM (CD) TOT	0.79	<0.5	1.3	<0.5
LEAD (PB) TOT	306.0	242.0	132.0	103.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S57	SAIC-S58	SAIC-S58	SAIC-S58	SAIC-S58	SAIC-S58
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-607	HYD-9105-608	HYD-9105-609	HYD-9105-610	HYD-9105-611	HYD-9105-612
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	18.0	16.0	8.0	3.5	3.1	4.1
CADMIUM (CD) TOT	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
LEAD (PB) TOT	167.0	253.0	34.9	<5.0	<5.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S59	SAIC-S60	SAIC-S61	SAIC-S62
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91
LAB				
LAB NUMBER				
REMARKS	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-613	HYD-9105-614	HYD-9105-615	HYD-9105-616
— METALS & MINOR CONSTITUENTS —				
ARSENIC (AS) TOT	4.0	23.3	80.0	90.0
CADMIUM (CD) TOT	<0.5	1.7	3.2	2.7
LEAD (PB) TOT	179.0	666.0	4540.0	150.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S63	SAIC-S64	SAIC-S64	SAIC-S64	SAIC-S64	SAIC-S64
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
SAMPLE TIME						:
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	6.0"	1.0'	2.0'	3.0'
SAMPLE NUMBER	HYD-9105-617	HYD-9105-618	HYD-9105-619	HYD-9105-620	HYD-9105-621	HYD-9105-622
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	141.0	151.0	776.0	363.0	11.0	1.8
CADMIUM (CD) TOT	2.9	6.5	14.3	11.0	<0.5	<0.5
LEAD (PB) TOT	178.0	384.0	1160.0	27.6	7.0	<5.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S65	SAIC-S66	SAIC-S67	SAIC-S67	SAIC-S67
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-623	HYD-9105-624	HYD-9105-625	HYD-9105-626	HYD-9105-627
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	131.0	134.0	143.0	63.6	21.2
CADMIUM (CD) TOT	1.7	2.7	2.5	0.76	<0.5
LEAD (PB) TOT	111.0	129.0	35.0	26.0	8.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S67	SAIC-S67	SAIC-S68	SAIC-S69	SAIC-S69
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	3.0'	0-2"	0-2"	6.0"
SAMPLE NUMBER	HYD-9105-628	HYD-9105-629	HYD-9105-630	HYD-9105-631	HYD-9105-632
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	1.9	1.7	100.0	66.7	121.0
CADMIUM (CD) TOT	<0.5	<0.5	1.3	1.2	3.4
LEAD (PB) TOT	<5.0	<5.0	90.4	248.0	3940.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S69	SAIC-S69	SAIC-S69	SAIC-S70	SAIC-S71
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	1.0'	2.0'	3.0'	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-633	HYD-9105-634	HYD-9105-635	HYD-9105-636	HYD-9105-637
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	40.7	3.5	4.4	51.2	333.0
CADMIUM (CD) TOT	4.8	0.89	1.7	0.82	1.9
LEAD (PB) TOT	330.0	12.7	<5.0	217.0	630.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S72	SAIC-S72	SAIC-S72	SAIC-S72	SAIC-S72	SAIC-S73
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB						
LAB NUMBER						
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	6.0"	1.0'	2.0'	3.0"	0-2"
SAMPLE NUMBER	HYD-9105-638	HYD-9105-639	HYD-9105-640	HYD-9105-641	HYD-9105-642	HYD-9105-643
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	891.0	1140.0	5360.0	11500.0	53100.0	70.9
CADMIUM (CD) TOT	1.2	1.6	4.7	20.0	22.0	1.7
LEAD (PB) TOT	82.4	119.0	268.0	374.0	161.0	57.9

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S73	SAIC-S73	SAIC-S73	SAIC-S73	SAIC-S74
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	6.0"	1.0'	2.0'	3.0'	0-2"
SAMPLE NUMBER	HYD-9105-644	HYD-9105-645	HYD-9105-646	HYD-9105-647	HYD-9105-648
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	80.6	84.5	27.8	26.8	788.0
CADMIUM (CD) TOT	1.6	1.2	<0.5	<0.5	4.9
LEAD (PB) TOT	65.8	44.4	<5.0	5.8	323.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S75	SAIC-S76	SAIC-S77	SAIC-S77	SAIC-S77
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91	05/01/91
LAB					
LAB NUMBER					
REMARKS	SAIC	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	6.0"	1.0'
SAMPLE NUMBER	HYD-9105-649	HYD-9105-650	HYD-9105-651	HYD-9105-652	HYD-9105-653
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	8080.0	556.0	114.0	9.5	33.8
CADMIUM (CD) TOT	5.1	6.3	2.1	<0.5	<0.5
LEAD (PB) TOT	386.0	419.0	71.8	27.6	53.6

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S77	SAIC-S78	SAIC-S79	SAIC-S80
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91
LAB				
LAB NUMBER				
REMARKS	SAIC	SAIC	SAIC	SAIC
DEPTH	2.0'	0-2"	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-654	HYD-9105-655	HYD-9105-656	HYD-9105-657
— METALS & MINOR CONSTITUENTS —				
ARSENIC (AS) TOT	23.5	1460.0	33.5	39.6
CADMIUM (CD) TOT	<0.5	137.0	1.4	1.1
LEAD (PB) TOT	49.1	827.0	71.6	152.0

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S81	SAIC-S82	SAIC-S83	SAIC-S84
SAMPLE DATE	05/01/91	05/01/91	05/01/91	05/01/91
LAB				
LAB NUMBER				
REMARKS	SAIC	SAIC	SAIC	SAIC
DEPTH	0-2"	0-2"	0-2"	0-2"
SAMPLE NUMBER	HYD-9105-658	HYD-9105-659	HYD-9105-660	HYD-9105-661
— METALS & MINOR CONSTITUENTS —				
ARSENIC (AS) TOT	53.9	54.9	276.0	22.8
CADMIUM (CD) TOT	1.8	0.82	1.6	0.69
LEAD (PB) TOT	67.1	89.4	175.0	74.1

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SAIC-S85	SL-1	SL-1	SL-1	SL-1
SAMPLE DATE	05/01/91	02/05/93	02/05/93	02/05/93	02/05/93
SAMPLE TIME		09:15	09:15	09:15	09:20
LAB		TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER		93-7262	93-7252	93-7255	93-7501
REMARKS	SAIC				
TYPE		TOTAL	SPLP	TCLP	
DEPTH	0-2"	27'	27'	27'	8' - 14'
SAMPLE NUMBER	HYD-9105-662	EVT-9302-852	EVT-9302-852S	EVT-9302-852T	EVT-9302-853
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) TOT	119.0	432.0	<0.1	0.2	163.0
BARIUM (BA) TOT		1645.0	<0.1	2.3	
CADMIUM (CD) TOT	<0.5	3.0	<0.1	<0.1	2.0
CHROMIUM (CR) TOT		145.0	<0.1	<0.1	
COPPER (CU) TOT		1011.0	<0.1	<0.1	
LEAD (PB) TOT	7.0	14790.0	<0.1	31.0	113.0
MERCURY (HG) TOT		0.0002	<0.001	<0.001	
SELENIUM (SE) TOT		32.0	<0.1	<0.1	
SILVER (AG) TOT		87.0	<0.1	<0.1	
ZINC (ZN) TOT		31870.0	<0.1	30.0	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SL-3	SL-3	SL-3	SL-3	SL-4	SL-4
SAMPLE DATE	02/04/93	02/05/93	02/05/93	02/05/93	02/04/93	02/04/93
SAMPLE TIME	14:00	08:10	08:10	08:10	09:00	09:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7503	93-7261	93-7251	93-7254	93-7260	93-7250
TYPE		TOTAL	SPLP	TCLP	TOTAL	SPLP
DEPTH	12 - 15'	55-60'	55-60'	55-60'	28-34'	28' - 34'
SAMPLE NUMBER	EVT-9302-860	EVT-9302-851	EVT-9302-851S	EVT-9302-851T	EVT-9302-850	EVT-9302-850S
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) TOT	270.0	410.0	<0.1	0.2	787.0	1.3
BARIUM (BA) TOT		8340.0	0.2	13.0	412.0	<0.1
CADMIUM (CD) TOT	2.0	1.0	<0.1	<0.1	7.0	<0.1
CHROMIUM (CR) TOT		99.0	<0.1	<0.1	44.0	<0.1
COPPER (CU) TOT		1701.0	<0.1	<0.1	1767.0	<0.1
LEAD (PB) TOT	486.0	8501.0	<0.1	7.8	18800.0	<0.1
MERCURY (HG) TOT		0.0002	<0.001	<0.001	0.0005	<0.001
SELENIUM (SE) TOT		25.0	<0.1	<0.1	19.0	<0.1
SILVER (AG) TOT		94.0	<0.1	<0.1	50.0	<0.1
ZINC (ZN) TOT		67410.0	<0.1	47.0	79380.0	<0.1

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Soil

SITE CODE	SL-4	SL-4
SAMPLE DATE	02/04/93	02/04/93
SAMPLE TIME	09:00	10:25
LAB	TSC-SLC	TSC-SLC
LAB NUMBER	93-7253	93-7502
TYPE	TCLP	
DEPTH	28-34'	18 - 20'
SAMPLE NUMBER	EVT-9302-850T	EVT-9302-855
— METALS & MINOR CONSTITUENTS —		
ARSENIC (AS) TOT	0.4	92.0
BARIUM (BA) TOT	0.5	
CADMIUM (CD) TOT	<0.1	5.0
CHROMIUM (CR) TOT	<0.1	
COPPER (CU) TOT	<0.1	
LEAD (PB) TOT	19.0	371.0
MERCURY (HG) TOT	<0.001	
SELENIUM (SE) TOT	<0.1	
SILVER (AG) TOT	<0.1	
ZINC (ZN) TOT	110.0	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-1	SW-1	SW-1	SW-1	SW-2	SW-2
SAMPLE DATE	03/18/93	03/18/93	05/19/93	12/10/93	03/18/93	05/19/93
SAMPLE TIME	10:05	10:30	08:30	11:45	10:15	09:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7580	93-7582	93-7868	93-9768	93-7581	93-7869
REMARKS		DUPLICATE				
SAMPLE NUMBER	EVT-9303-150	EVT-9303-152	EVT-9305-158	EVT-9312-107	EVT-9303-151	EVT-9305-159
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	PONDED	PONDED	PONDED	PONDED	2E	PONDED
PH (FLD)	7.13	7.13	7.38	6.26	7.6	7.41
PH	7.4	7.4	7.4		7.4	7.3
SC (UMHOS/CM AT 25 C)	360.0	380.0	450.0		400.0	445.0
SC (UMHOS/CM AT 25 C) (FLD)			421.0	128.0		419.0
WATER TEMPERATURE (C) (FLD)	9.3	9.3	16.7	8.9	8.9	16.4
— MAJOR CONSTITUENTS —						
CALCIUM (CA) DIS	39.0	42.0	64.0		47.0	66.0
MAGNESIUM (MG) DIS	6.7	7.0	12.0		7.3	12.0
SODIUM (NA) DIS	18.0	18.0	23.0		15.0	23.0
POTASSIUM (K) DIS	8.7	9.3	15.0		10.0	15.0
TOTAL ALKALINITY AS CACO3	141.0	147.0	214.0		174.0	220.0
BICARBONATE ALKALINITY AS CACO3	141.0	147.0	214.0		174.0	220.0
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0	<1.0		<1.0	<1.0
SULFATE (SO4)	9.9	9.2	15.0		11.0	12.0
CHLORIDE (CL)	14.0	15.0	10.0		6.7	9.0
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.619	0.542	1.24	.48	0.909	1.133
ARSENIC (AS) TOT	0.679	0.736	1.841	.39	3.265	1.652
CADMIUM (CD) DIS	<0.005	<0.005	<0.005	.003	<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<.003	<0.005	<0.005
LEAD (PB) DIS	0.007	0.006	0.011	.02	0.007	0.0093
LEAD (PB) TOT	0.025	0.032	0.029	.034	0.148	0.031
	J4		J4		J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-2	SW-3	SW-3	SW-3	SW-4
SAMPLE DATE	12/10/93	03/18/93	05/19/93	12/10/93	03/18/93
SAMPLE TIME	12:00	10:45	10:00	12:15	11:00
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-9769	93-7583	93-7871	93-9770	93-7584
SAMPLE NUMBER	EVT-9312-108	EVT-9303-153	EVT-9305-161	EVT-9312-109	EVT-9303-154
— PHYSICAL PARAMETERS —					
FLOW (gal/min)	PONDED	PONDED	PONDED	PONDED	PONDED
PH (FLD)	6.34	8.66	7.7	6.08	7.26
PH		8.4	7.6		7.0
SC (UMHOS/CM AT 25 C)		475.0	482.0		180.0
SC (UMHOS/CM AT 25 C) (FLD)	178.0		455.0	96.0	
WATER TEMPERATURE (C) (FLD)	9.0	11.7	13.8	8.6	11.6
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS		60.0	77.0		17.0
MAGNESIUM (MG) DIS		7.7	9.4		4.9
SODIUM (NA) DIS		19.0	22.0		6.6
POTASSIUM (K) DIS		14.0	14.0		7.1
TOTAL ALKALINITY AS CACO3		217.0	238.0		75.0
BICARBONATE ALKALINITY AS CACO3		207.0	238.0		75.0
CARBONATE ALKALINITY AS CACO3		10.0	<1.0		<1.0
SULFATE (SO4)		14.0	11.0		11.0
CHLORIDE (CL)		7.4	7.3		5.2
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS	.48	1.444	1.696	.14	0.427
ARSENIC (AS) TOT	.53	1.663	1.863	.47	0.778
CADMIUM (CD) DIS	.003	<0.005	<0.005	<.003	<0.005
CADMIUM (CD) TOT	.003	<0.005	<0.005	<.003	0.013
LEAD (PB) DIS	.026	0.016	0.011	.024	0.019
LEAD (PB) TOT	.046	0.057	0.07	.048	0.229

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-4	SW-4	SW-5	SW-5	SW-5
SAMPLE DATE	05/19/93	12/10/93	03/18/93	05/19/93	12/10/93
SAMPLE TIME	09:30	12:30	11:30	10:30	12:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7870	93-9771	93-7585	93-7872	93-9772
SAMPLE NUMBER	EVT-9305-160	EVT-9312-110	EVT-9303-155	EVT-9305-162	EVT-9312-111
— PHYSICAL PARAMETERS —					
FLOW (gal/min)	PONDED	PONDED	PONDED	PONDED	PONDED
PH (FLD)	7.59	6.23	6.34	6.93	5.5
PH	7.1		6.7	6.9	
SC (UMHOS/CM AT 25 C)	310.0		350.0	440.0	
SC (UMHOS/CM AT 25 C) (FLD)	292.0	88.0		389.0	114.0
WATER TEMPERATURE (C) (FLD)	16.4	8.1	9.4	15.8	8.9
— MAJOR CONSTITUENTS —					
CALCIUM (CA) DIS	43.0		33.0	43.0	
MAGNESIUM (MG) DIS	12.0		13.0	14.0	
SODIUM (NA) DIS	13.0		20.0	26.0	
POTASSIUM (K) DIS	5.3		11.0	15.0	
TOTAL ALKALINITY AS CACO3	156.0		133.0	206.0	
BICARBONATE ALKALINITY AS CACO3	156.0		133.0	206.0	
CARBONATE ALKALINITY AS CACO3	<1.0		<1.0	<1.0	
SULFATE (SO4)	3.2		29.0	38.0	
CHLORIDE (CL)	1.7		16.0	14.0	
— METALS & MINOR CONSTITUENTS —					
ARSENIC (AS) DIS	0.418	.15	0.035	0.15	.047
ARSENIC (AS) TOT	0.826	.19	0.064	0.428	.048
CADMIUM (CD) DIS	<0.005	.008	<0.005	<0.005	<.003
CADMIUM (CD) TOT	<0.005	.006	<0.005	<0.005	<.003
LEAD (PB) DIS	<0.005	.006	0.012	0.012	.025
LEAD (PB) TOT	0.029	.019	0.023	0.467	.035
	J4		J4	J4	

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-5B	SW-6	SW-6	SW-6	SW-6	SW-6
SAMPLE DATE	12/10/93	03/22/93	03/22/93	03/22/93	03/23/93	03/23/93
SAMPLE TIME	13:00	15:15	15:15	17:10	07:30	07:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-9773	93-7587	93-7588	93-7595	93-7603	93-7604
REMARKS			DUPLICATE			DUPLICATE
SAMPLE NUMBER	EVT-9312-112	EVT-9303-160	EVT-9303-161	EVT-9303-168	EVT-9303-176	EVT-9303-177
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	2E	2E	2E	4E	0.1E	0.1E
PH (FLD)	6.28	7.56	7.56	7.44	7.86	7.86
SC (UMHOS/CM AT 25 C) (FLD)	92.0					
WATER TEMPERATURE (C) (FLD)	8.5	13.1	13.1	13.0	9.6	9.6
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	1.2					
ARSENIC (AS) TOT	1.4	0.034	0.024	0.028	1.068	1.048
CADMIUM (CD) DIS	.006					
CADMIUM (CD) TOT	.005	<0.005	<0.005	<0.005	<0.005	<0.005
LEAD (PB) DIS	<.005					
LEAD (PB) TOT	.016	0.146	0.088	0.118	0.025	0.025

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-6	SW-6	SW-6	SW-6	SW-6	SW-7
SAMPLE DATE	12/10/93	12/10/93	01/23/94	01/23/94	01/23/94	03/22/93
SAMPLE TIME	10:15	10:30	12:40	13:00	16:10	15:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-9766	93-9767	94-317	94-319	94-327	93-7589
REMARKS		DUPLICATE		DUPLICATE		
SAMPLE NUMBER	EVT-9312-105	EVT-9312-106	EVT-9401-906	EVT-9401-908	EVT-9401-916	EVT-9303-162
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	9.2	9.2	16.5	16.5	19.8	0.1E
PH (FLD)	6.93	6.93	8.26	8.26	7.04	7.5
SC (UMHOS/CM AT 25 C) (FLD)	104.0	104.0	63.0	63.0	54.0	
WATER TEMPERATURE (C) (FLD)	8.4	8.4	10.1	10.1	9.9	12.9
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	4.7	5.1	0.111	0.146	0.253	
			J4		J4	
ARSENIC (AS) TOT	5.8	5.6	0.2	0.23	0.2	0.026
CADMIUM (CD) DIS	.024	.026	<0.005	<0.005	<0.005	
CADMIUM (CD) TOT	.025	.023	<0.005	<0.005	<0.005	<0.005
LEAD (PB) DIS	<.005	<.005	<0.005	<0.005	<0.005	
LEAD (PB) TOT	.025	.023	0.07	0.073	0.15	0.027
			J4		J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
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Sample Type: Surface Water

SITE CODE	SW-7	SW-7	SW-7	SW-7	SW-8	SW-8
SAMPLE DATE	03/22/93	12/10/93	01/23/94	01/23/94	03/22/93	03/22/93
SAMPLE TIME	17:20	10:00	12:20	16:00	16:00	17:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7596	93-9765	94-316	94-326	93-7590	93-7597
SAMPLE NUMBER	EVT-9303-169	EVT-9312-104	EVT-9401-905	EVT-9401-915	EVT-9303-163	EVT-9303-170
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	0.2E	2.31	0.8	1.5	1E	1.5E
PH (FLD)	7.6	7.14	7.63	6.85	7.62	7.46
SC (UMHOS/CM AT 25 C) (FLD)		187.0	44.0	42.0		
WATER TEMPERATURE (C) (FLD)	12.7	8.1	10.3	10.6	13.4	12.8
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS		10.0	0.348	0.1		
ARSENIC (AS) TOT	0.022	12.0	0.44	0.094	0.011	0.02
	UJ1				UJ1	UJ1
CADMIUM (CD) DIS		.058	<0.005	<0.005		
CADMIUM (CD) TOT	<0.005	.06	<0.005	<0.005	<0.005	<0.005
LEAD (PB) DIS		<.005	<0.005	<0.005		
LEAD (PB) TOT	0.023	.008	0.034	0.035	0.036	0.043
	J4		J4	J4	J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-8	SW-8	SW-8	SW-9	SW-9	SW-9
SAMPLE DATE	12/10/93	01/23/94	01/23/94	03/22/93	03/22/93	12/10/93
SAMPLE TIME		12:10	15:45	16:15	17:40	09:45
LAB	HYDRO	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	HYDRO	94-315	94-325	93-7591	93-7598	93-9764
REMARKS	NO SAMPLE					
SAMPLE NUMBER	EVT-9312-115	EVT-9401-904	EVT-9401-914	EVT-9303-164	EVT-9303-171	EVT-9312-103
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	DRY	0.5	4.0	0.5E	0.5E	0.14
PH (FLD)		7.98	7.05	7.01	7.01	7.47
SC (UMHOS/CM AT 25 C) (FLD)		41.0	36.5			147.0
WATER TEMPERATURE (C) (FLD)		10.3	10.0	13.4	13.0	8.4
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS		0.0053	0.0073			<.005
ARSENIC (AS) TOT		0.01	0.015	0.027	0.054	.006
CADMIUM (CD) DIS		<0.005	<0.005			.004
CADMIUM (CD) TOT		<0.005	<0.005	<0.005	<0.005	<.003
LEAD (PB) DIS		<0.005	<0.005			<.005
LEAD (PB) TOT		0.024	0.047	0.069	0.116	.009

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-9	SW-9	SW-10	SW-10	SW-10	SW-10
SAMPLE DATE	01/23/94	01/23/94	03/22/93	03/22/93	12/10/93	01/23/94
SAMPLE TIME	11:55	15:35	16:20	17:50	09:30	11:40
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-314	94-324	93-7592	93-7599	93-9763	94-313
SAMPLE NUMBER	EVT-9401-903	EVT-9401-913	EVT-9303-165	EVT-9303-172	EVT-9312-102	EVT-9401-902
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	0.54	2.3	1E	0.7E	2.31	0.76
PH (FLD)	6.9	7.06	6.95	7.01	7.08	7.11
SC (UMHOS/CM AT 25 C) (FLD)	153.0	14.7			206.0	133.0
WATER TEMPERATURE (C) (FLD)	10.4	10.2	13.2	12.7	8.8	10.1
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	<0.005	<0.005			6.4	0.021
	J4	J4				J4
ARSENIC (AS) TOT	0.01	0.013	0.014	0.009	6.2	0.025
CADMIUM (CD) DIS	<0.005	<0.005			.026	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<0.005	.025	<0.005
LEAD (PB) DIS	<0.005	<0.005			<.005	<0.005
LEAD (PB) TOT	0.02	0.076	0.0086	0.0078	<.005	0.0099
	J4	J4	J4	J4		J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-10	SW-11	SW-11	SW-11	SW-11	SW-11
SAMPLE DATE	01/23/94	03/22/93	03/22/93	12/10/93	01/23/94	01/23/94
SAMPLE TIME	15:20	16:30	18:00	09:10	11:30	13:45
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-322	93-7593	93-7600	93-9762	94-312	94-321
SAMPLE NUMBER	EVT-9401-911	EVT-9303-166	EVT-9303-173	EVT-9312-101	EVT-9401-901	EVT-9401-910
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	0.4	0.5E	<0.1E	0.61	0.99	0.23
PH (FLD)	7.02	6.99	6.93	6.84	5.34	7.22
SC (UMHOS/CM AT 25 C) (FLD)	12.6			106.0	59.0	75.0
WATER TEMPERATURE (C) (FLD)	10.3	12.8	12.6	8.6	9.9	11.3
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	0.018			<.005	<0.005	<0.005
	J4				J4	J4
ARSENIC (AS) TOT	0.022	<0.005	<0.005	<.005	0.0063	0.012
CADMIUM (CD) DIS	<0.005			<.003	<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<.003	<0.005	<0.005
LEAD (PB) DIS	<0.005			<.005	<0.005	<0.005
LEAD (PB) TOT	<0.005	0.0071	<0.005	<.005	0.009	0.01
	J4	J4	J4		J4	J4

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-11	SW-12	SW-12	SW-12	SW-12	SW-12
SAMPLE DATE	01/23/94	03/22/93	03/22/93	12/10/93	01/23/94	01/23/94
SAMPLE TIME	14:15	16:40	18:10	08:30	12:00	13:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	94-323	93-7594	93-7601	93-9761	94-311	94-320
REMARKS	DUPLICATE					
SAMPLE NUMBER	EVT-9401-912	EVT-9303-167	EVT-9303-174	EVT-9312-100	EVT-9401-900	EVT-9401-909
— PHYSICAL PARAMETERS —						
FLOW (gal/min)	0.23	1E	0.5E	0.05	2.0	0.15
PH (FLD)	7.22	7.04	6.87	6.68	7.02	7.53
SC (UMHOS/CM AT 25 C) (FLD)	75.0			15.7	125.0	62.0
WATER TEMPERATURE (C) (FLD)	11.3	12.9	12.7	8.8	9.8	10.4
— METALS & MINOR CONSTITUENTS —						
ARSENIC (AS) DIS	<0.005			<.005	<0.005	<0.005
ARSENIC (AS) TOT	0.011	<0.005	<0.005	<.005	<0.005	<0.005
CADMIUM (CD) DIS	<0.005			<.003	<0.005	<0.005
CADMIUM (CD) TOT	<0.005	<0.005	<0.005	<.003	<0.005	<0.005
LEAD (PB) DIS	<0.005			<.005	<0.005	<0.005
LEAD (PB) TOT	0.0075	0.025	0.017	.005	0.023	0.015

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
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J5:QC Ommission; R:Rejected; T:Frequency Violation.

Sample Type: Surface Water

SITE CODE	SW-14	SW-14	SW-14
SAMPLE DATE	05/19/93	05/19/93	12/10/93
SAMPLE TIME	11:00	11:30	13:30
LAB	TSC-SLC	TSC-SLC	TSC-SLC
LAB NUMBER	93-7873	93-7874	93-9775
REMARKS		DUPLICATE	
SAMPLE NUMBER	EVT-9305-163	EVT-9305-165	EVT-9312-114
— PHYSICAL PARAMETERS —			
FLOW (gal/min)	PONDED	PONDED	PONDED
PH (FLD)	7.25	7.25	
PH	7.0	6.9	
SC (UMHOS/CM AT 25 C)	600.0	550.0	
SC (UMHOS/CM AT 25 C) (FLD)	590.0	590.0	
WATER TEMPERATURE (C) (FLD)	17.3	17.3	
— MAJOR CONSTITUENTS —			
CALCIUM (CA) DIS	48.0	49.0	
MAGNESIUM (MG) DIS	12.0	12.0	
SODIUM (NA) DIS	61.0	64.0	
POTASSIUM (K) DIS	9.1	9.0	
TOTAL ALKALINITY AS CACO3	274.0	270.0	
BICARBONATE ALKALINITY AS CACO3	274.0	270.0	
CARBONATE ALKALINITY AS CACO3	<1.0	<1.0	
SULFATE (SO4)	29.0	24.0	
CHLORIDE (CL)	19.0	19.0	
— METALS & MINOR CONSTITUENTS —			
ARSENIC (AS) DIS	0.77	0.787	0.0006
ARSENIC (AS) TOT	2.861	2.203	.72
CADMIUM (CD) DIS	<0.005	<0.005	.003
CADMIUM (CD) TOT	<0.005	<0.005	.003
LEAD (PB) DIS	<0.005	<0.005	.035
LEAD (PB) TOT	0.372 J4	0.082	.031

NOTES: All results in mg/L (Water) or mg/kg (Soil) unless noted and are laboratory (LAB) unless field (FLD) or calculated (CALC)
TOT:Total; DIS:Dissolved; TRC:Total Recoverable; E:Estimated; <:Less Than Detect. Blank: parameter not tested
Validation Flags: A:Anomalous; UJ1:Blank; J2,UJ2: Standard; J3:Hold Time; J4,UJ4:Duplicate, Spike, or Split Exceedance;
J5:QC Ommission; R:Rejected; T:Frequency Violation.

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ANALYSES SUMMARY REPORT

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153	SAIC-S19	SAIC-S19	Soil		
153	SAIC-S20	SAIC-S20	Soil		
154	SAIC-S21	SAIC-S21	Soil		
155	SAIC-S22	SAIC-S22	Soil		
155	SAIC-S23	SAIC-S23	Soil		
156	SAIC-S24	SAIC-S24	Soil		
156	SAIC-S25	SAIC-S25	Soil		
157	SAIC-S26	SAIC-S26	Soil		
158	SAIC-S27	SAIC-S27	Soil		
159	SAIC-S28	SAIC-S28	Soil		
160	SAIC-S29	SAIC-S29	Soil		
161	SAIC-S30	SAIC-S30	Soil		
161	SAIC-S31	SAIC-S31	Soil		
162	SAIC-S32	SAIC-S32	Soil		
163	SAIC-S33	SAIC-S33	Soil		
163	SAIC-S34	SAIC-S34	Soil		
164	SAIC-S35	SAIC-S35	Soil		
165	SAIC-S36	SAIC-S36	Soil		
166	SAIC-S37	SAIC-S37	Soil		
167	SAIC-S38	SAIC-S38	Soil		
167	SAIC-S39	SAIC-S39	Soil		
168	SAIC-S40	SAIC-S40	Soil		
169	SAIC-S41	SAIC-S41	Soil		
170	SAIC-S42	SAIC-S42	Soil		
170	SAIC-S43	SAIC-S43	Soil		
171	SAIC-S44	SAIC-S44	Soil		
172	SAIC-S45	SAIC-S45	Soil		
172	SAIC-S46	SAIC-S46	Soil		
173	SAIC-S47	SAIC-S47	Soil		
174	SAIC-S48	SAIC-S48	Soil		
175	SAIC-S49	SAIC-S49	Soil		
175	SAIC-S50	SAIC-S50	Soil		
176	SAIC-S51	SAIC-S51	Soil		
176	SAIC-S52	SAIC-S52	Soil		
177	SAIC-S53	SAIC-S53	Soil		
177	SAIC-S54	SAIC-S54	Soil		
177	SAIC-S55	SAIC-S55	Soil		
177	SAIC-S56	SAIC-S56	Soil		
178	SAIC-S57	SAIC-S57	Soil		
178	SAIC-S58	SAIC-S58	Soil		
179	SAIC-S59	SAIC-S59	Soil		
179	SAIC-S60	SAIC-S60	Soil		
179	SAIC-S61	SAIC-S61	Soil		
179	SAIC-S62	SAIC-S62	Soil		
180	SAIC-S63	SAIC-S63	Soil		
180	SAIC-S64	SAIC-S64	Soil		
181	SAIC-S65	SAIC-S65	Soil		
181	SAIC-S66	SAIC-S66	Soil		
181	SAIC-S67	SAIC-S67	Soil		
182	SAIC-S68	SAIC-S68	Soil		
182	SAIC-S69	SAIC-S69	Soil		
183	SAIC-S70	SAIC-S70	Soil		
183	SAIC-S71	SAIC-S71	Soil		
184	SAIC-S72	SAIC-S72	Soil		
184	SAIC-S73	SAIC-S73	Soil		
185	SAIC-S74	SAIC-S74	Soil		
186	SAIC-S75	SAIC-S75	Soil		
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197	SW-8	SW-8	Surface Water		
198	SW-9	SW-9	Surface Water		
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194	EVT-9303-155	93-7585	03/18/93	SW-5
31	EVT-9303-156	93-7586	03/18/93	D.I.BLANK
195	EVT-9303-160	93-7587	03/22/93	SW-6
195	EVT-9303-161	93-7588	03/22/93	SW-6
196	EVT-9303-162	93-7589	03/22/93	SW-7
197	EVT-9303-163	93-7590	03/22/93	SW-8
198	EVT-9303-164	93-7591	03/22/93	SW-9
199	EVT-9303-165	93-7592	03/22/93	SW-10
200	EVT-9303-166	93-7593	03/22/93	SW-11
201	EVT-9303-167	93-7594	03/22/93	SW-12
195	EVT-9303-168	93-7595	03/22/93	SW-6
197	EVT-9303-169	93-7596	03/22/93	SW-7
197	EVT-9303-170	93-7597	03/22/93	SW-8
198	EVT-9303-171	93-7598	03/22/93	SW-9
199	EVT-9303-172	93-7599	03/22/93	SW-10
200	EVT-9303-173	93-7600	03/22/93	SW-11
201	EVT-9303-174	93-7601	03/22/93	SW-12
31	EVT-9303-175	93-7602	03/22/93	D.I.BLANK
195	EVT-9303-176	93-7603	03/23/93	SW-6
195	EVT-9303-177	93-7604	03/23/93	SW-6
31	EVT-9303-178	93-7605	03/23/93	D.I.BLANK
22	EVT-9304-110	93-7699	04/21/93	MW-1
5	EVT-9304-111	93-7700	04/21/93	EV-3
6	EVT-9304-111	D612A	04/21/93	EV-3
10	EVT-9304-112	93-7701	04/21/93	EV-4B
5	EVT-9304-113	93-7702	04/21/93	EV-1
11	EVT-9304-114	93-7703	04/21/93	EV-5
11	EVT-9304-114	D612B	04/21/93	EV-5
26	EVT-9304-115	93-7704	04/21/93	MW-4B
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11	EVT-9304-116	D612C	04/21/93	EV-5
25	EVT-9304-117	93-7706	04/22/93	MW-4A
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23	EVT-9304-119	93-7708	04/22/93	MW-2
28	EVT-9304-120	93-7709	04/22/93	MW-5
29	EVT-9304-121	93-7710	04/22/93	WP-1
29	EVT-9304-122	93-7711	04/22/93	WP-1
31	EVT-9304-123	93-7712	04/22/93	D.I.BLANK
9	EVT-9304-124		04/22/93	EV-4A
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55	EVT-9304-251	93-7659	04/12/93	MW-4B-S
55	EVT-9304-252	93-7660	04/12/93	MW-4B-S
56	EVT-9304-255	93-7661	04/12/93	MW-4B-S
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27	33022	EVT-9306-141	06/16/93	MW-4B
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117	33468-3	EVT-9307-715	07/15/93	S-111
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28	33751	EVT-9408-100	08/23/94	MW-5
25	33752	EVT-9408-102	08/23/94	MW-3
39	35793-1	EVT-9302-205	02/01/93	EV-2A-S
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22	93-7242	EVT-9302-100	02/17/93	MW-1
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189	93-7252	EVT-9302-852S	02/05/93	SL-1
191	93-7253	EVT-9302-850T	02/04/93	SL-4
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141	EVT-9401-214	94-131	01/10/94	S-309
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192	93-7582	EVT-9303-152	03/18/93	SW-1
193	93-7583	EVT-9303-153	03/18/93	SW-3
193	93-7584	EVT-9303-154	03/18/93	SW-4
194	93-7585	EVT-9303-155	03/18/93	SW-5
31	93-7586	EVT-9303-156	03/18/93	D.I.BLANK
195	93-7587	EVT-9303-160	03/22/93	SW-6
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196	93-7589	EVT-9303-162	03/22/93	SW-7
197	93-7590	EVT-9303-163	03/22/93	SW-8
198	93-7591	EVT-9303-164	03/22/93	SW-9
199	93-7592	EVT-9303-165	03/22/93	SW-10
200	93-7593	EVT-9303-166	03/22/93	SW-11
201	93-7594	EVT-9303-167	03/22/93	SW-12
195	93-7595	EVT-9303-168	03/22/93	SW-6
197	93-7596	EVT-9303-169	03/22/93	SW-7
197	93-7597	EVT-9303-170	03/22/93	SW-8
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201	93-7601	EVT-9303-174	03/22/93	SW-12
31	93-7602	EVT-9303-175	03/22/93	D.I.BLANK
195	93-7603	EVT-9303-176	03/23/93	SW-6
195	93-7604	EVT-9303-177	03/23/93	SW-6
31	93-7605	EVT-9303-178	03/23/93	D.I.BLANK
55	93-7658	EVT-9304-250	04/12/93	MW-4B-S
55	93-7659	EVT-9304-251	04/12/93	MW-4B-S
55	93-7660	EVT-9304-252	04/12/93	MW-4B-S
56	93-7661	EVT-9304-255	04/12/93	MW-4B-S
54	93-7662	EVT-9304-259	04/12/93	MW-3-S
54	93-7663	EVT-9304-260	04/12/93	MW-3-S
54	93-7664	EVT-9304-262	04/12/93	MW-3-S
54	93-7665	EVT-9304-263	04/12/93	MW-3-S
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53	93-7669	EVT-9304-267	04/13/93	MW-2-S
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24	93-7952	EVT-9306-136	06/16/93	MW-3
23	93-7953	EVT-9306-137	06/16/93	MW-2
26	93-7954	EVT-9306-138	06/16/93	MW-4A
27	93-7955	EVT-9306-139	06/16/93	MW-4B
33	93-7956	EVT-9306-140	06/16/93	RINSBLANK
27	93-7957	EVT-9306-141	06/16/93	MW-4B
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146	HYD-9105-826		05/01/91	SAIC-S9
146	HYD-9105-827		05/01/91	SAIC-S9
146	HYD-9105-828		05/01/91	SAIC-S9
146	HYD-9105-829		05/01/91	SAIC-S10
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LAB NUMBER ORDER

Page	Lab ##	Sample Number	Date	Site Code
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58	94-940	EVT-9404-206	04/19/94	PU-2
58	94-941	EVT-9404-207	04/19/94	PU-2
58	94-942	EVT-9404-208	04/19/94	PU-2
58	94-943	EVT-9404-209	04/19/94	PU-3
58	94-944	EVT-9404-210	04/19/94	PU-3
59	94-945	EVT-9404-211	04/19/94	PU-3
59	94-946	EVT-9404-212	04/19/94	PU-3
59	94-947	EVT-9404-213	04/19/94	PU-4
59	94-948	EVT-9404-214	04/19/94	PU-4
59	94-949	EVT-9404-215	04/19/94	PU-4
59	94-950	EVT-9404-216	04/19/94	PU-4
60	94-951	EVT-9404-217	04/19/94	PU-5
60	94-952	EVT-9404-218	04/19/94	PU-5
60	94-953	EVT-9404-219	04/19/94	PU-5
60	94-954	EVT-9404-220	04/19/94	PU-5
60	94-955	EVT-9404-221	04/19/94	PU-6
60	94-956	EVT-9404-222	04/19/94	PU-6
61	94-957	EVT-9404-223	04/19/94	PU-6
61	94-958	EVT-9404-224	04/19/94	PU-6
61	94-959	EVT-9404-225	04/19/94	PU-7
61	94-960	EVT-9404-226	04/19/94	PU-7
61	94-961	EVT-9404-227	04/19/94	PU-7
61	94-962	EVT-9404-228	04/19/94	PU-7
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62	94-965	EVT-9404-231	04/19/94	PU-8
62	94-966	EVT-9404-232	04/19/94	PU-8
62	94-967	EVT-9404-233	04/19/94	PU-8
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64	94-975	EVT-9404-242	04/19/94	PU-11
64	94-976	EVT-9404-243	04/19/94	PU-11
64	94-977	EVT-9404-244	04/19/94	PU-11
64	94-978	EVT-9404-245	04/19/94	PU-11
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66	94-988	EVT-9404-256	04/19/94	PU-14
66	94-989	EVT-9404-258	04/19/94	PU-15
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67	94-991	EVT-9404-260	04/19/94	PU-15
67	94-992	EVT-9404-261	04/19/94	PU-15
15	94-9923	EVT-9312-200	12/28/93	EV-6B
14	94-9924	EVT-9312-201	12/28/93	EV-6A
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10	94-9927	EVT-9312-204	12/28/93	EV-4B
9	94-9928	EVT-9312-205	12/28/93	EV-4A
6	94-9929	EVT-9312-206	12/29/93	EV-3
67	94-993	EVT-9404-262	04/19/94	PU-16
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19	94-9931	EVT-9312-208	12/29/93	EV-8B
19	94-9932	EVT-9312-209	12/29/93	EV-8A
19	94-9933	EVT-9312-210	12/29/93	EV-8B
22	94-9934	EVT-9312-211	12/29/93	EV-9B
21	94-9935	EVT-9312-212	12/29/93	EV-9A
29	94-9936	EVT-9312-213	12/29/93	WP-1
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APPENDIX B

SOIL METAL CONCENTRATION TRENDS

APPENDIX B

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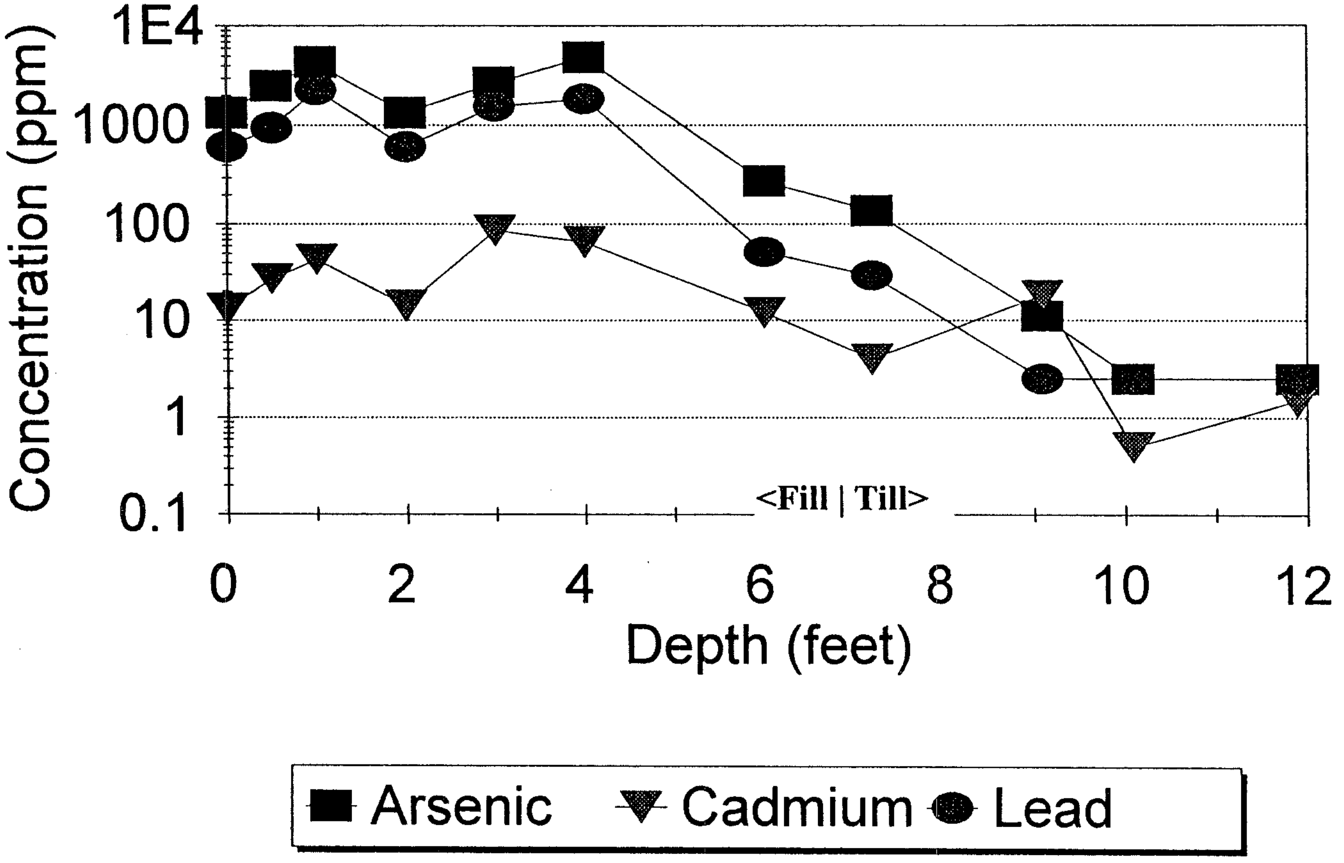
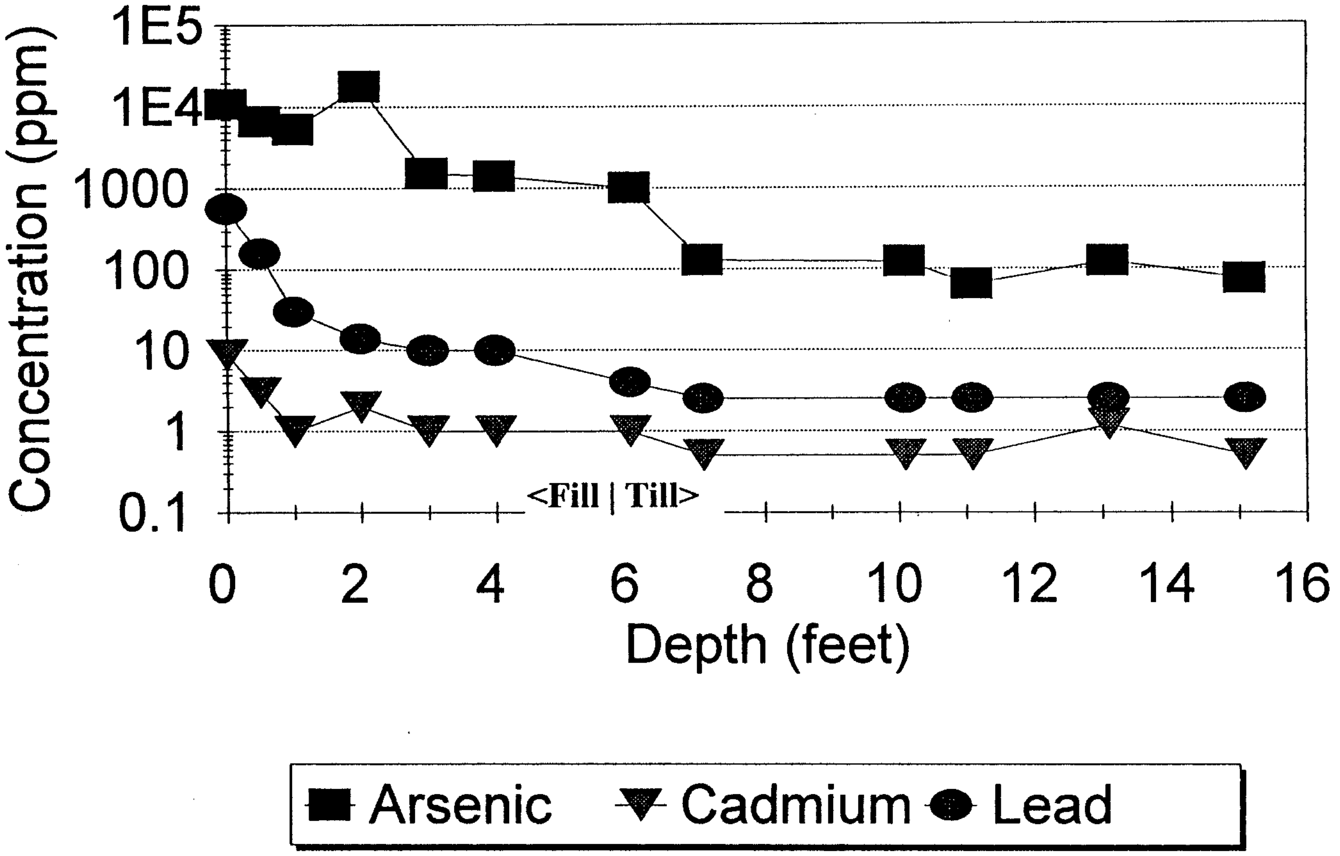
RESIDENTIAL AREA

LOWLAND AREA



5/23/94

Soil Metal Concentrations
Location S-4
Figure B-1



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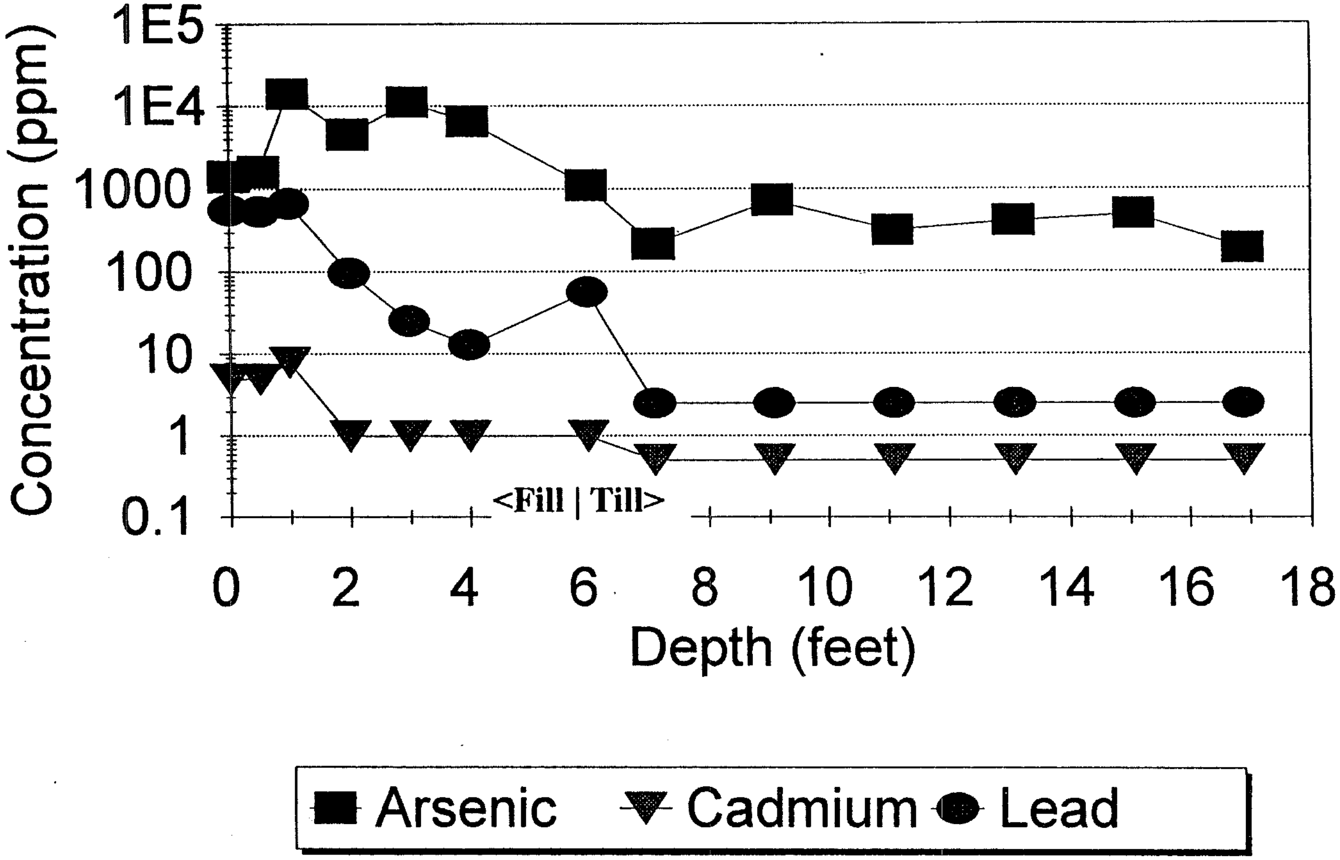
Soil Metal Concentrations
Location S–8
Figure B–2



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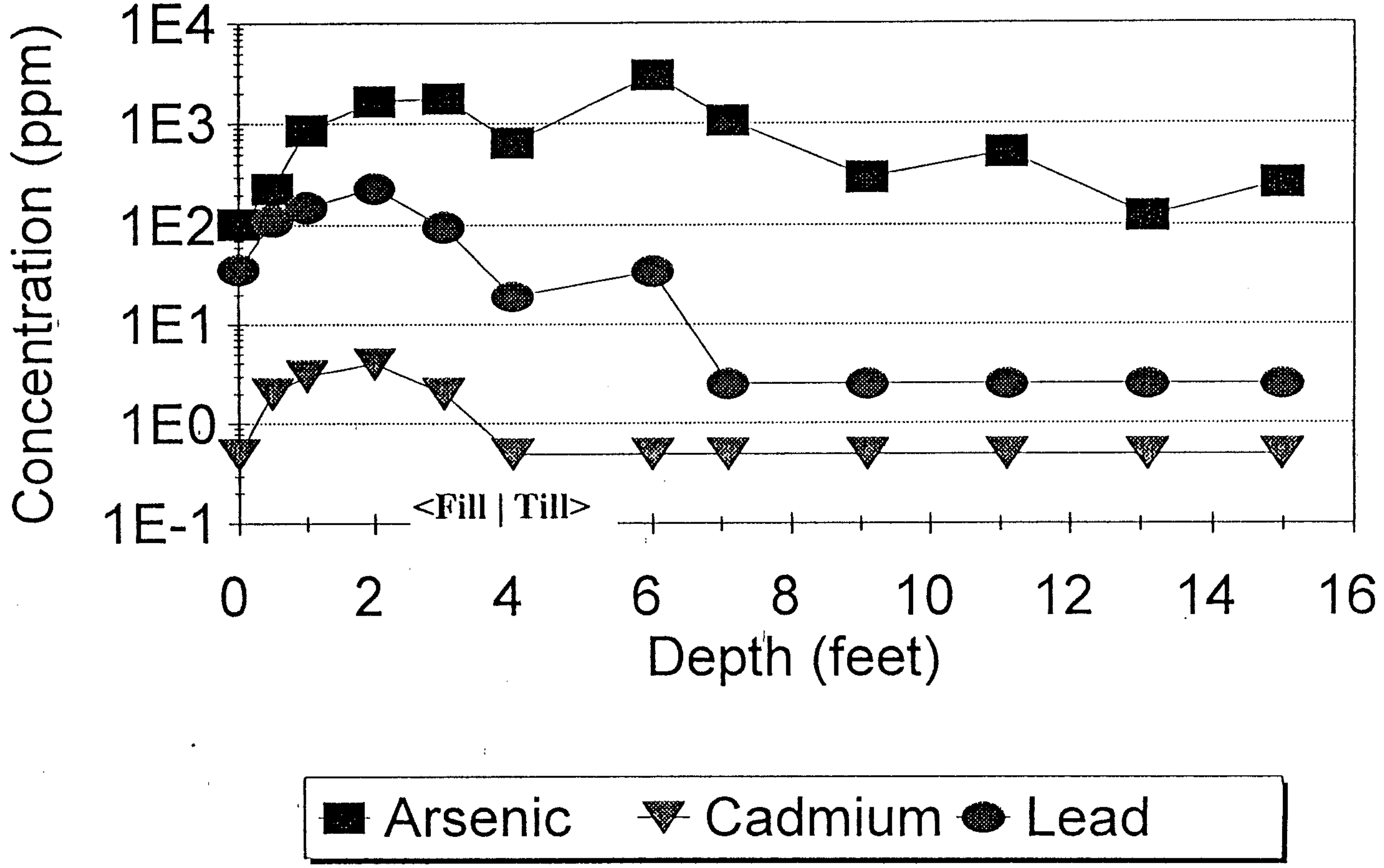
Soil Metal Concentrations
Location S-13
Figure B-3



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Soil Metal Concentrations
Location S-15
Figure B-4

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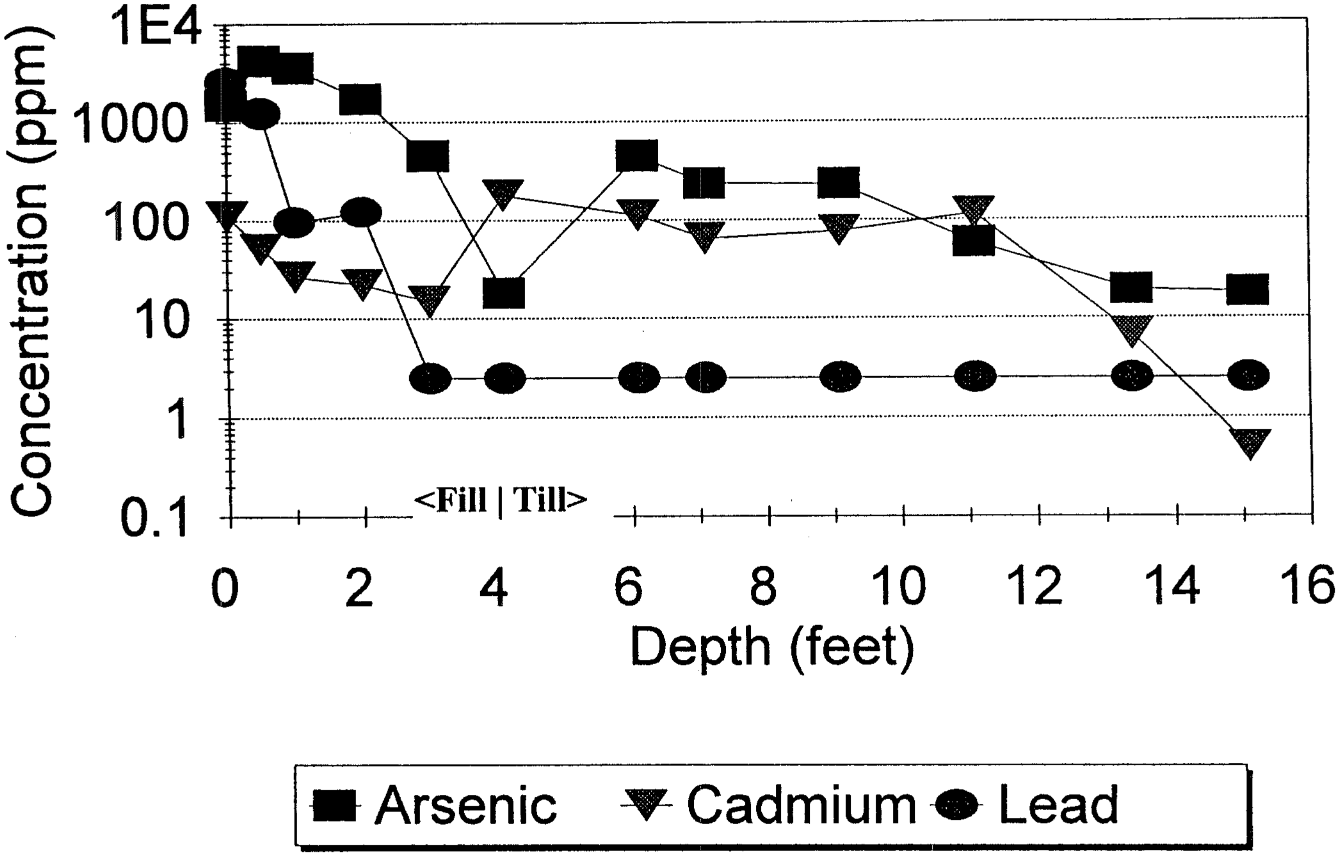

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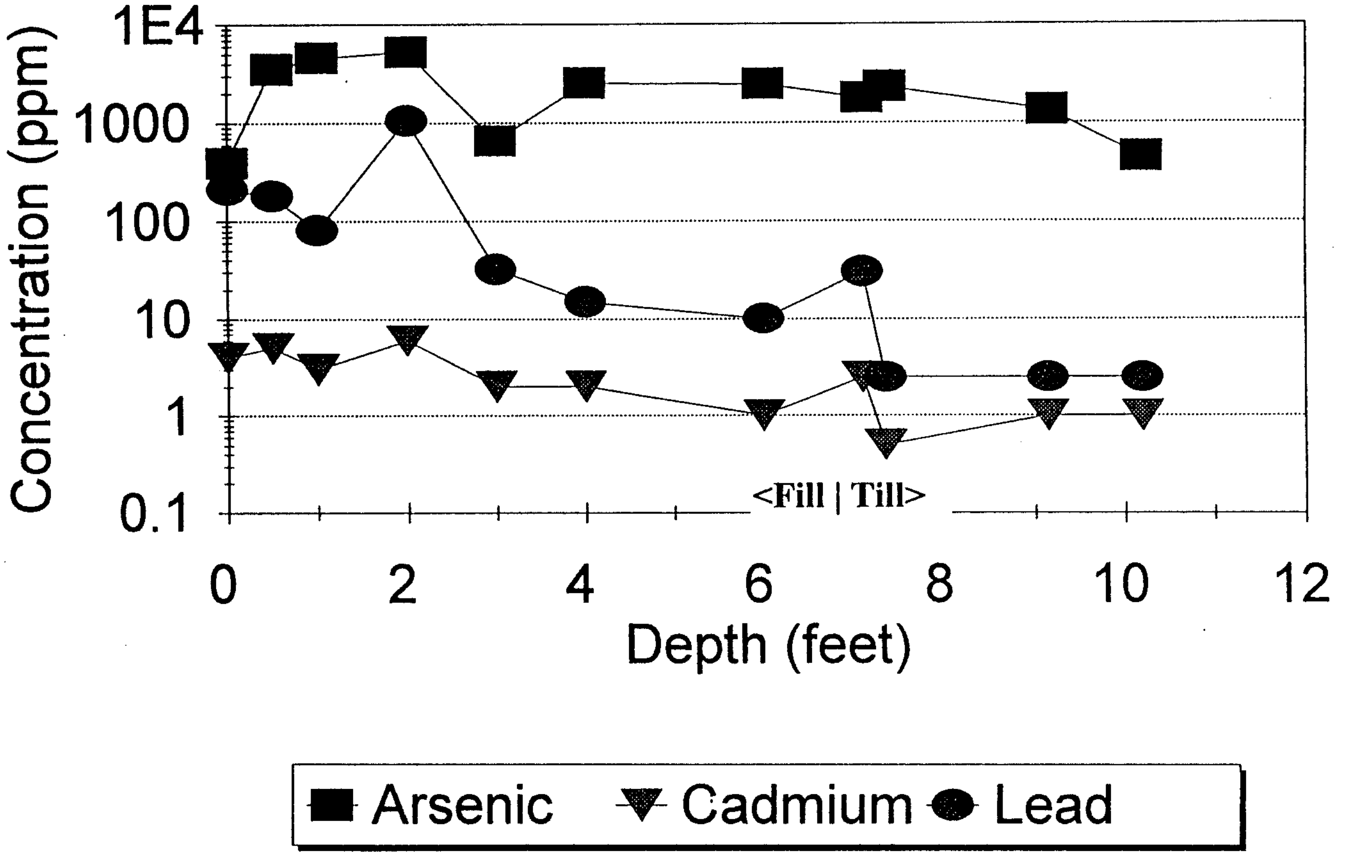
Soil Metal Concentrations
Location S-22
Figure B-5



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Soil Metal Concentrations
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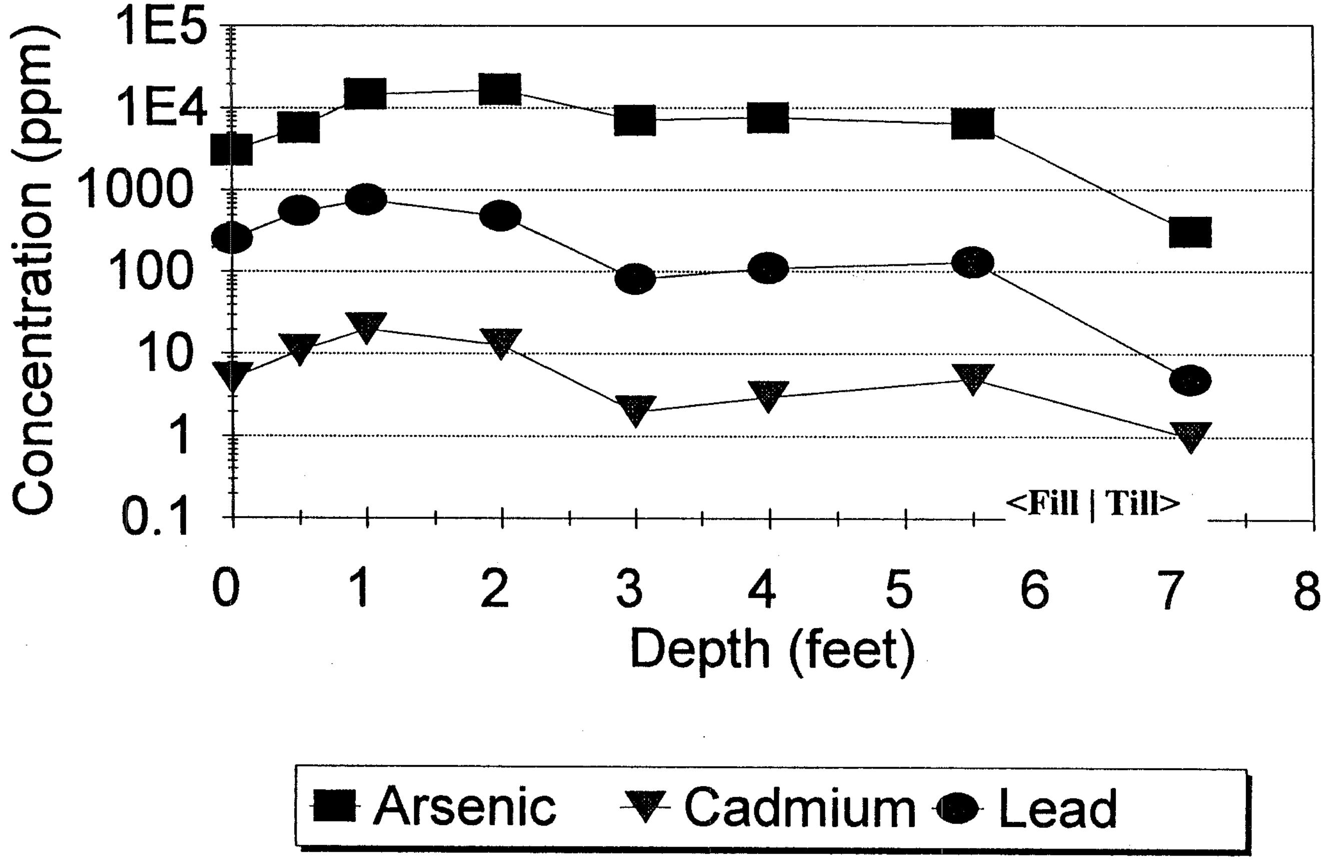
Figure B–6



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Soil Metal Concentrations
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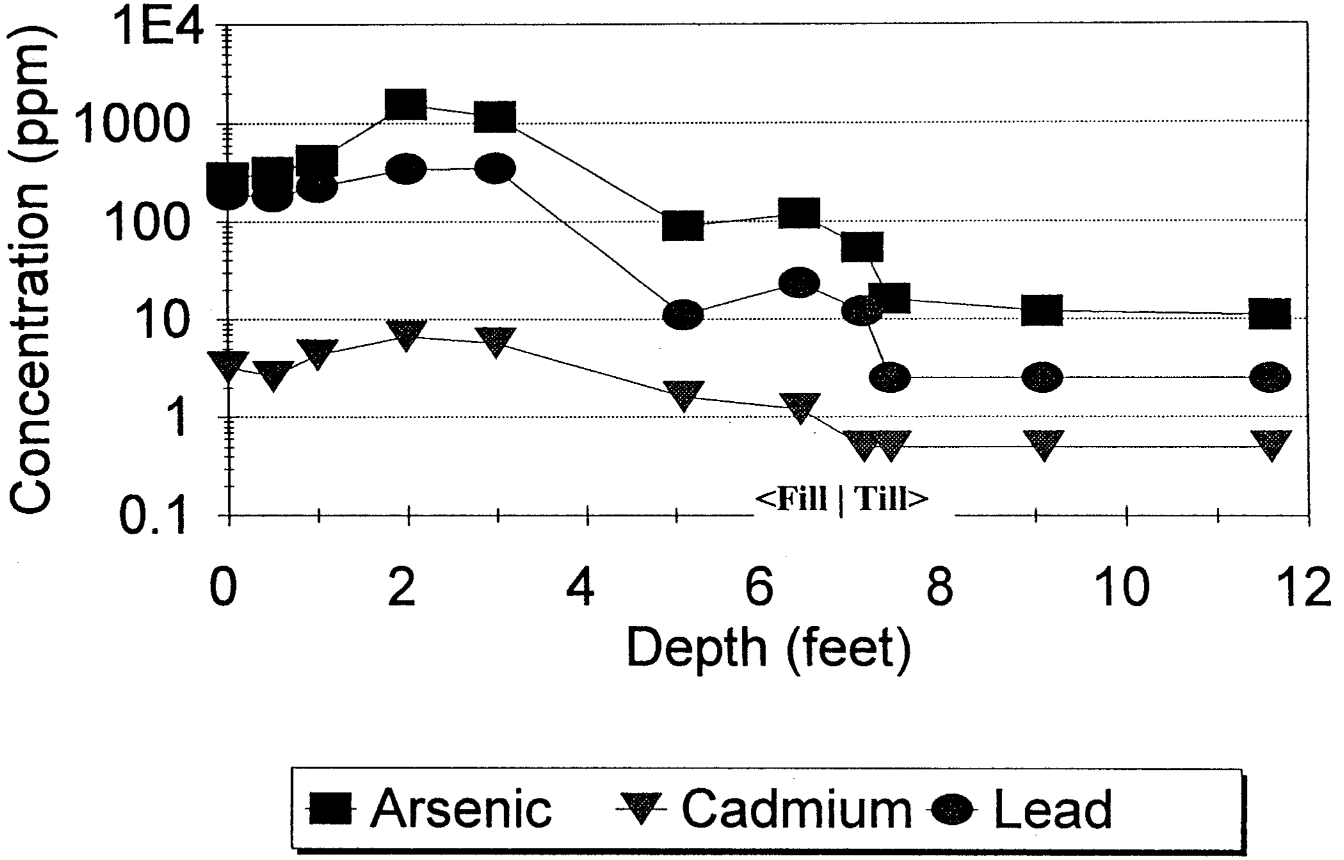
Figure B-7



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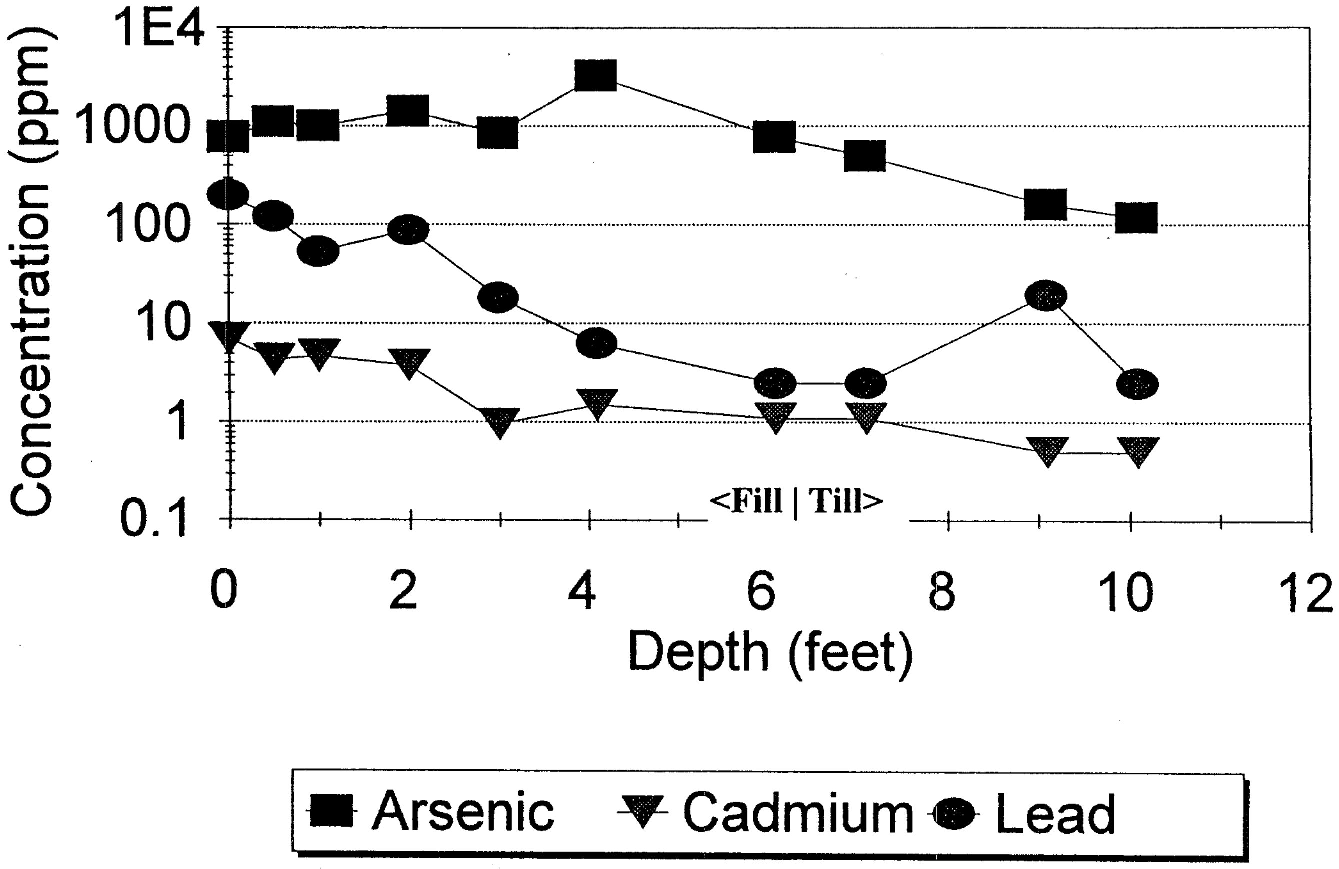
Soil Metal Concentrations
Location S-34
Figure B-8



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Soil Metal Concentrations
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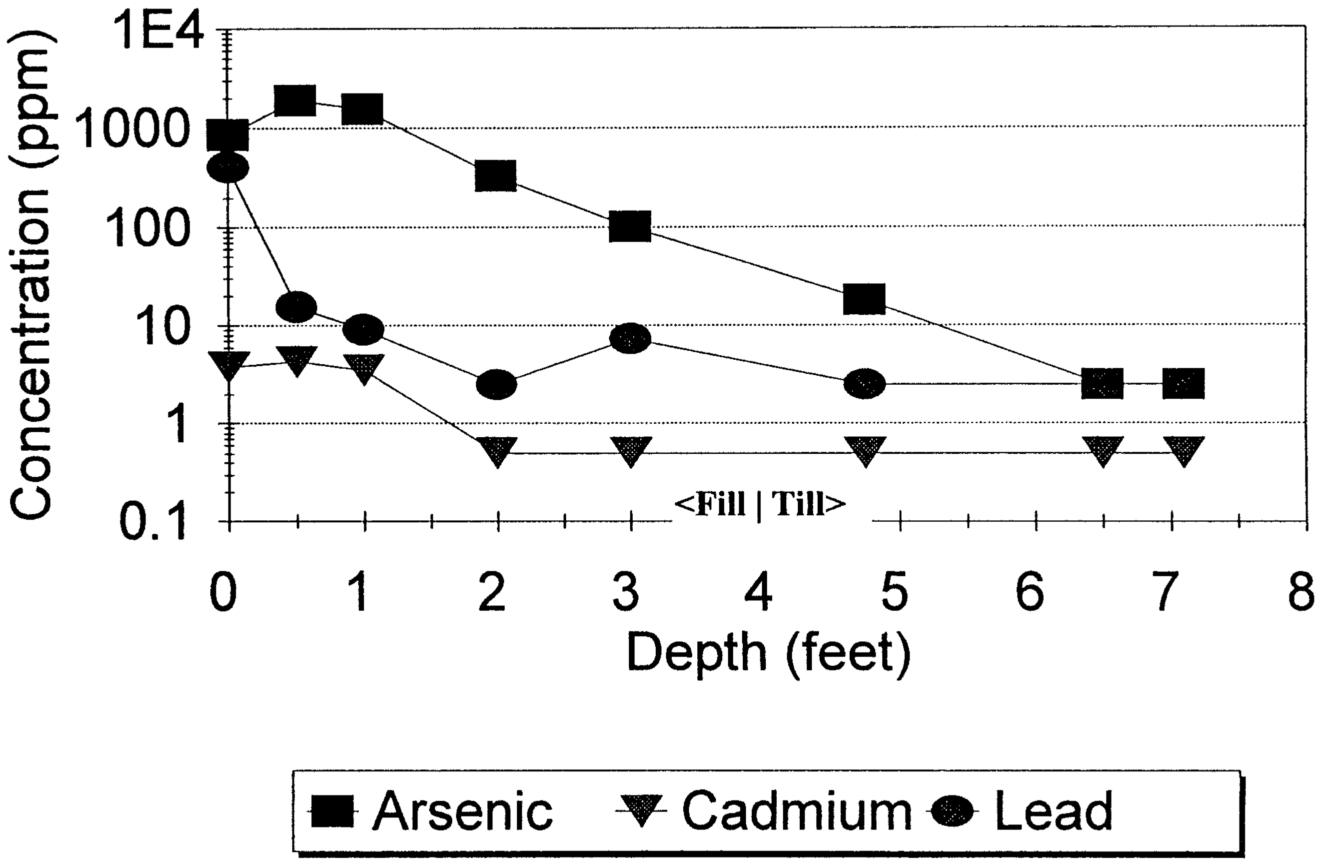

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Soil Metal Concentrations
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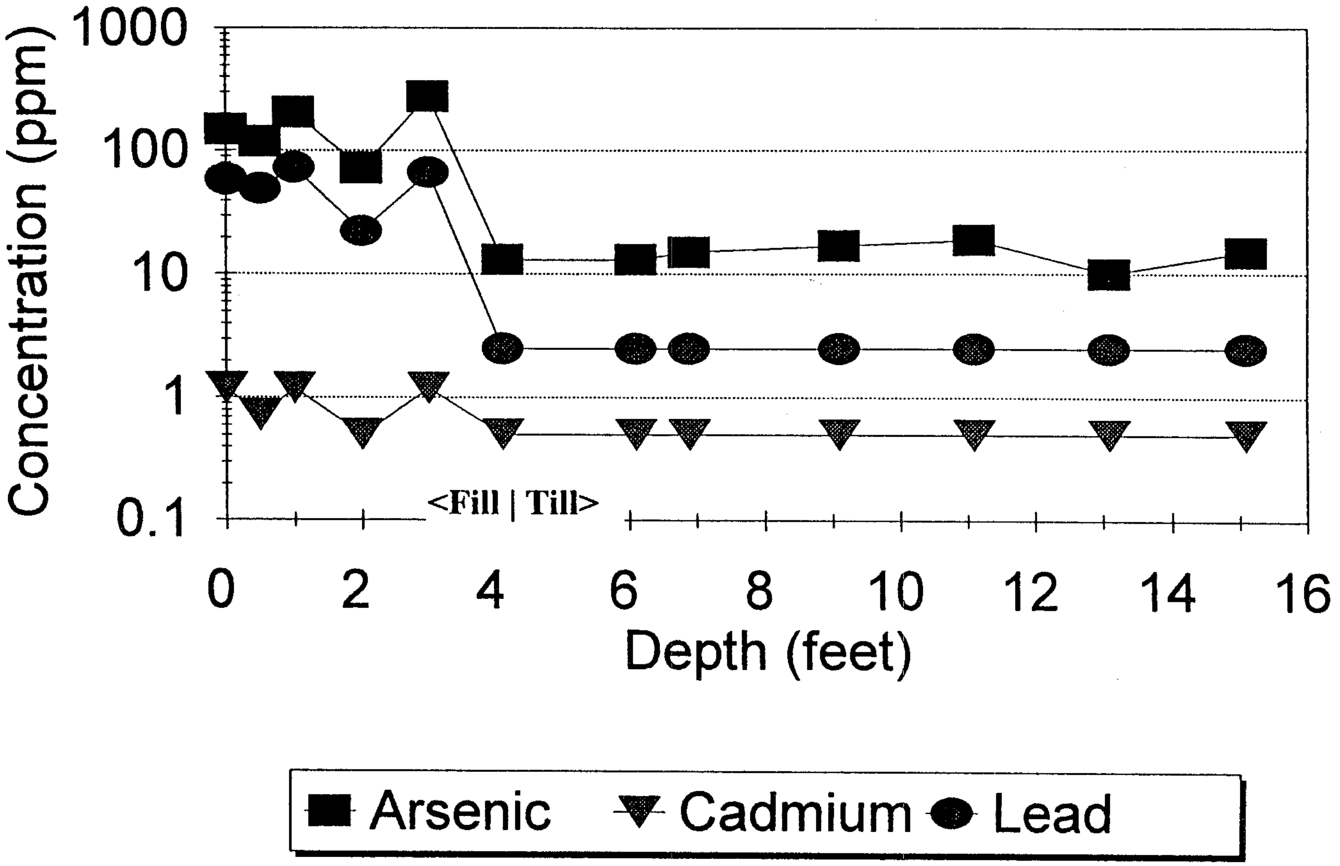
Figure B-10



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Soil Metal Concentrations
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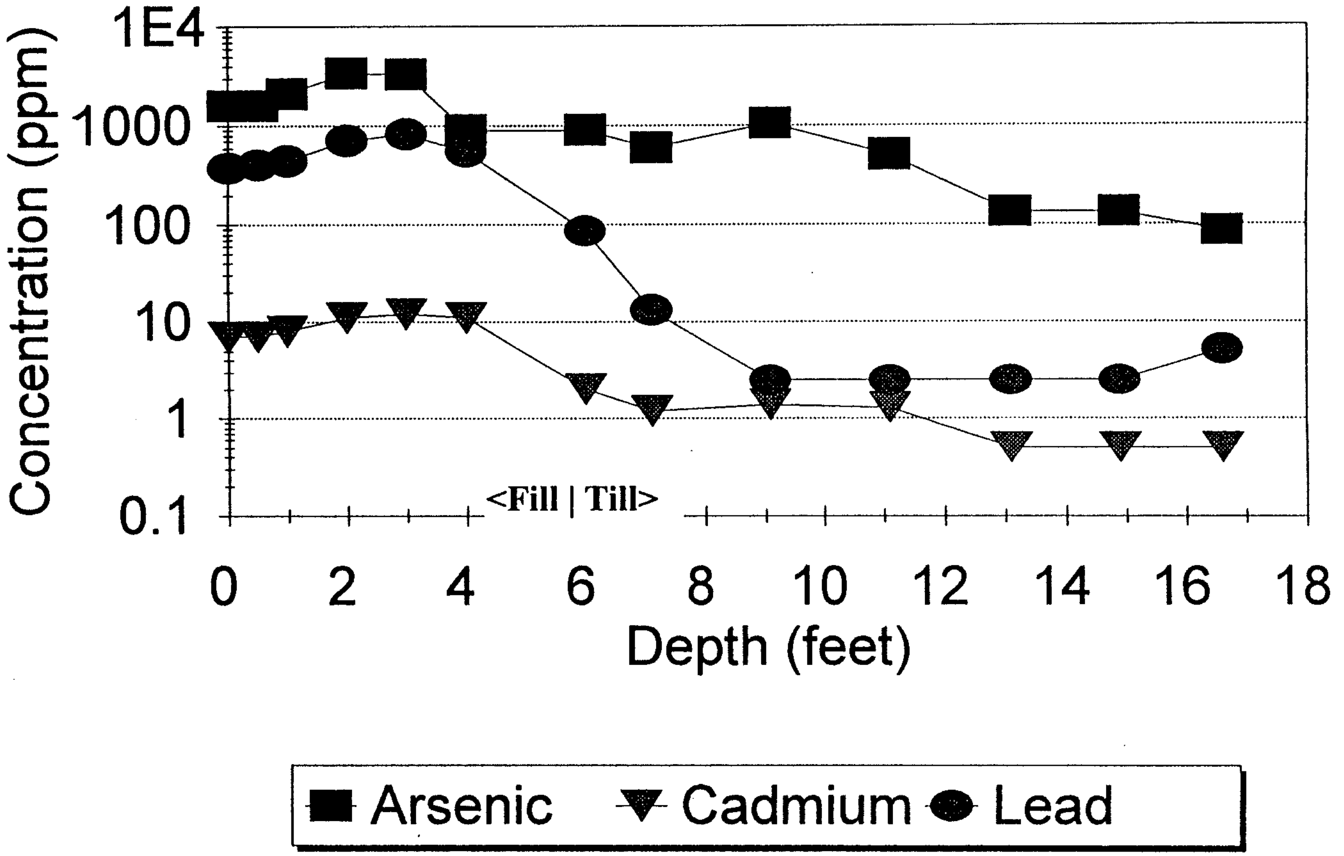

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Soil Metal Concentrations
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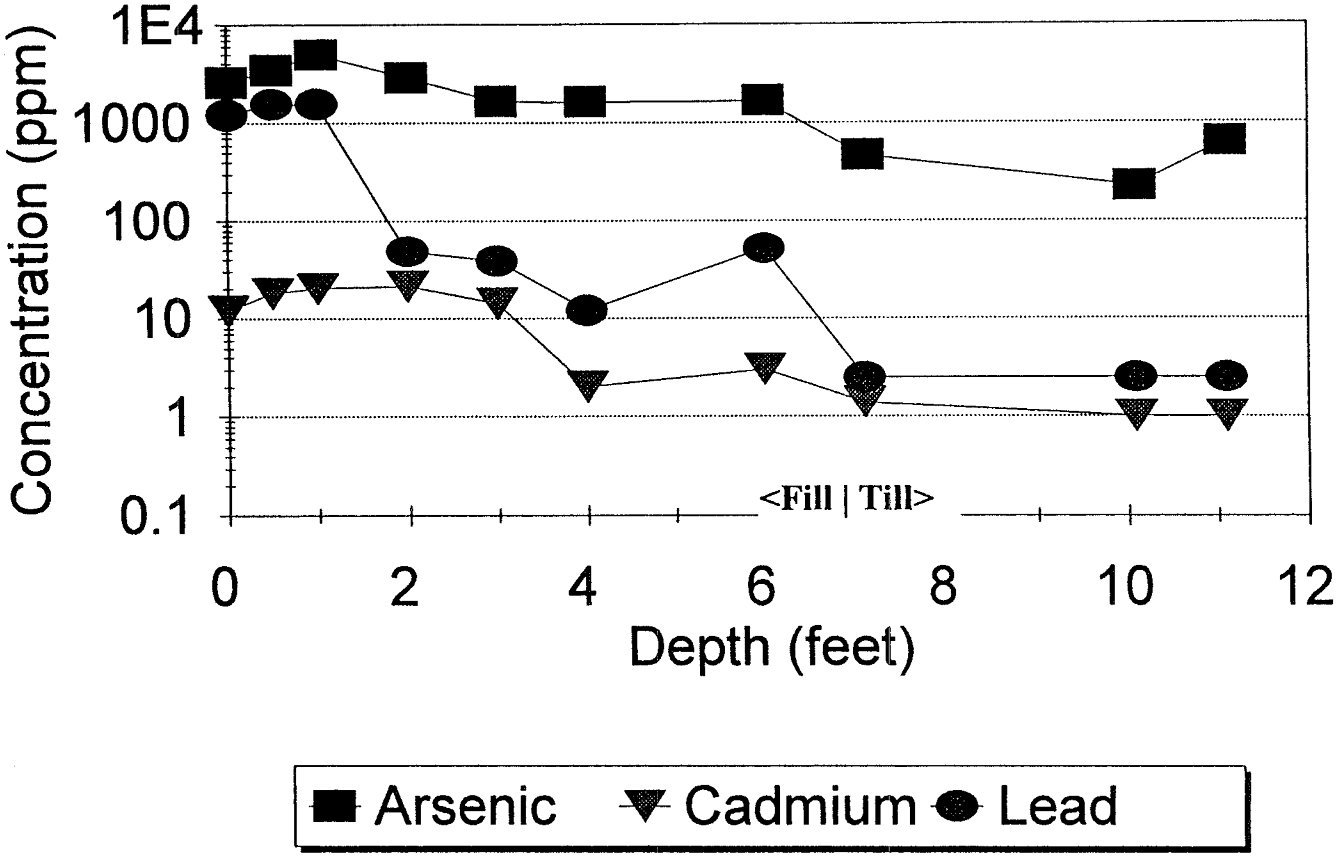

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Soil Metal Concentrations
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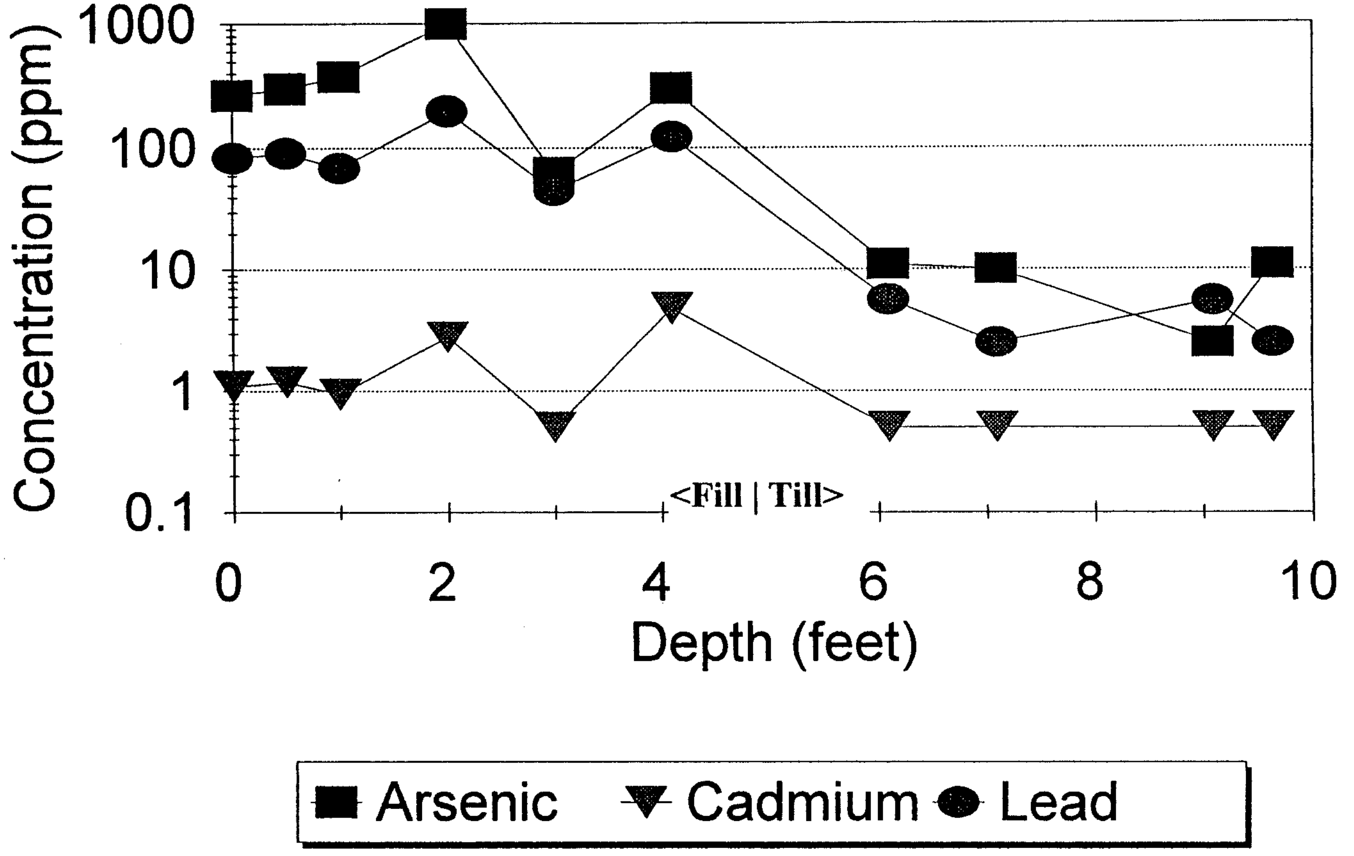

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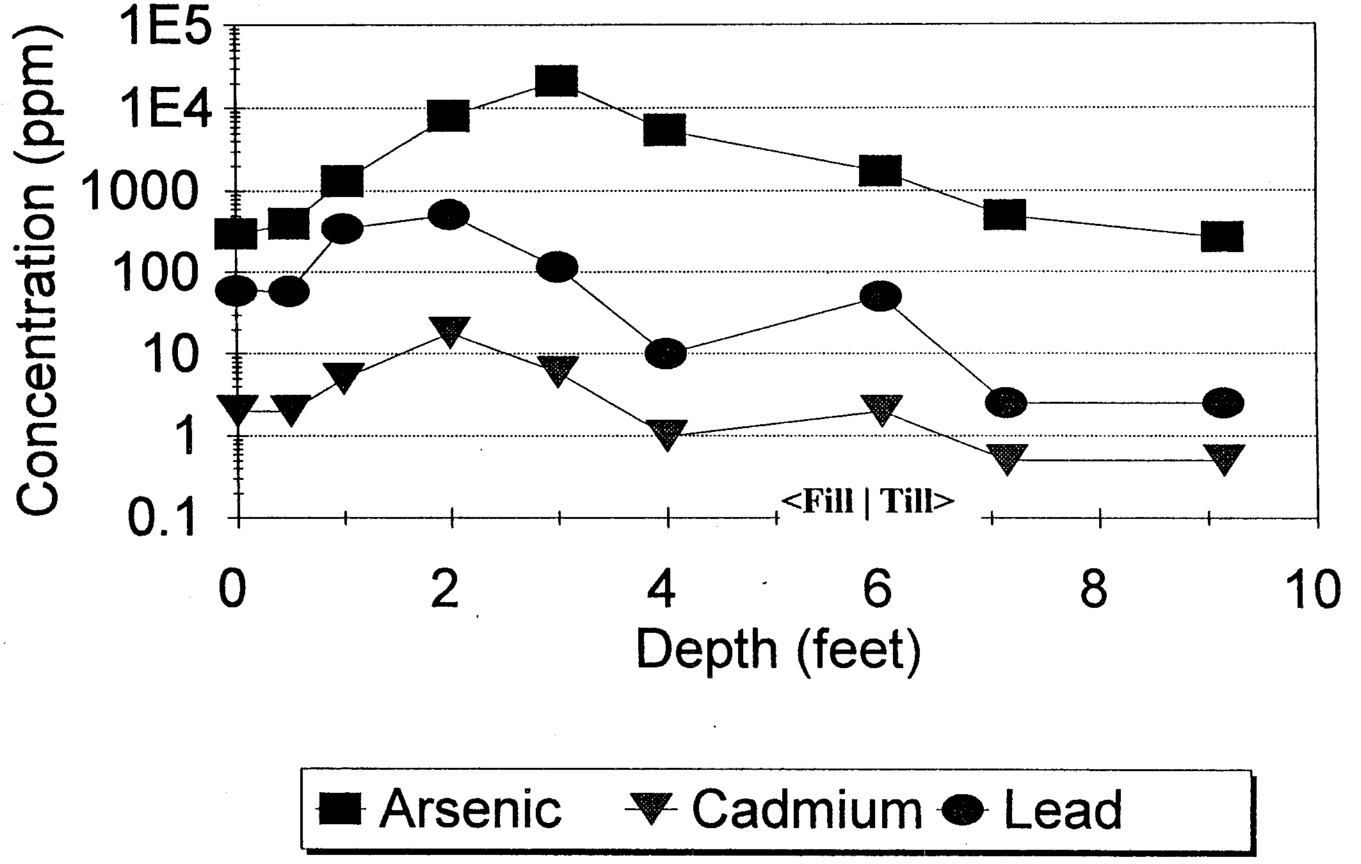
Soil Metal Concentrations
Location S-50
Figure B-14



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Soil Metal Concentrations
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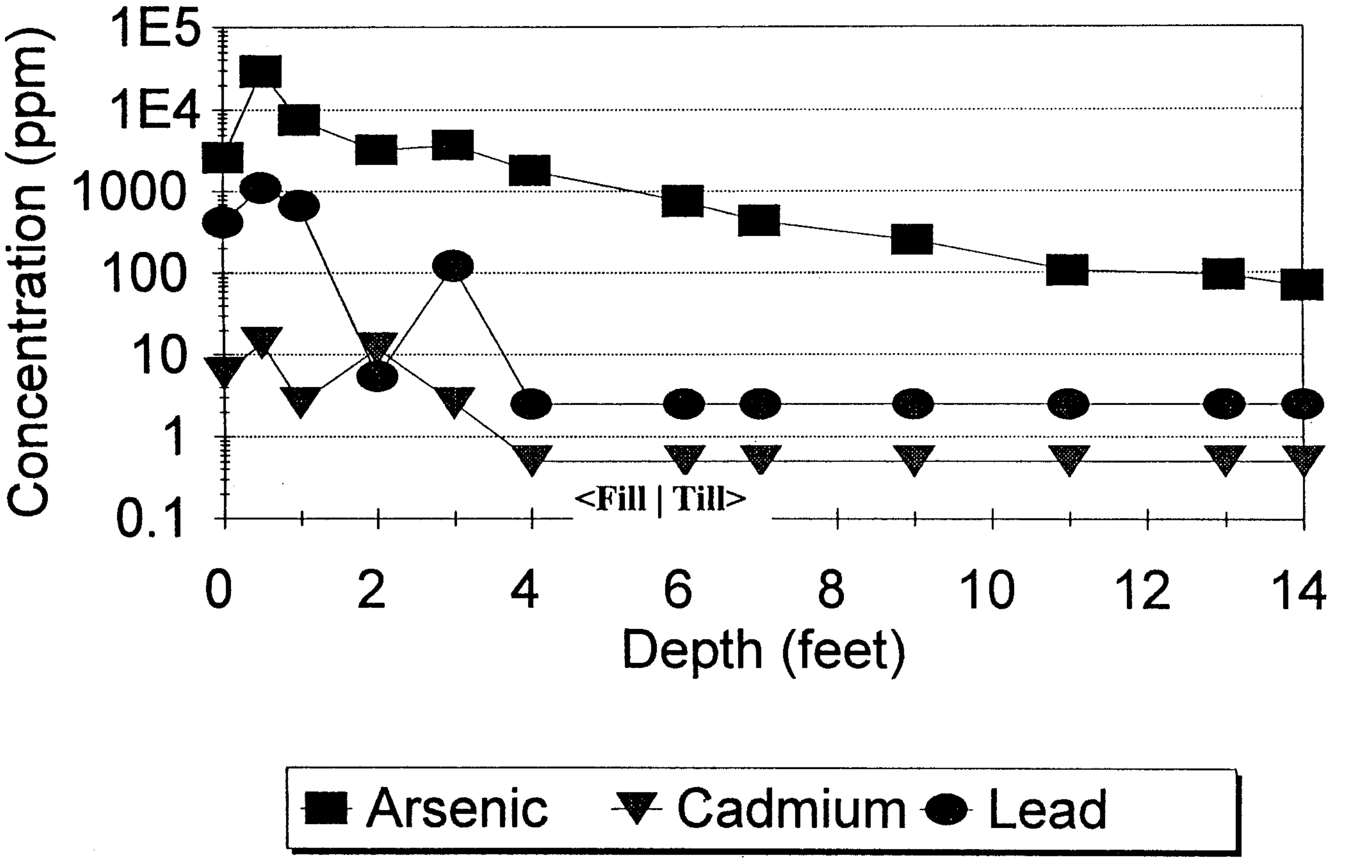

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Soil Metal Concentrations
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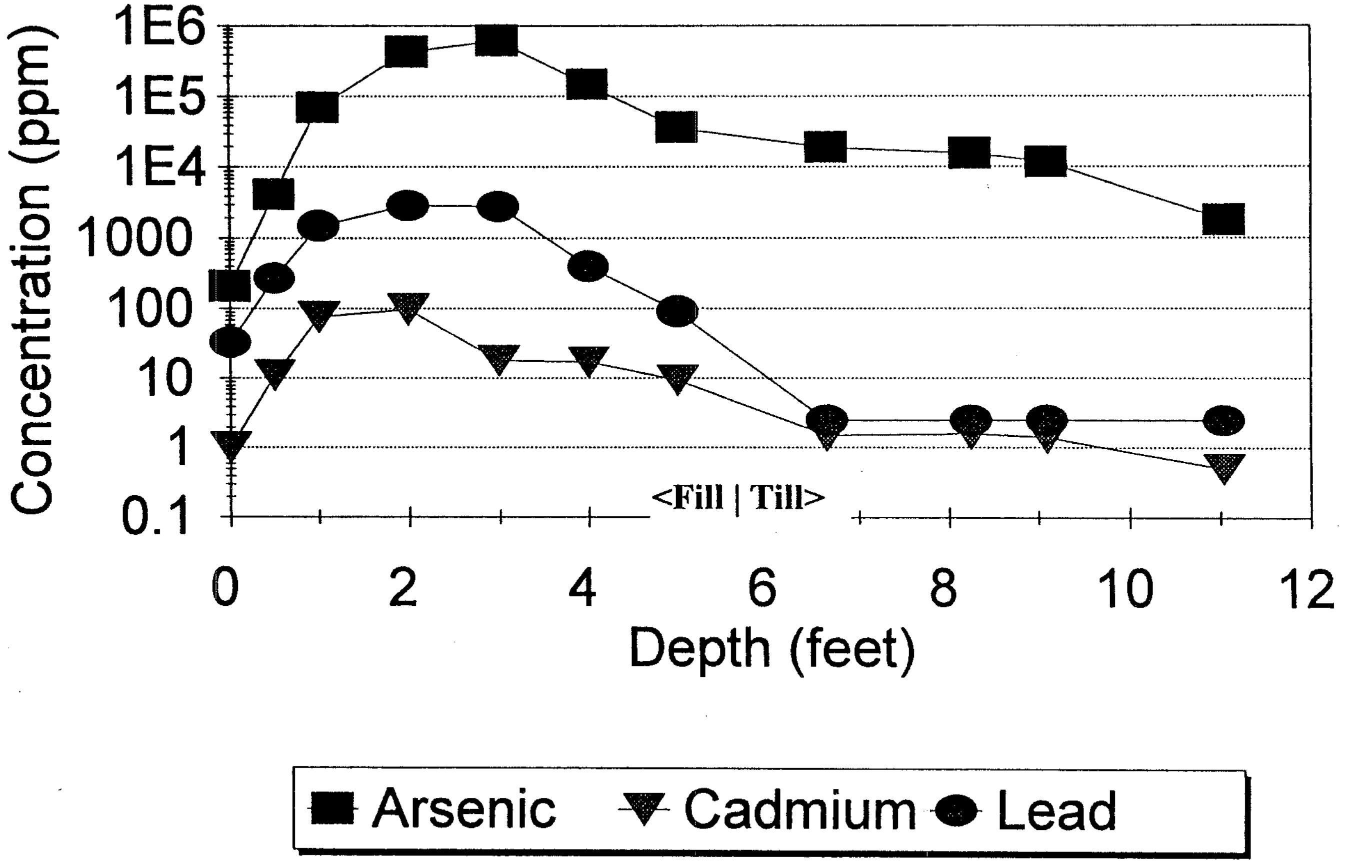

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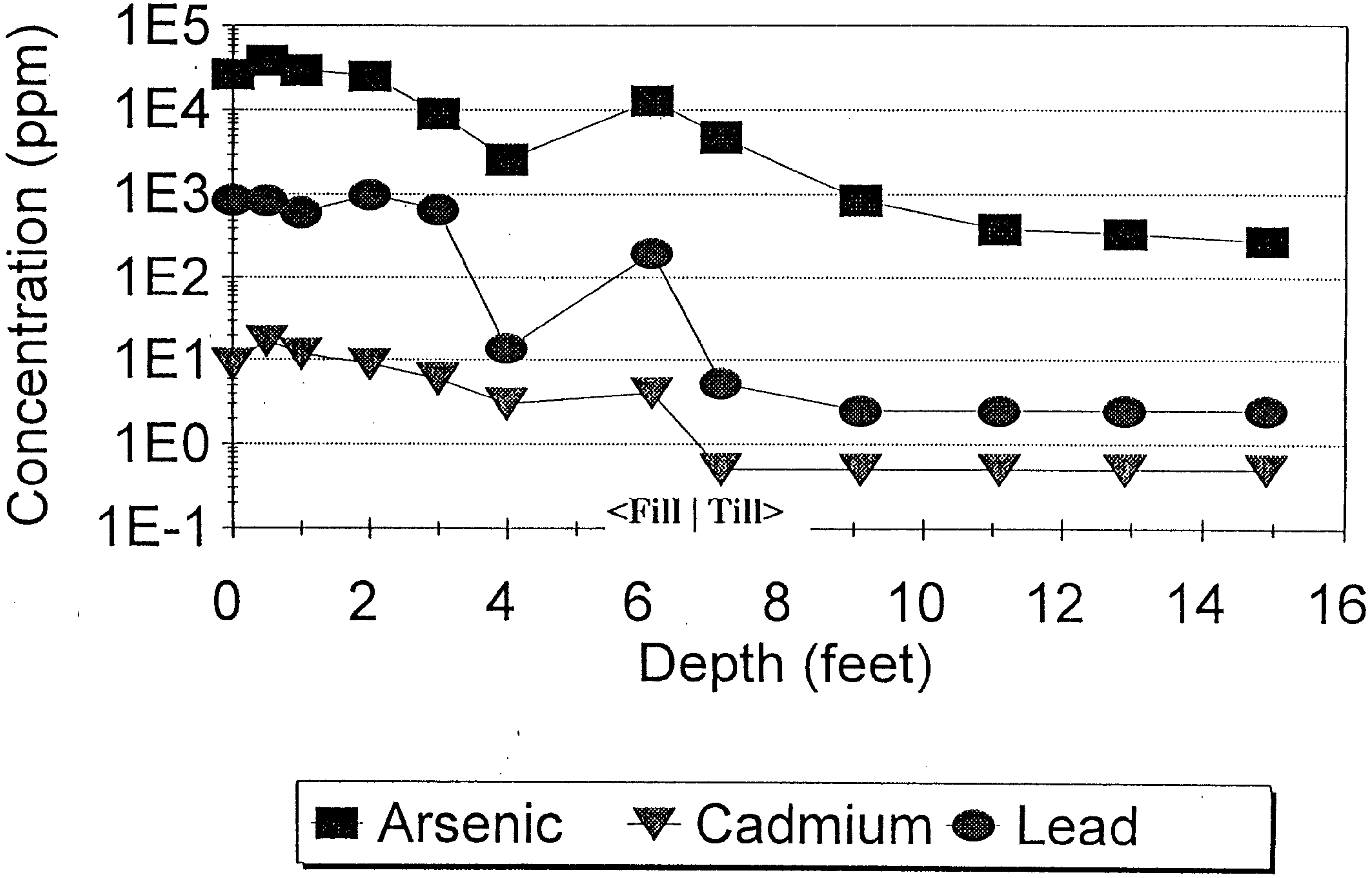
Soil Metal Concentrations
Location S-111
Figure B-17



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Soil Metal Concentrations
Location S–113
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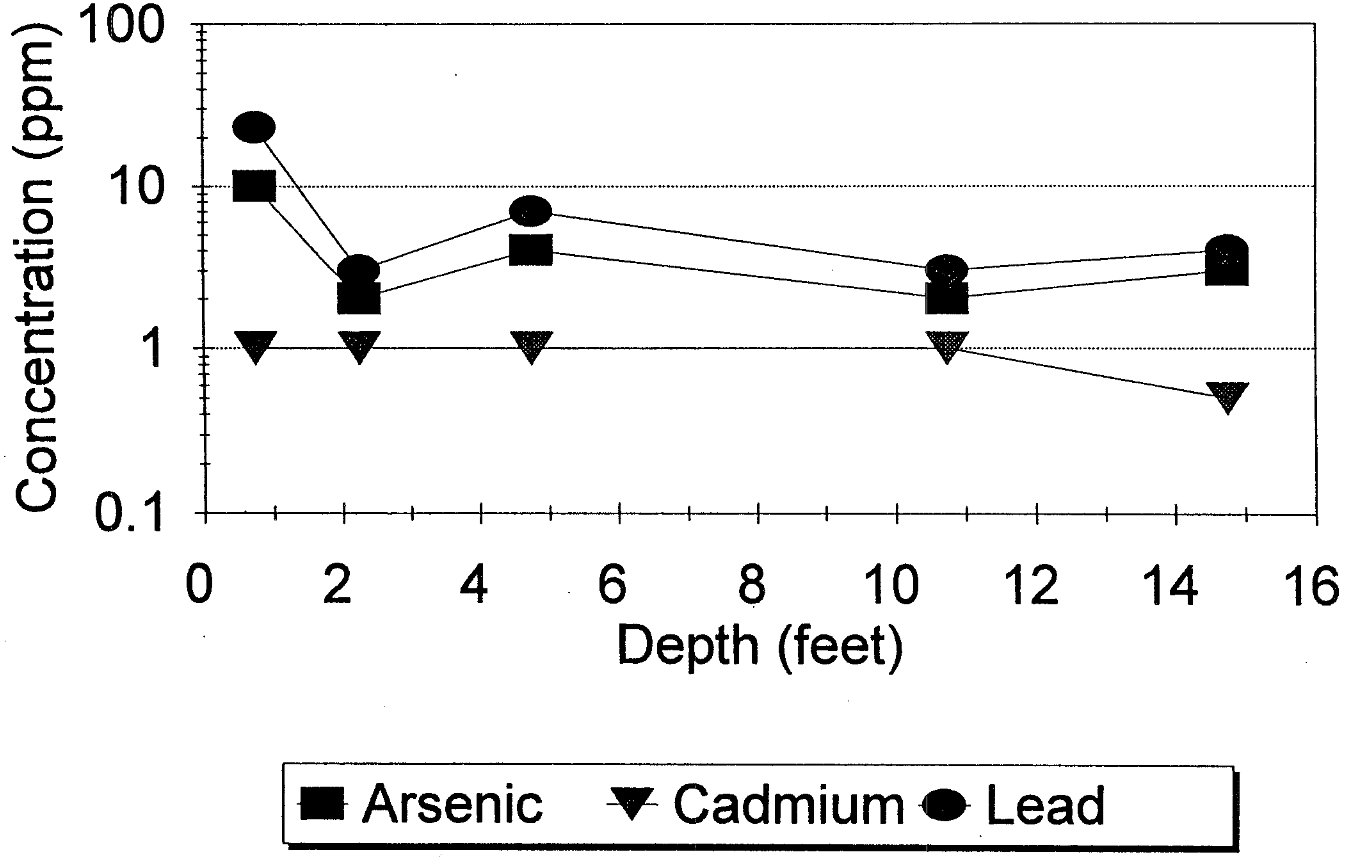

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Soil Metal Concentrations
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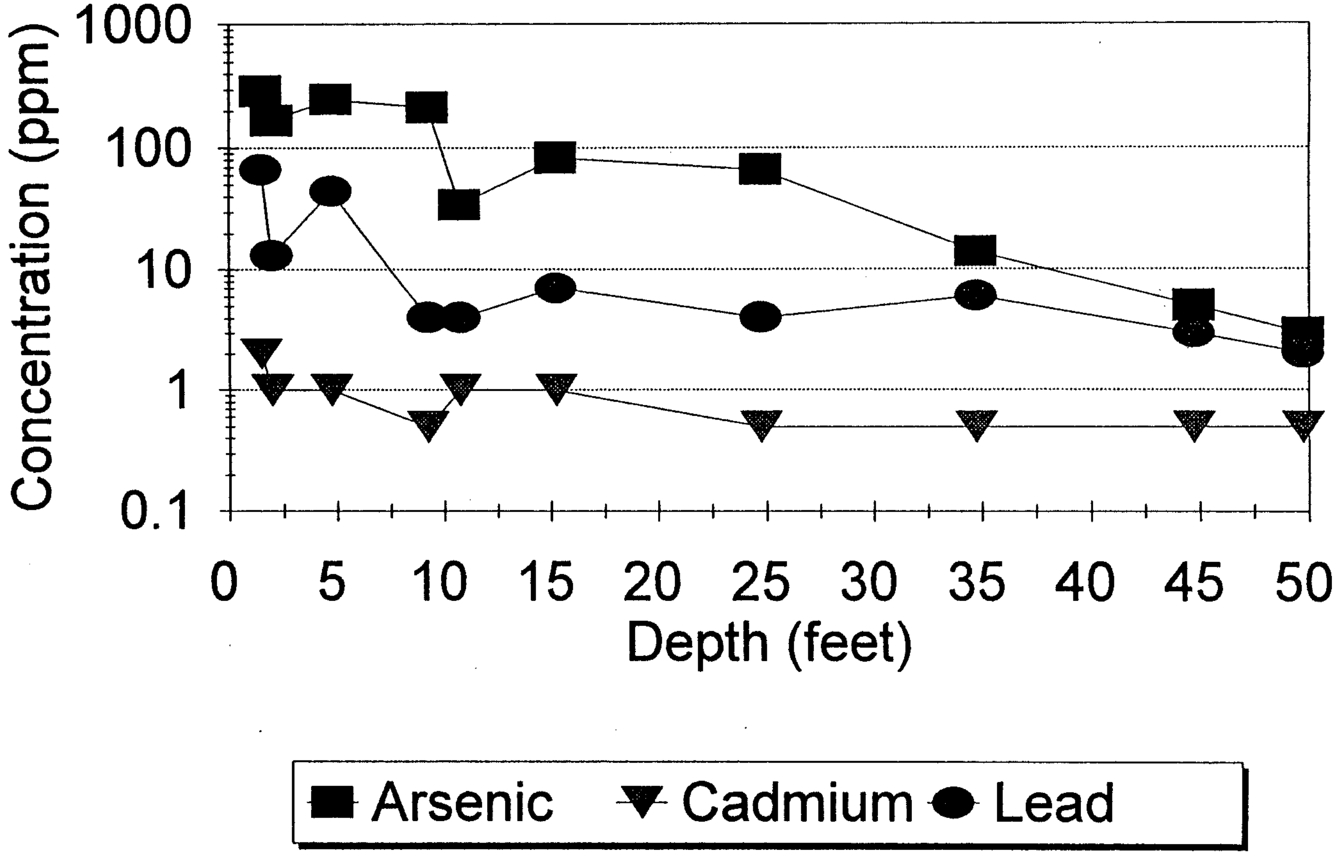

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Soil Metal Concentrations
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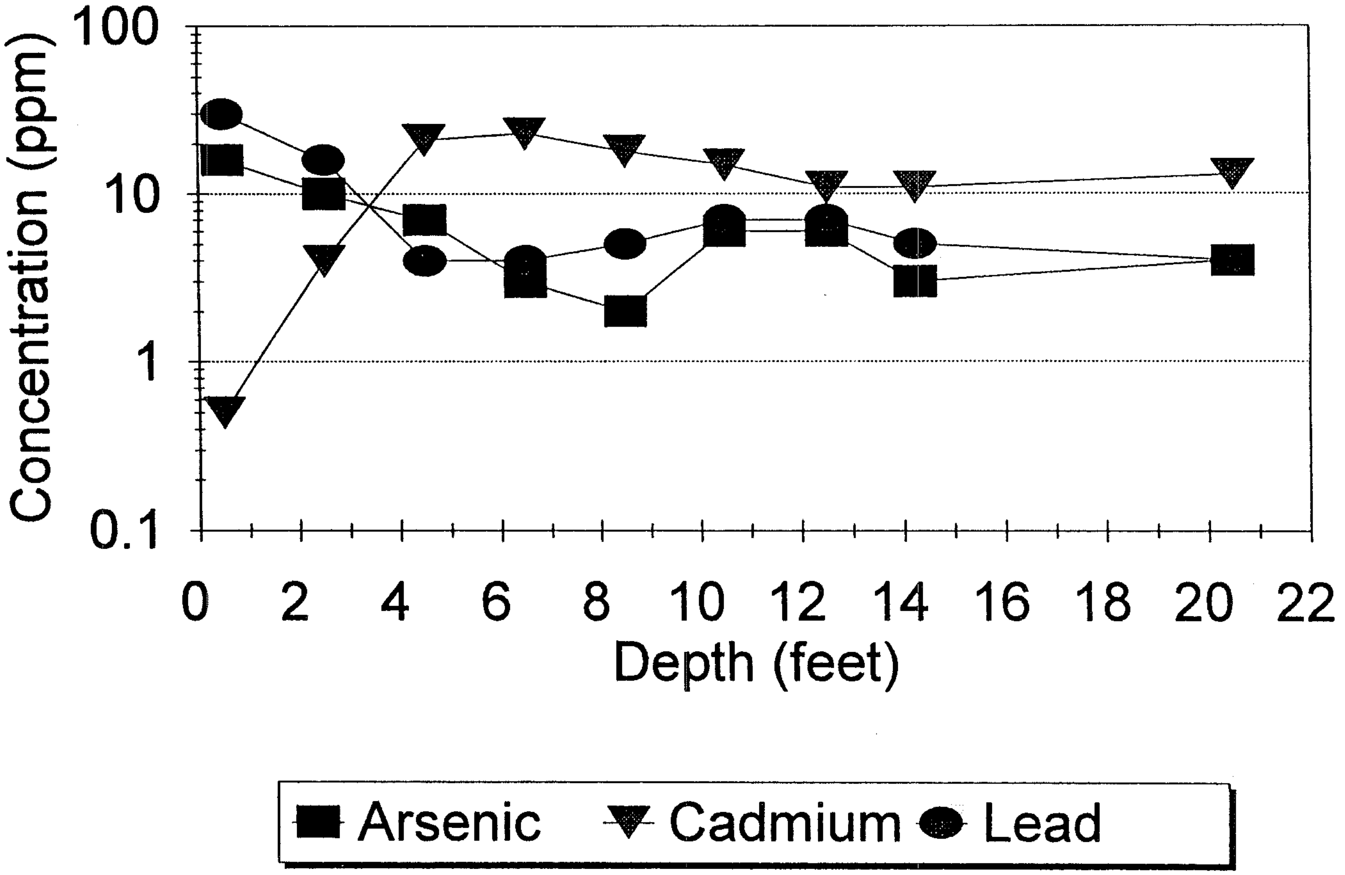

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Soil Metal Concentrations
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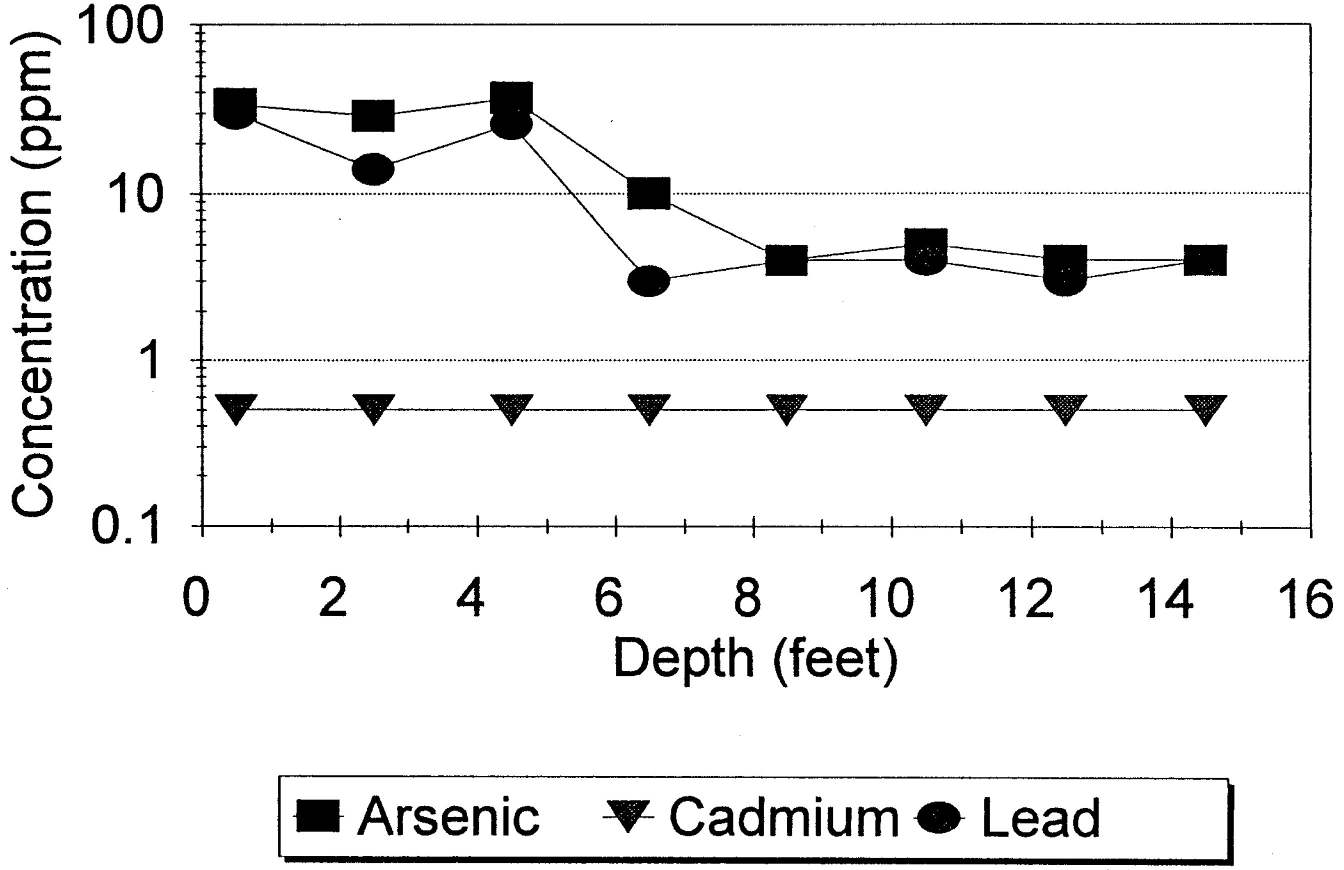
Figure B-21



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Soil Metal Concentrations
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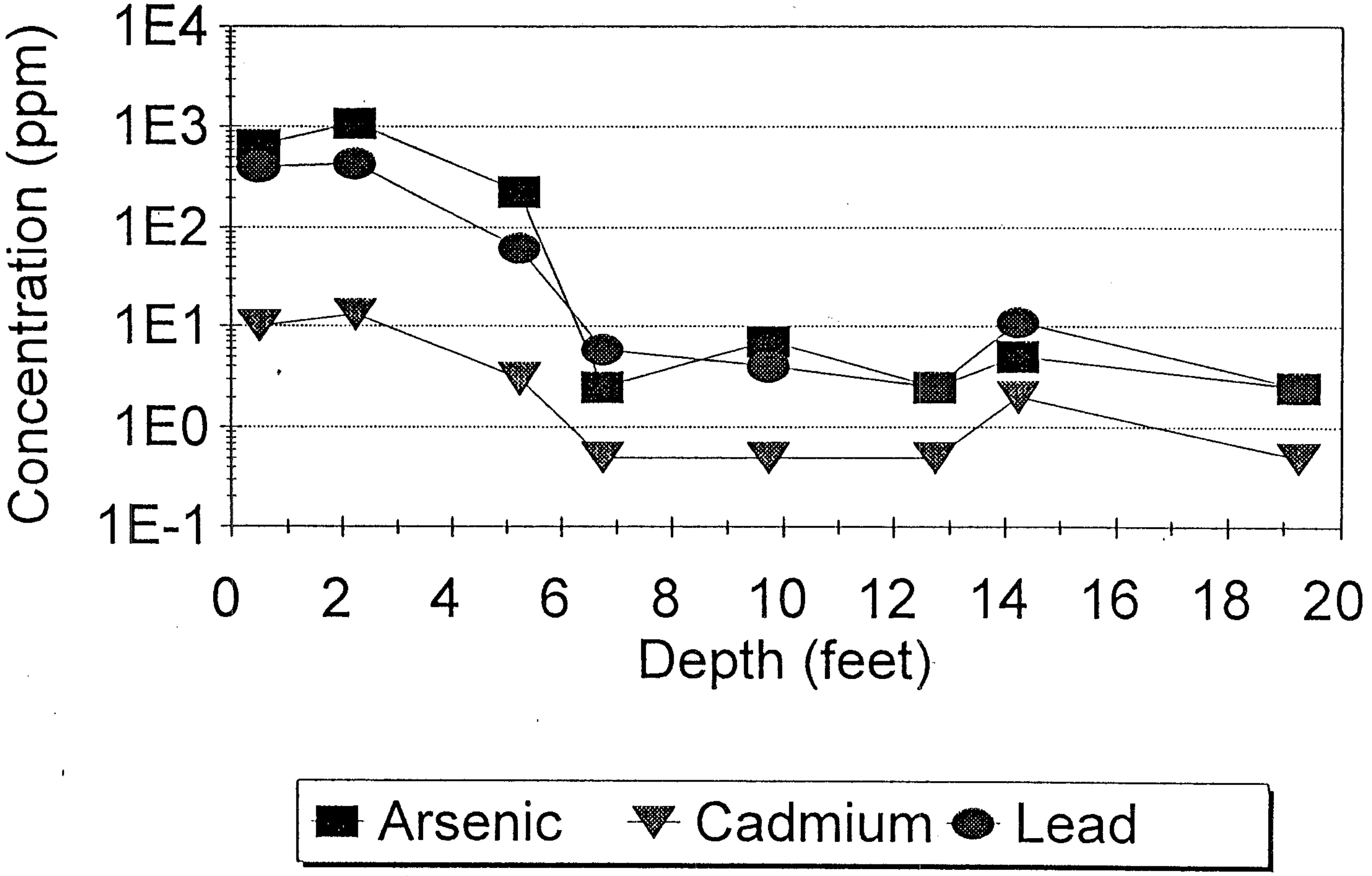
Figure B–22



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Soil Metal Concentrations
Location EV–2A
Figure B–23

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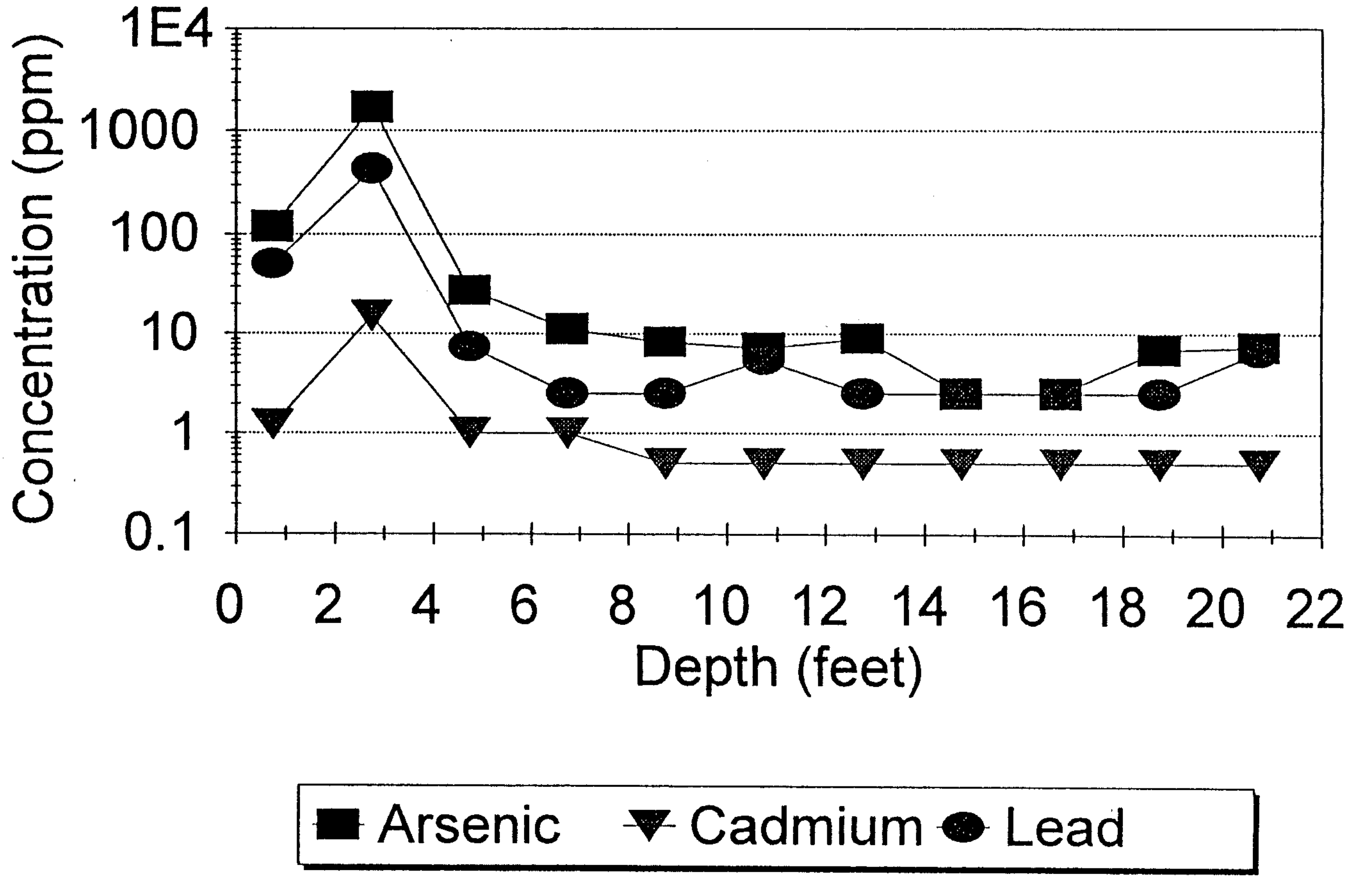

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Soil Metal Concentrations
Location EV-2B
Figure B-24

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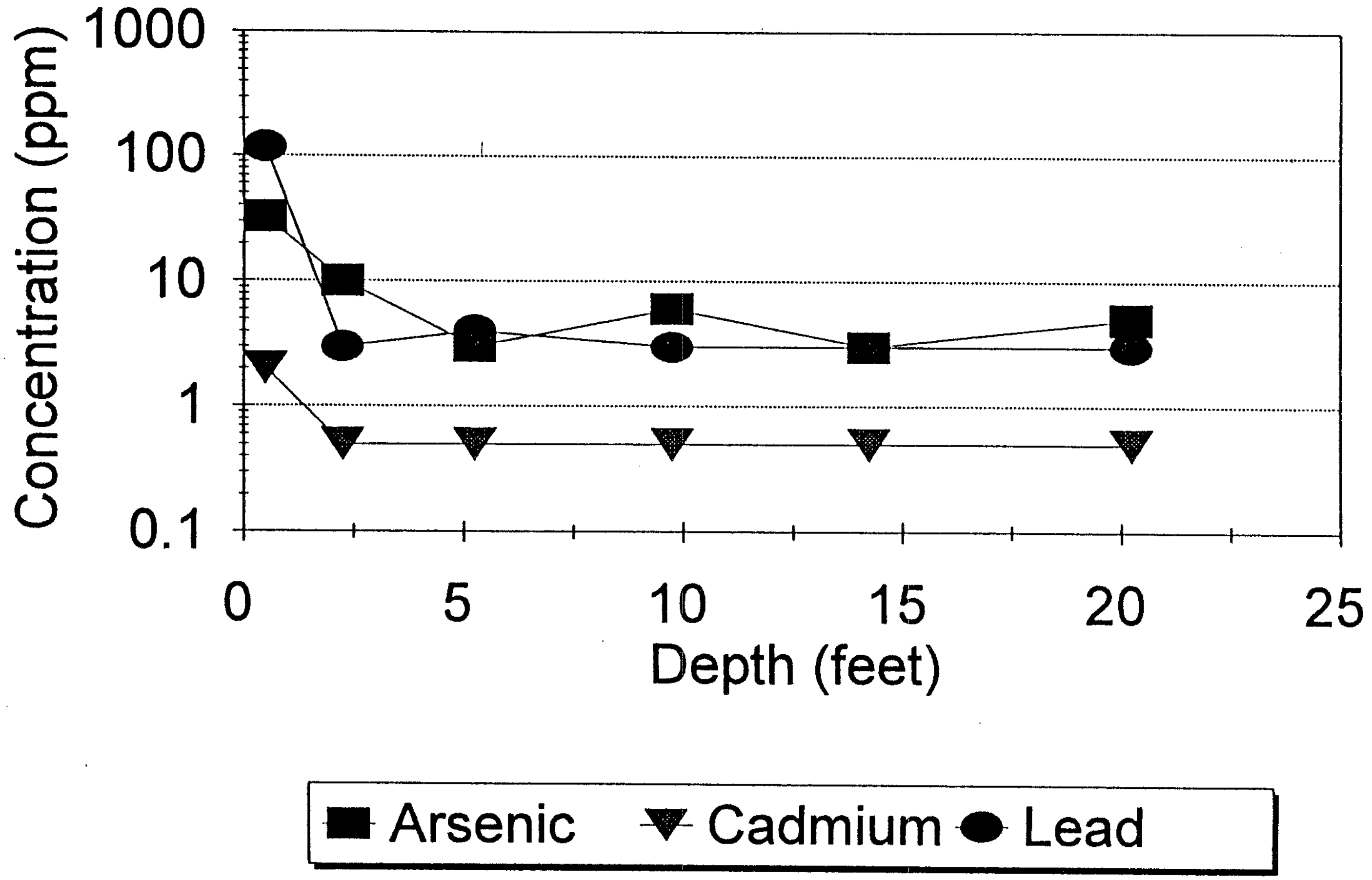

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Soil Metal Concentrations
Monitoring Well MW-1
Figure B-25

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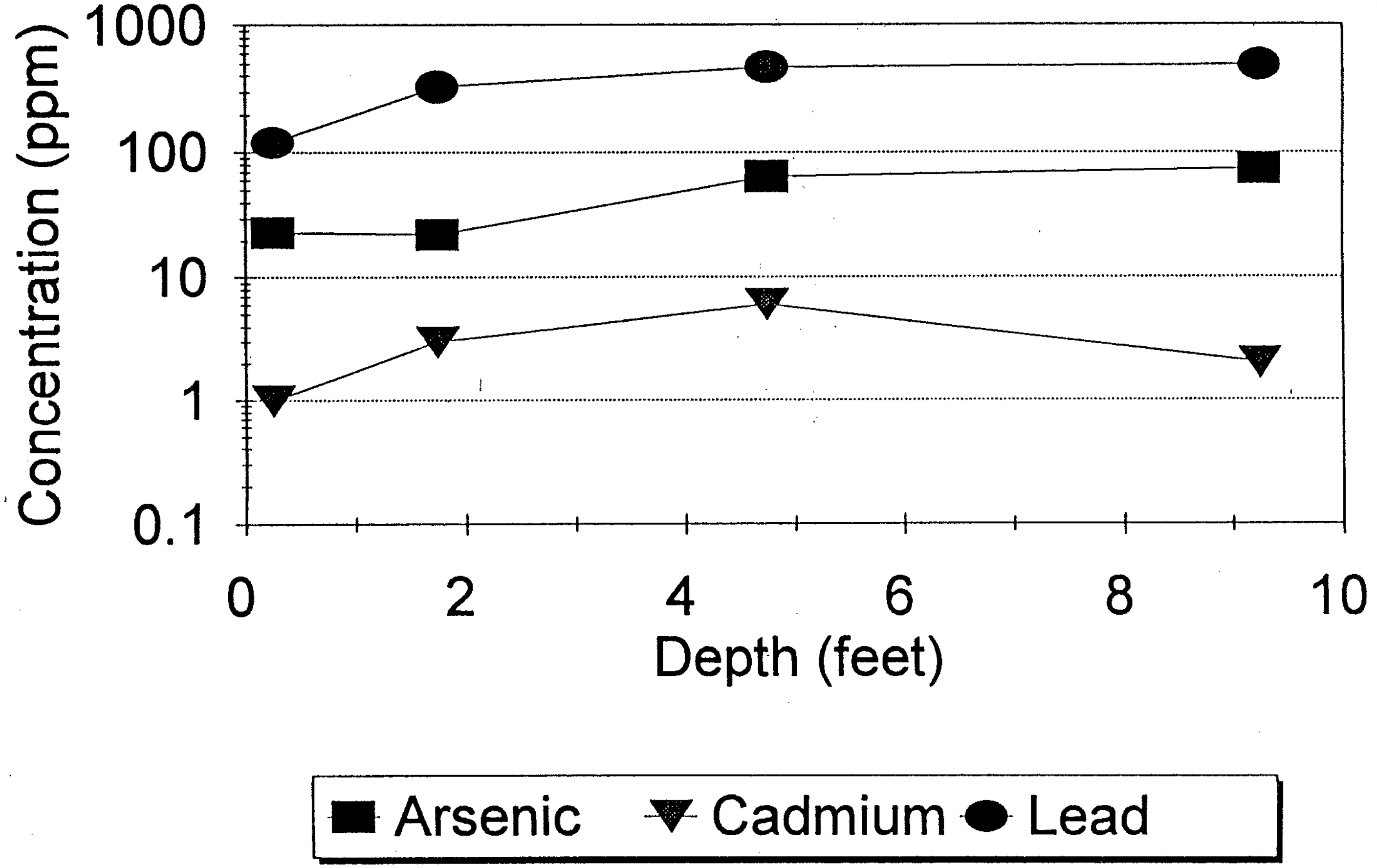

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Soil Metal Concentrations
Monitoring Well MW–2
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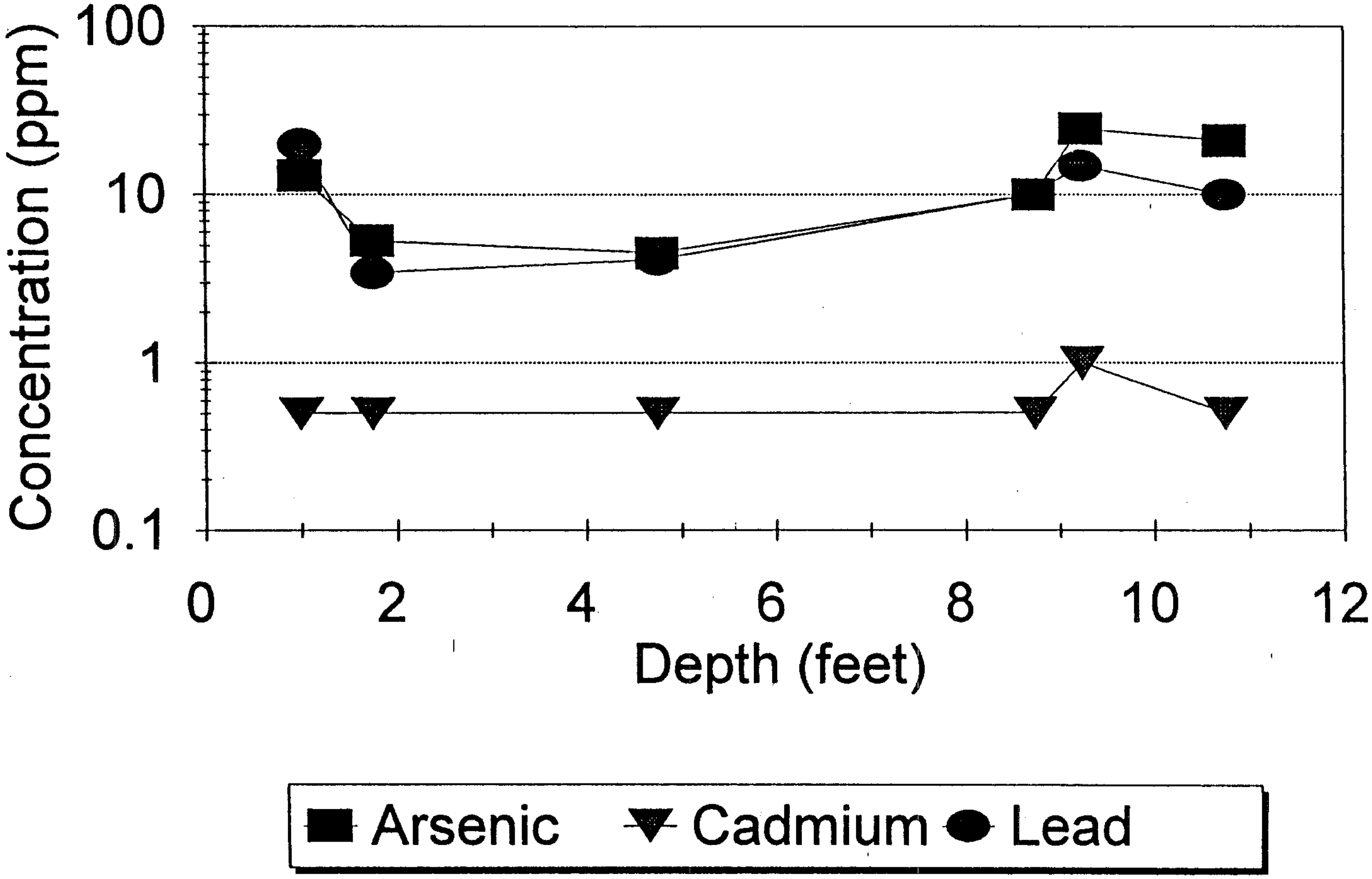

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Soil Metal Concentrations
Monitoring Well MW-3
Figure B-27

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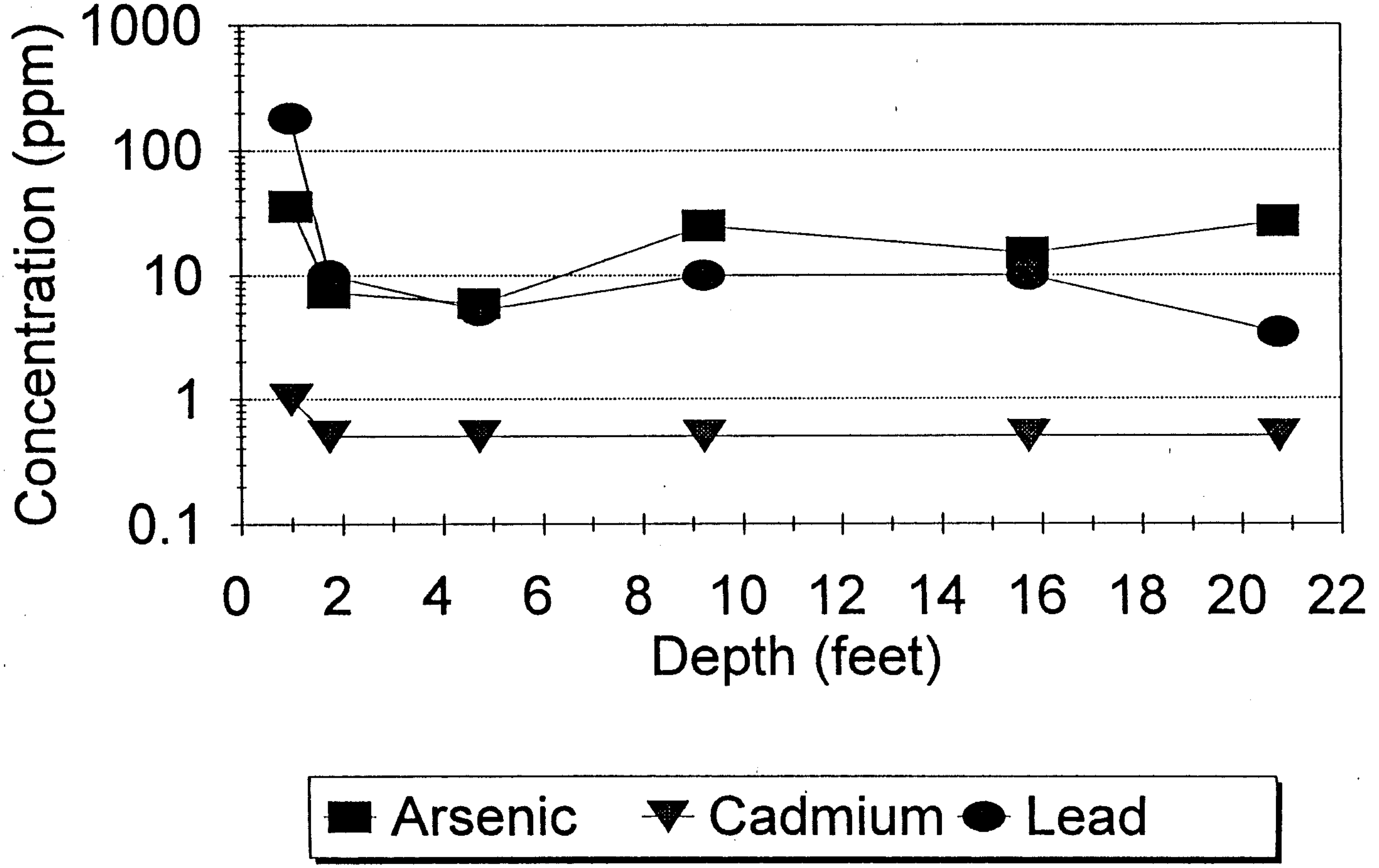

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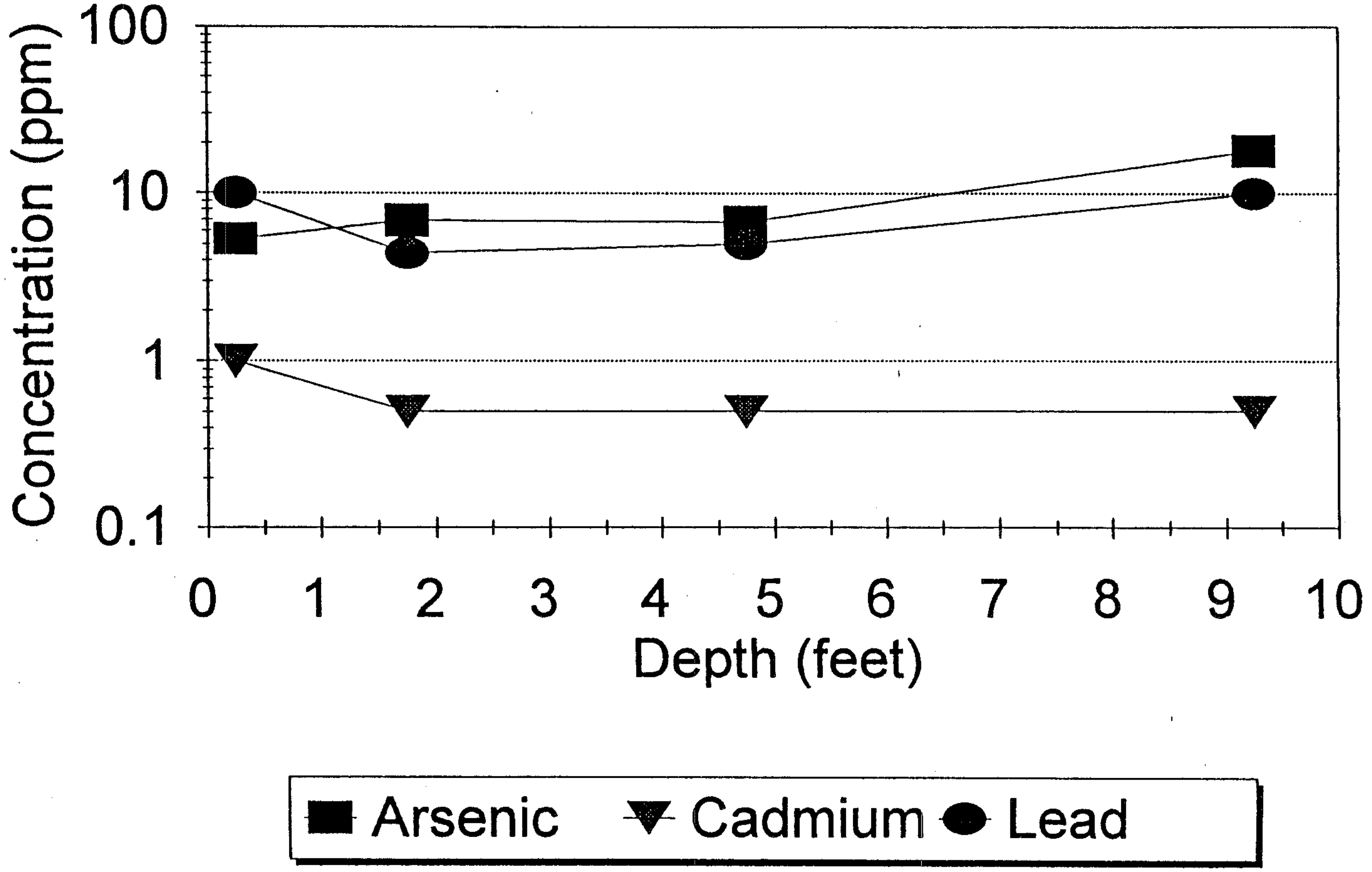

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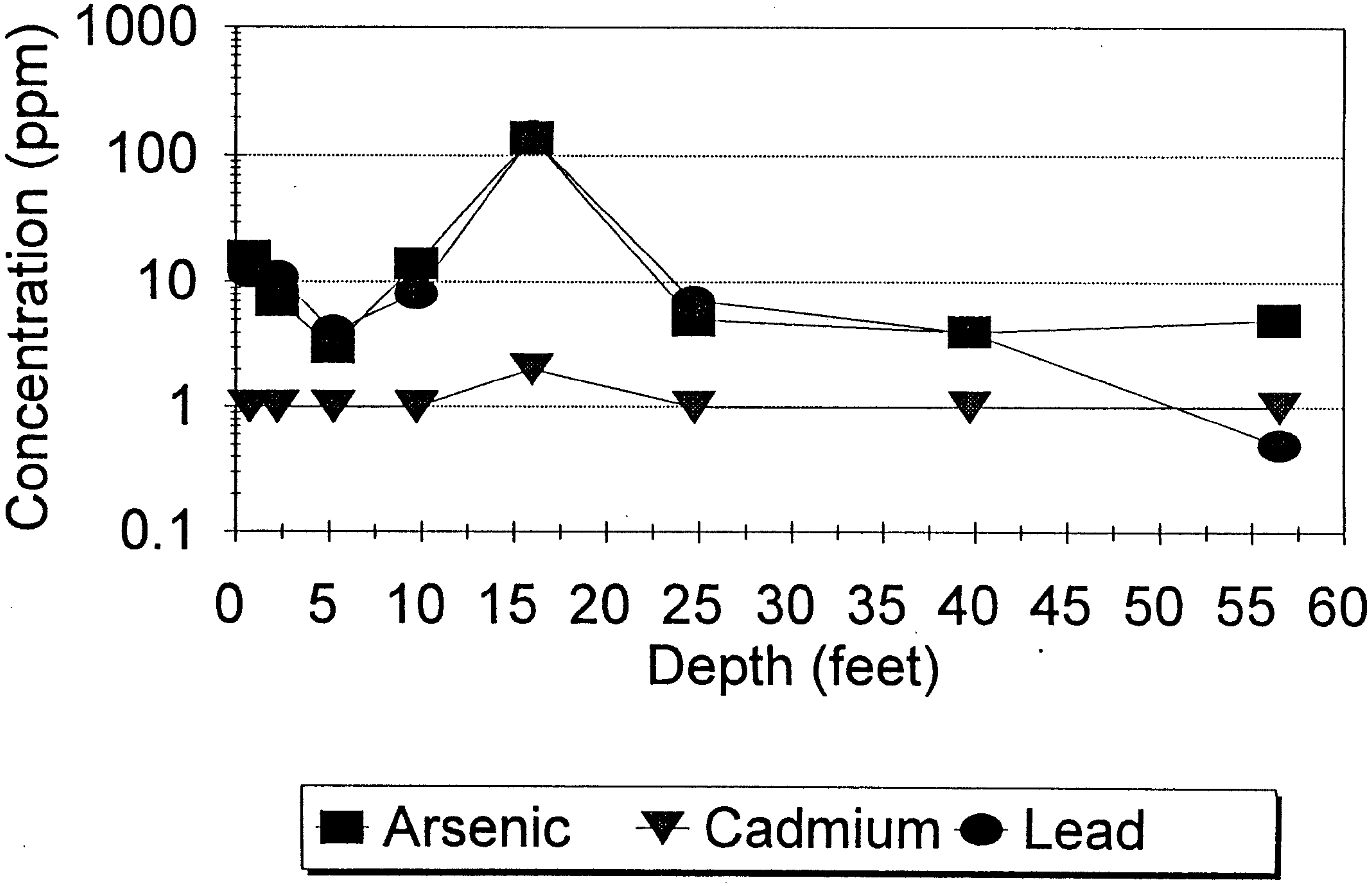
Soil Metal Concentrations
Monitoring Well MW–5
Figure B–29



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Soil Metal Concentrations
Monitoring Well EV-4
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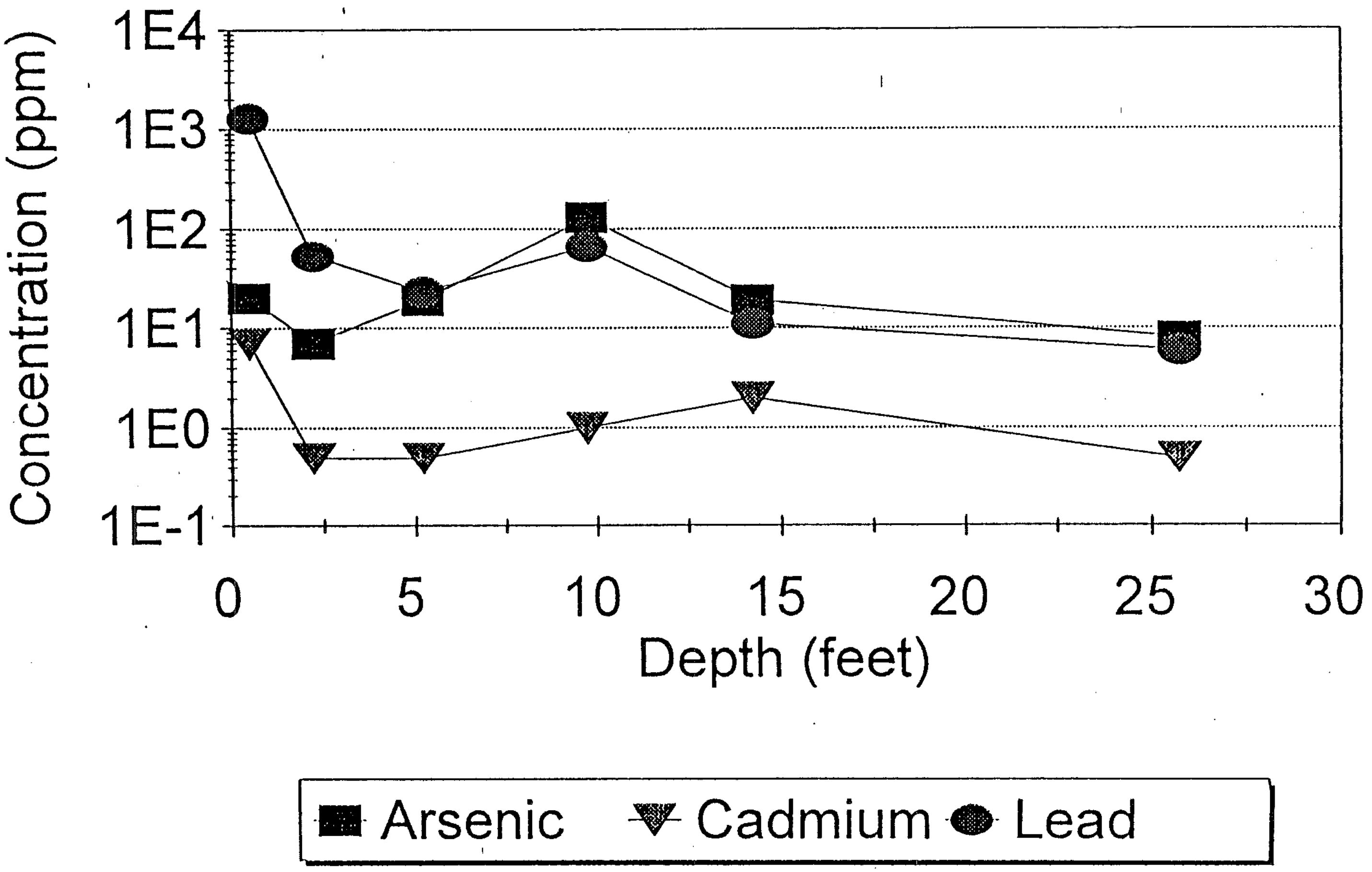

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Soil Metal Concentrations
Monitoring Well EV-5
Figure B-31

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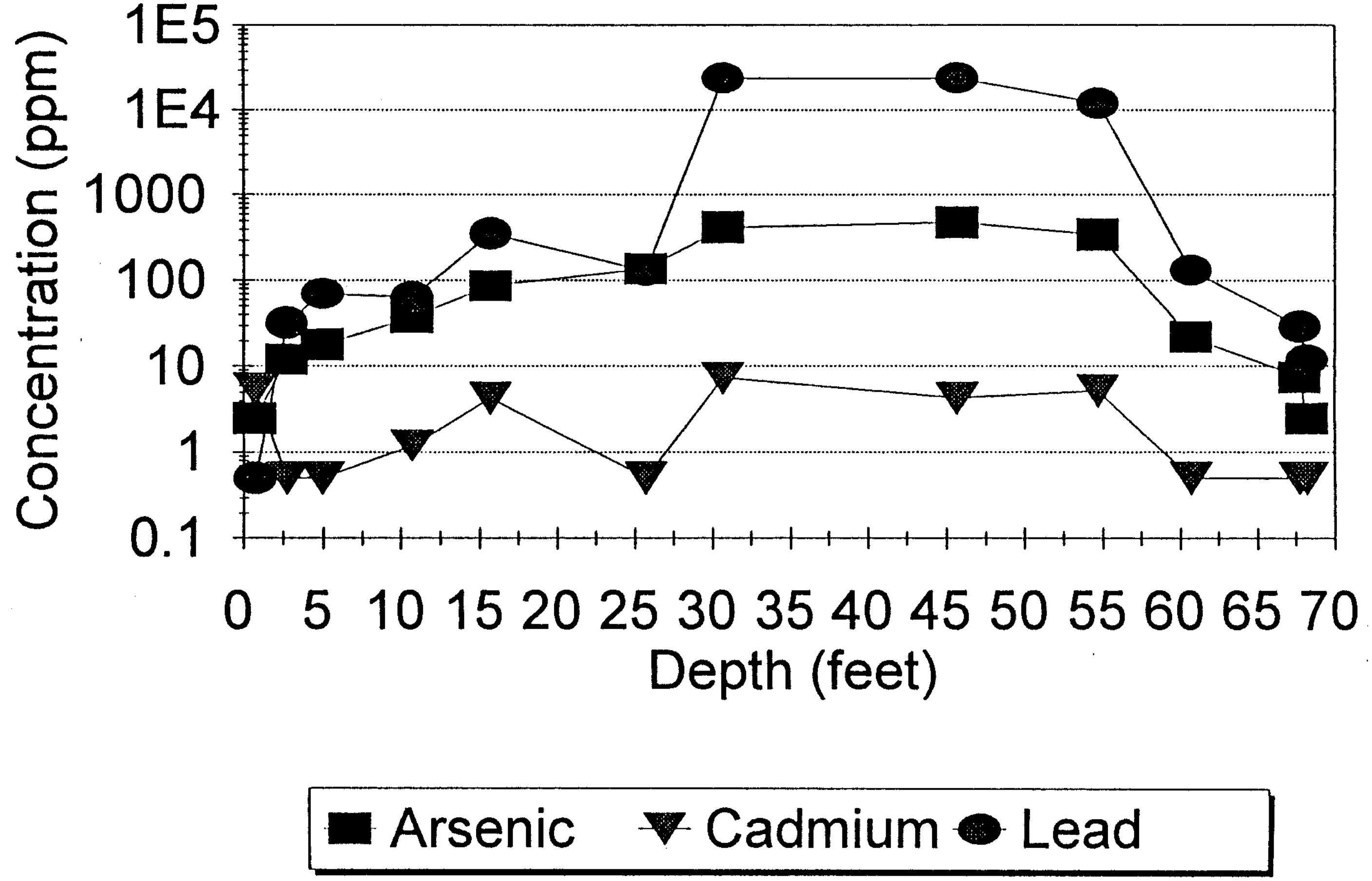

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Soil Metal Concentrations
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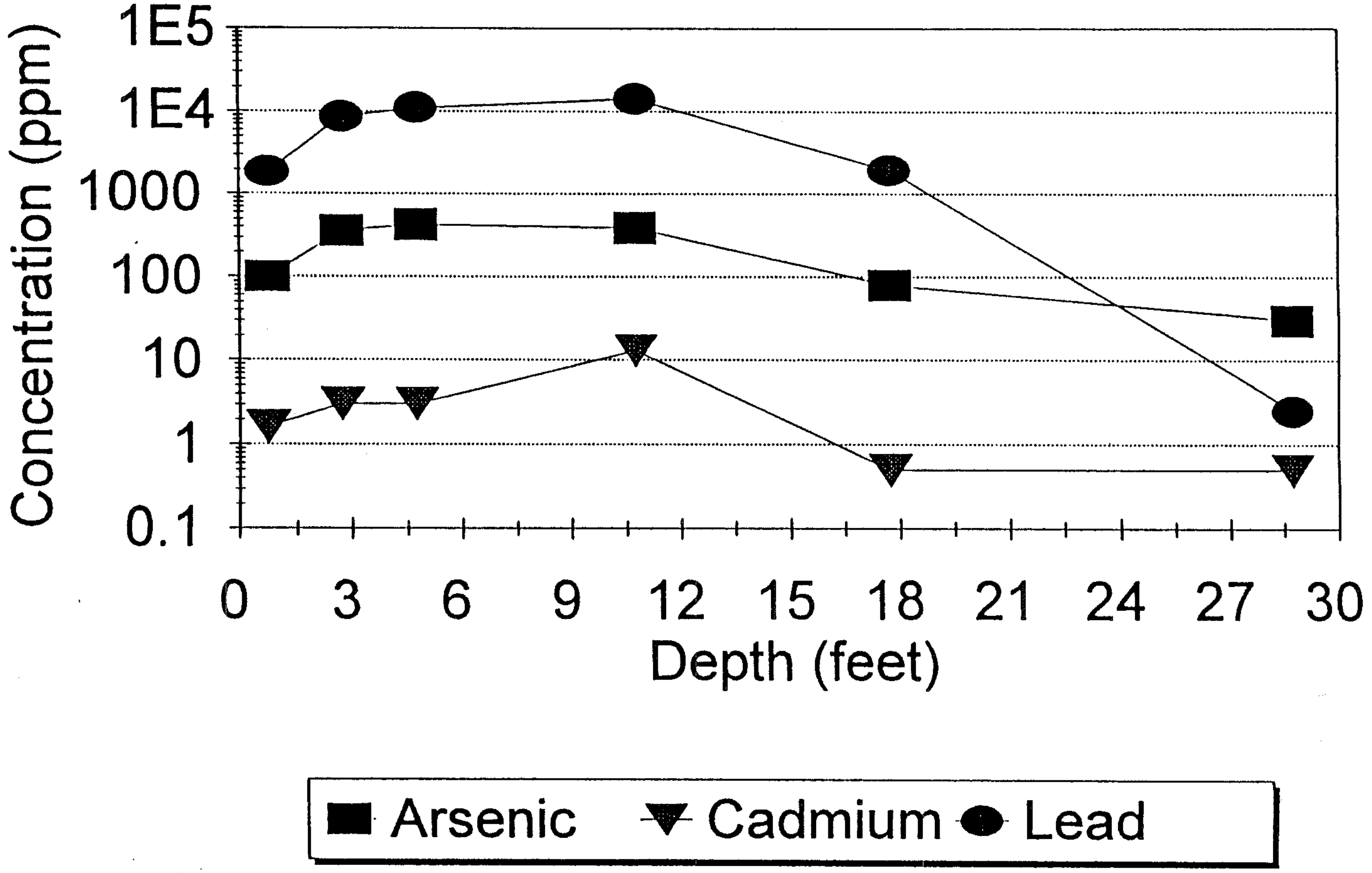

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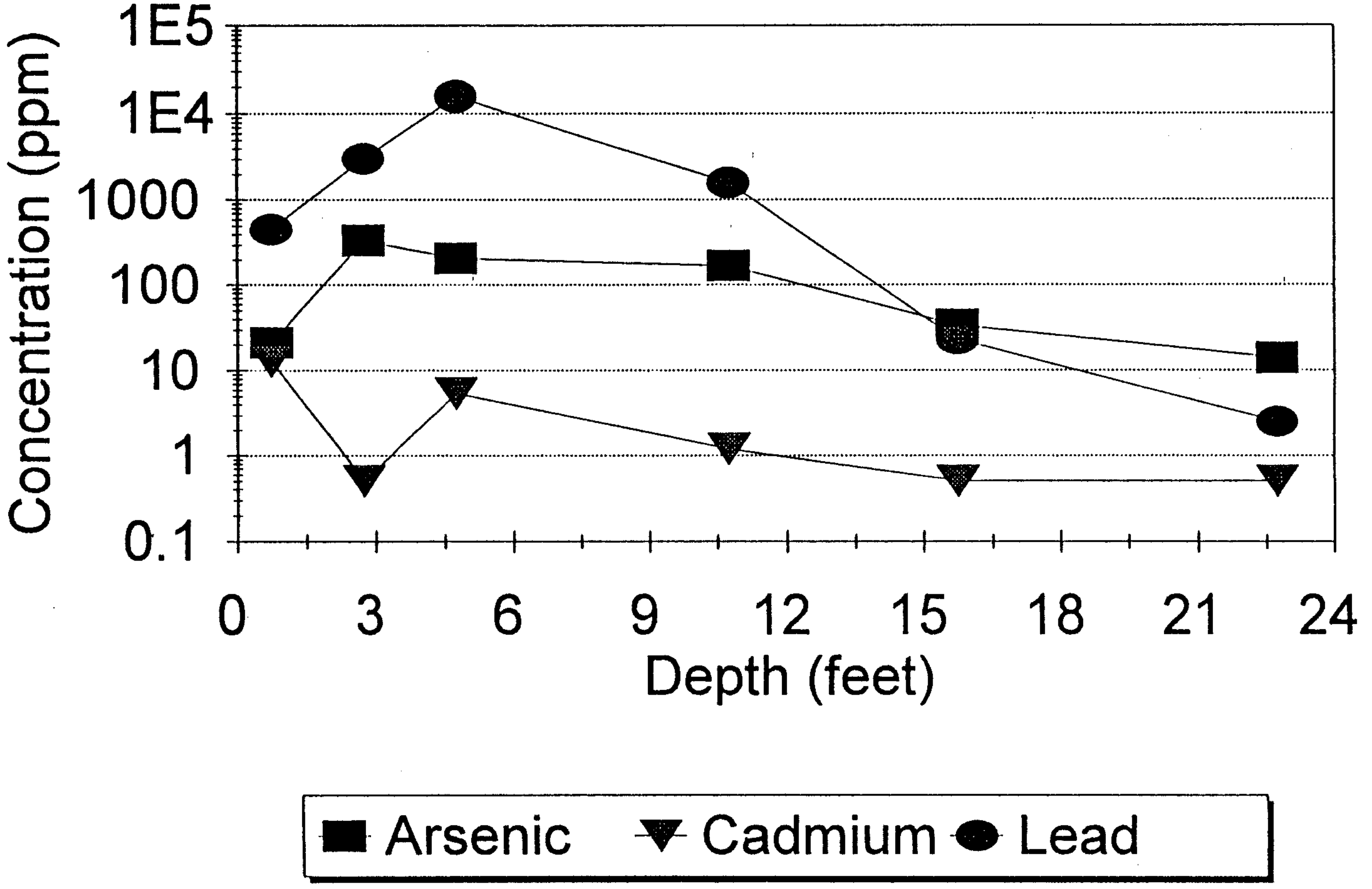
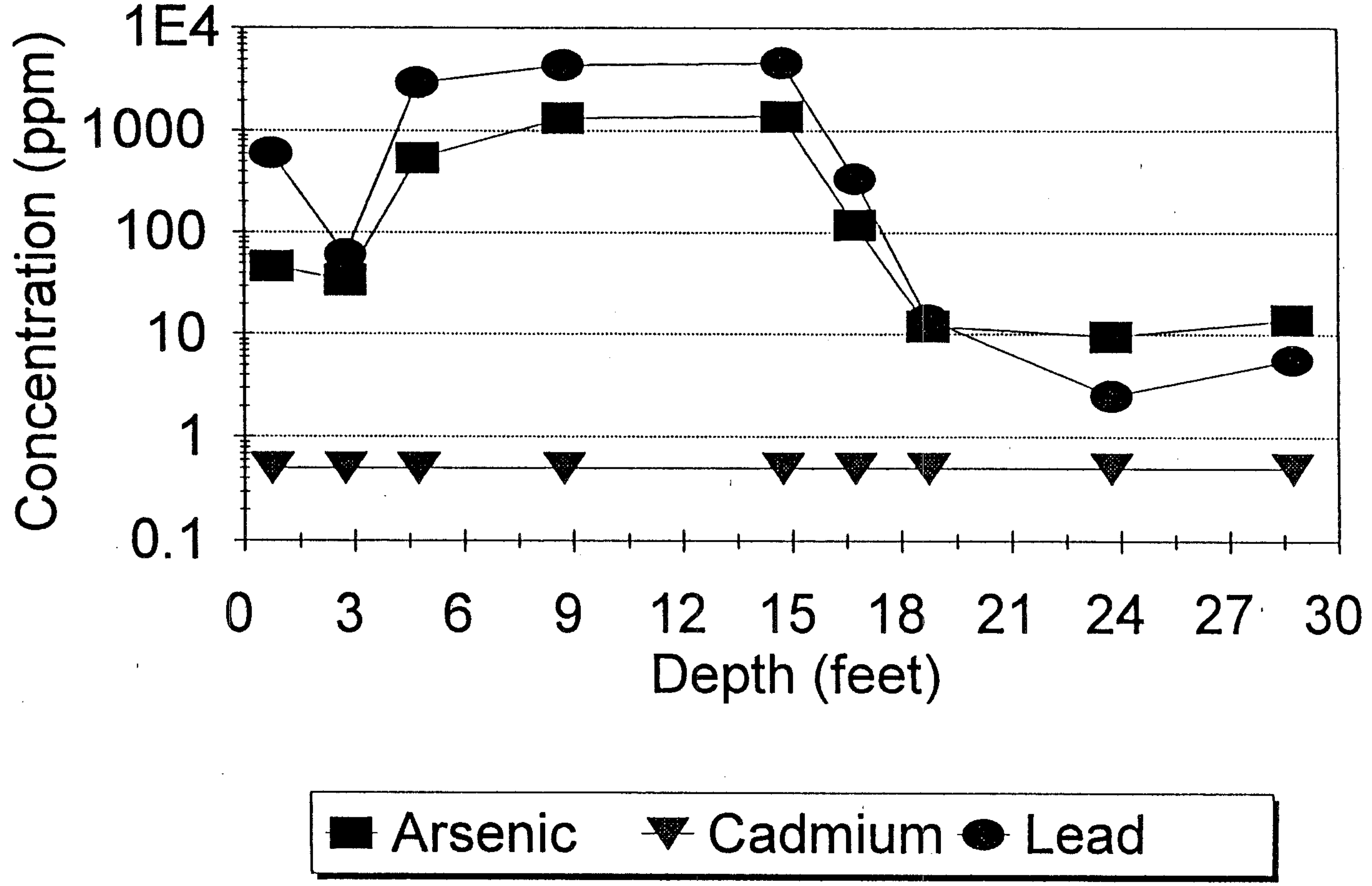
Soil Metal Concentrations
Monitoring Well EV-7
Figure B-33



5/11/95

Soil Metal Concentrations
Monitoring Well EV–8
Figure B–34

LAST UPDATE: 3:56pm
030\080\0076\TAC\950511\I:STORAGE\EVERETT\RI\03095T24.DWG



5/11/95

Soil Metal Concentrations
Monitoring Well EV-9
Figure B-35

APPENDIX C

LOGS FOR PHASE I/II RESIDENTIAL SOIL BORINGS

Summary of Contents of Appendices C, D, and E

Appendix C contains the logs for Phase I/II residential soil borings S-4, S-8, S-13, S-15, S-22, S-27, S-28, S-34, S-36, S-37, S-39, S-46, S-47, S-50, S-72, and S-101 through S-117.

During Phase I, samples were collected at 26 of these locations (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, and S-101 through S-117. During the first round of Phase II, eleven of these locations were revisited (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113), as well as six SAIC locations reinvestigated (S-22, S-34, S-36, S-37, S-39, and S-50). As a result, the logs for borings S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113 are a combination of two sampling efforts which took place approximately 6 months apart. The logs are reflections of individual preferences of the various geologists that have been involved in the logging. Due to their different styles, terminology as well as scales may vary between the two sections of the logs. However, these logs should be considered one continuous log for the purpose of the RI. The logs for the remaining soil borings are the result of single-event investigations. Phase I locations S-101 through S-110, S-112, and S-114 through S-117 were never revisited; logs from the SAIC effort at Phase II first round locations S-22, S-34, S-36, S-37, S-39, and S-50 were not available.

Appendix D contains the logs for Phase II second round residential soil borings S-74, S-83, S-90 through S-97, S-201 through S-209, and S-301 through S-309. These logs all consist of single-event descriptions.

Appendix E contains the logs of deep soil borings B-1, B-2, EV-2A, and EV-2B, and slag borings SL-1, SL-3, and SL-4. These logs all consist of single-event descriptions.

SUMMARY OF TERMINOLOGY USED ON BORING/WELL LOGS

Drilling Methods Used

HSA - Hollow Stem Auger Drilling method. Reported dimension refers to inside diameter of the hollow stem augers used.

Air Rotary - Forward Rotary Drilling method in which air is used to circulate cuttings from the hole.

Hand Auger - Where indicated, shallow borings completed using 4" diameter stainless steel bucket auger

Sample Collection

Split Spoon Samplers - Except in the case of hand augured borings, samples were collected using standard split spoon samplers. One of two sampler types were used:

- Dames and Moore Sampler - 3" ID split spoon used in conjunction with 300 lb. hammer
- Standard 1 3/8" ID split spoon used in conjunction with a 140 lb. hammer

Blow Counts (noted as Hammer Blows on some logs)

Both split-spoon samplers provide standard penetration data (ASTM D1586), reported on the well logs as the number of blows required to drive the split spoon over a 6-inch sampling interval. Eighteen-inch samples were commonly collected at monitoring well and deep boring sites. Six-inch to one-foot samples were collected at some of the shallow borings. In all cases, the reported blow count refers to the number of blows per 6 inch interval unless specifically noted. In instances where blow counts exceeded 50, the spoon was retrieved and the reported blow count is followed by the amount of penetration achieved for that sampling interval (for example 50/5").

Sample

Sample numbers were assigned to individual sampling intervals in the field. In some instances, distinct variations in lithology are reported within a sampling interval and the sample number is followed by an A and B. In these cases, the retrieved sample was separated into two discrete samples at the lithologic break and analyzed separately.

Sample Type

s.s. = split spoon sample as described above
grab = Grab sample off auger flights

Many of the logs include a drilling and sampling methodology in the header information. For sites indicating that a split spoon sampler was used, all samples were collected accordingly unless specifically noted under sample type. For borings completed with a hollow stem auger, all samples are grab samples taken from the auger bucket unless otherwise noted.

Geologic Description

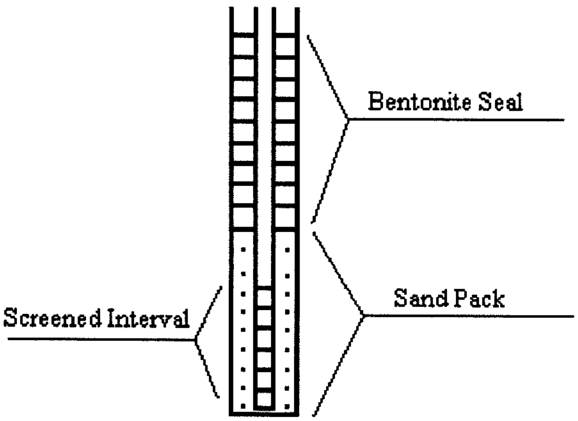
The logs contain field descriptions of soil samples, which generally include color, texture and soil moisture conditions at time of drilling. In some instances, geologic classification and contacts are noted based on interpretation of field data. Where geologic contacts were indistinct due to similarity in appearance, texture, and density, field interpretations were omitted from the logs.

B.O.H. = Bottom of Drilled Hole. In some instances, a sample may have been collected at the bottom of the hole; the sampling depth may therefore be greater than the reported B.O.H.

SWL. = Static Water Level in well at the time of drilling. In some instances, the well may have been allowed to recover prior to static water level measurement. In this case, date is indicated at the time of static water level measurement.

Well Completion Diagrams

In addition to descriptions of well completion, schematic diagrams of well completion are also shown on well logs. The symbols shown on these schematics are defined below:



TEST HOLE LOG

PAGE 1 OF 2

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-4

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 415 Pilchuck Path

ELEVATION G.S.

DATE 1-28-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-616		0930				Brown to black topsoil, sandy, small gravels
2"									
6"			9301-617		0935				Brown sandy silt
9"									
1'			9301-618		0940				Brown silty sand (brick chips)
2'			9301-619		0945				Brown silty sand, small gravel
3'			9301-620		0950				Black organic material, silty (brick chips)
4'			9301-621		0955				Dark brown silty, mainly wood fibers
5'									
6'			9301-622		1000				Tan silty sand, small gravels
7'									

TEST HOLE LOG

PAGE 2 OF 2

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-4

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 415 Pilchuck Path

ELEVATION G.S.

DATE 7-13-93

RECORDED BY RV

DRILL METHOD H S A

DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 13'

CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA

WELL COMPLETION DESCRIPTION NA

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7' 8'			EVT-9307 700 (7'-7'4")		0830	9/6 17/6 23/6 27/6	10%	Dup. 701 (0845) sample: mixture fill/till	7-7.2 olive grey fill >7.2 light grey till, sandy silt, angular gravel (GM)
9' 10'			702 (9'-9'2") 703 (10'-10'2")		0930 1015	50/5 >50/6 >50/6	100% 100%	1 gallon 2 gallon	Light grey silt, very dense, dry, some gravel Light grey silt, very dense, dry, angular gravel (GM)
11' 12'			704 (11'10"-12')		1130	50/6	100%	Split: 704 to SAS >5 gallon	Light grey silt, very dense, dry, some gravel (GM, ML)
13' 14' 15'									

TEST HOLE LOG

PAGE 1 OF 2

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-8

STATE WA

COUNTY Snohomish

LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION 3010 Fifth Street

ELEVATION G.S. ___

DATE 1-20-93

RECORDED BY R. V.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6'

CASING TYPE AND DESCRIPTION ___

TOTAL DEPTH CASED ___

WELL COMPLETION DESCRIPTION ___

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			ASEV01 9301-507		1500				Topsoil, organic - rich
2"									
6"			9301-508		1505				Brown silt, sandy, gravelly
9"									
1'			9301-509		1510				Brown silt, sandy, gravelly
			9301-510 Dupl. of 509		1515				
2'			9301-511		1520				Gray silt, gravelly, clayey, dark organic material
3'			9301-512		1525				Hit water at 2.5', gray silt, clayey, oxidation spots
4'			9301-513		1530				Gray silt, clayey, some gravel
5'									
6'			9301-514		1535				Gray, silt, clayey, dense
7'									

TEST HOLE LOG

PAGE 2 OF 2

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-8

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 3010 5th Street ELEVATION G.S. DATE 7-13-93

RECORDED BY RV/JC DRILL METHOD H S A DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 15.5' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7' 8'			EVT-9307 705 (7'-7'2")		1415	39/6	100%	0.5 gallon 0.5 gallon	Light grey silt, very dense, dry, some gravel (GM) (1" sand layer at 6.5' medium-fine, well sorted)
9' 10'			706 (10'-10'2")		1600	47/6 50/3 34/6 50/4	0% 100%	1 gallon	Light grey silt, very dense, dry, some gravel (MC, GM)
11'			707 (11'-11'2")		0815	50/3	100%	1 gallon	Light grey silt, very dense, dry, small gravel (ML, GM)
12'			708 (13'-13'2")		0830				Light grey silt, fine sand (SM)
13' 14'						20/6 50/6	100%	1 gallon	Light grey silt, fine sand, coarser than previous sample, possible water (SM)
14.75'									Hard drilling, dense silt
15' 15.5'			709 (15'-15'2")		0845	33/6	100%		Light grey silt, small gravel (5%) (ML, GM) Till first encountered at 5'8"

TEST HOLE LOG

PAGE 1 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-13

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 515 Pilchuck Path ELEVATION G.S. DATE 1-21-93

RECORDED BY V. S. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-528		1030				Topsoil, organic material, clay
2"									
6"			9301-529		1035				Topsoil, sandy, silty, organic material
9"									
1'			9301-530		1040				Sandy silt, gravel, brown with light gray sand, brick
2'			9301-531		1045				Light gray silt, clayey, sandy
3'			9301-532		1050				Brown sand, some gravel, silt
4'			9301-533		1055				Sand, gravel, light brown, clayey
5'									
6'			9301-534		1100				Light gray sandy silt, some brick
7'									

TEST HOLE LOG

PAGE 2 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-13 Al,B,C

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 515 Pilchuch Path

ELEVATION G.S.

DATE 7-14-93

RECORDED BY J.C.

DRILL Method HSA

DRILLER

DRILLING CO.

TOTAL DEPTH 4.75'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0'									Topsoil
								Spud Bar & Drill	Smelter debris
1'								Spud Bar & Drill	Bricks
2'									Smelter debris Bricks
3'									Bricks
4'	4.25 4.5		EVI-9507-713		1430	28-6	100%		Smelter debris-till interface Till light grey, silt, dense, small gravel. Light grey silt, very dense small gravel.
5'	4.75 5.0		EVI-9307 714		1550	35-6	100%		S-13 A Auger Refusal 3' S-13 B Auger Fefusl Concrete 4' S-13 C Auger Refusal 3.5' Talked to property owner, he said when he added addition to house, they hit an old brick roadway, approximately 7 layers of brick.

TEST HOLE LOG

PAGE 3 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-13

STATE WA

COUNTY Snohomish

LOCATION T R

SEC.

TRACT

SITE DESCRIPTION 515 Pilchuck Path

ELEVATION G.S.

DATE 7-20-93

RECORDED BY Sam Billin

DRILL METHOD HSA

DRILLER R. Gibson

DRILLING CO. Boretec

TOTAL DEPTH 17.0'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS (Note bit-auger size) Till @ <7'

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7		EVT-	9307 747 7-7.2		1045	55/6 51/6	100%		Slightly moist, gray silt with occasional gravel.
8									
9			748 9-9.2		1120	37/6 53/6	100%		Dry as above
10						59/6			
11			749 11-11.2		1145	26/6 77/6	100%		Two-inch uniform fine sand Lens at 22', dry, gray silt from 11.2-12'.
12									
13			750 13-13.2			24/6 88/6	100%		Dry, gray silt with occasional well rounded gravel <3/4"
14									

TEST HOLE LOG

PAGE 4 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ashi01 HOLE NUMBER S-13

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 515 Pilchuck Path ELEVATION G.S. DATE 7-20-93

RECORDED BY S. Billin DRILL METHOD H S A DRILLER R. Gibson DRILLING CO. Boretec

TOTAL DEPTH 17.0' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
14						34/6			
						29/6			
15		EVT-	9307- 751 15-15.2			22/6	100%		Moist sandy gray silt, some silty sand, Lenses
						17/6			
16						16/6			Slightly moist, gray si\ilt with gravel
						60/6			
17			752 16.6-17		1235				

TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-15

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 523 Pilchuck Path ELEVATION G.S. DATE 1-26-93

RECORDED BY J. C. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-595		1550				Organic material, sandy, crushed gravel
2"									
6"			9301-596		1555				Brown, silty sand
9"									
1'			9301-597		1600				Brown silty sand, 5% clays, brick material
2'			9301-598		1605				Brown silty clay, small gravels
3'			9301-599		1610				Brown silty/very little clay, wet
4'			9301-600		1615				Tan, silty clay Hit top of flume? Hard, pipe? Sized off & had 1' void
5'									
6'			9301-601		1620				Tan, silty clay
7'									

TEST HOLE LOG

PAGE 2 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-15

STATE WA COUNTY Snohomish LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION 523 Pilchuck Path ELEVATION G.S. ___ DATE 7-20-93

RECORDED BY S. Billin DRILL METHOD HSA DRILLER R Gibson DRILLING CO. Boretec

TOTAL DEPTH 15.0' CASING TYPE AND DESCRIPTION ___

TOTAL DEPTH CASED ___ WELL COMPLETION DESCRIPTION ___

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7		EVT-	9307 753 7-7.2		1345	11/6 27/6	100		Moist, light gray silt with occasional gravel
8									
9			754 9-9.2		1400	19/6 29/6	100		slightly moist as above
10									Sandy silt Lens 10.7-11'
11			755 11-11.2		1420	25/6 39/6	100		Very moist, light gray silt with occasional <1% well rounded gravel
12									
13			756 13-13.2		1400	45/6 50/3	100		Dry, light gray silt with occasional <1% coarse gravel
14									

TEST HOLE LOG

PAGE 3 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-15

STATE WA

COUNTY Snohomish

LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION 523 Pilchuck Path

ELEVATION G.S. ____

DATE 7-20-93

RECORDED BY Sam Billin

DRILL METHOD HSA

DRILLER R. Gibson DRILLING CO. Boretec

TOTAL DEPTH 15.0'

CASING TYPE AND DESCRIPTION ____

TOTAL DEPTH CASED ____

WELL COMPLETION DESCRIPTION ____

REMARKS ____

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
14						14/6			
						91/6			
15			757 144.8-15		1455				As above

TEST HOLE LOG

PAGE 1 OF 2

HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter

JOB NUMBER ASEV-01

HOLE NUMBER S-22

STATE Washington

COUNTY Snohomish

LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION 440 Pilchuck Path

ELEVATION G.S. ___

DATE 07/22/93

RECORDED BY Sam Billin

DRILL METHOD HSA

DRILLER Ritch Gibson

DRILLING COMPANY Boretec

TOTAL DEPTH 15.7'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ <4'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4		EVT-	9307 782 4-4.2		1145	17/6			Light gray, slightly moist silt with occasional fine gravel.
						22/6	50		
									Coarse gravel at 5.3'.
5						40/2			
6			783 6-6.2		1200	15/6			Slightly moist, light gray, silty fine sand.
						25/6	100		
7			784 7-7.2		1205	35/6			Slightly moist, light gray, uniform, medium-grained sand.
8									
9			785 9-9.2		1210	9/6			Slightly moist, light gray sandy silt.
							100		
						33/6			
						60/6			
10									
11									

TEST HOLE LOG

PAGE 2 OF 2

HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter

HOLE NUMBER S-22

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
11			786 11-11.2		1215	33/6			Light gray sand, silt with large (1") iron stained lenses.
							100		
						60/6			
12									
								1 gallon water added.	
13			787 13.3-13.5		1250	36/6			Moist, light gray, sandy silt with occasional fine gravel.
							100		
						62/6			
						133/6			
14									
15			788 RV 15-15.2		1300	63/6			Moist, dense, light gray, sandy silt with occasional gravels.
						58/5			
16									

TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-27

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 Pilchuck Path

ELEVATION G.S.

DATE 1-28-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-623		1055				Topsoil, organic material, sandy
2"									
6"			9301-624		1100				Brown silty sand, brick chips, small gravel
9"									
1'			9301-625		1105				Tan sandy silt, small gravel
2'			9301-626		1110				Brown silty sand, brick chips, black stains
3'			9301-627 9301-630 Dupl.		1115 1130				Tan, silty sand, oxidized, small gravels
4'			9301-628		1120				Tan, silty sand, oxidized
5'									
6'			9301-629		1125				Tan silty sand
7'									

TEST HOLE LOG

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter
JOB NUMBER ASEV01
HOLE NUMBER S-27 A

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 Pilchuck Path
ELEVATION G.S.
DATE 7-16-93

RECORDED BY JC
DRILL METHOD H S A
DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 7.2'
CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA
WELL COMPLETION DESCRIPTION NA

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	7.0 7.2		EVT-9307 721		0920	50/3	100%		Light grey silt, soft, moist, small gravel
									7.2 Auger Refusal Hit concrete

TEST HOLE LOG

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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-27 B
STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT
SITE DESCRIPTION 520 Pilchuck Path ELEVATION G.S. DATE 7-16-93
RECORDED BY JC DRILL METHOD H S A DRILLER J. Lewis DRILLING CO. Boretec
TOTAL DEPTH 10.4' CASING TYPE AND DESCRIPTION NA
TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA
REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	7.2 7.5		EVT-9307 722		0950	13/6	100%		Light grey silt, stiff, small gravels
8'									
9'	9.0 9.3		EVT-9307 723		1020	50/6	100%		Light grey silt, very dense, small gravel
10'	10.0 10.4		EVT-9307 724		1045	50/4	100%	1 gallon	Light grey silt, very dense, small gravel
									Till started at 8.0'

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-28

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 Pilchuck Path ELEVATION G.S. DATE 1-28-93

RECORDED BY J. C. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 5.5' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-631		1150				Topsoil, organic material, sandy, red brick chips
2"									
6"			9301-632		1155				Brown silty sand, red brick, small gravels
9"									
1'			9301-633		1200				Brown red, white silty sand with brick chips, smelter debris
2'			9301-634		1205				Brown silty sand, red brick smelter debris
3'			9301-635		1210				Tan, silty sand, small gravels
4'			9301-636		1215				Tan, silty sand, small gravels, wet
5'									
5.5'			9301-637		1220				Tan silty sand, wet, auger refusal at 5.5'
6'									
7'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-28 A,B,C

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 Pilchuck Path

ELEVATION G.S.

DATE 7-16-93

RECORDED BY JC

DRILL METHOD H S A

DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 7.2'

CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA

WELL COMPLETION DESCRIPTION NA

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	7.0 7.2		EVT-9307 725A		1340	50/3	100%	1 gallon 1 gallon	Light grey silt, very dense, small gravel
									Till started at 4.8' S-28A Auger Refusal at 2' (large cobble) S-28B Auger Refusal at 7.0' S-28C Auger Refusal at 4.0'

TEST HOLE LOG

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HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter JOB NUMBER ASEV-01 HOLE NUMBER S-34

STATE Washington COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 507 Hawthorne ELEVATION G.S. DATE 07/19/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER Ritch Gibson DRILLING COMPANY Boretec

TOTAL DEPTH 11.7' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ 7.2'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4					1630	4/6 10/6 23/6	0		Sand catcher broke, 0% recovery, augered to 5' and resampled.
5		EVT-	9307 734 5-5.2		1645	6/6 28/6	70		Slightly moist light brown silt with occasional gravels.
6			735 6.3-6.5		1050	36/6			Same as above.
7			736 7-7.2		1705	61/6	100	1/2 gallon	Slightly moist, light brown silt with gravel, light gray silt at 7.2'.
			737 7.3-7.5		1710				
8									
9			738 9-9.2		1740	65/6 77/6	100	1/4 gallon	Moist, light gray silt, with large (>1") gravel and weathered gravel.
10					1800	90/6	0		Apparently sitting on a rock. Stuck, removed. Same as above.
11			739 11.5-11.7		1900	170/2	100		

TEST HOLE LOG

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HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter JOB NUMBER ASEV-01 HOLE NUMBER S-36

STATE Washington COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION 511 Hawthorne ELEVATION G.S. ____ DATE 07/19/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER Ritch Gibson DRILLING COMPANY Boretec

TOTAL DEPTH 10.3' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ 6.5'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4		EVT-	9307 729 4-4.2		1315	2/6 4/6 5/6	30%		Moist, light brown, silt with small gravel and 5% brick fragments.
5									
6			730 6-6.2		1340	4/6 16/6	100	<1 liter	Moist, light brown silt with >3/4" gravel and brick fragments, moist, light gray silt at 6.5' with small gravel and no brick.
7			731 7-7.2		1345	35/6 47/6			
8									
9			732 9-9.2		1420	100/6		<1 liter	Dry, light gray silt with occasional small gravel.
10			733 10-10.2		1430	100/4		1.0 gallon	Light gray silt with occasional small gravel.
			Auger refused at 10.3'.						

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter JOB NUMBER ASEV-01 HOLE NUMBER S-37

STATE Washington COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 515 Hawthorne ELEVATION G.S. DATE 07/19/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER Ritch Gibson DRILLING COMPANY Boretec

TOTAL DEPTH 8.2' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ <4'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4		EVT- RV	9307 725B 4.5-5	1045		50/6 64/6	100		Moist, light gray silt, dense with gravel, sandy silt from 4.0 - 4.2'. Dup taken EVT-9307-726 1030. 4.5 - 5'
5									
6		EVT-	9307 727 6.3-6.7	1100		70/6	100	Add 1.0 liter	As above, less dense.
7			728 7.0-7.2	1130		36/6 70/3	100	<1 liter	As above, but drier.
8			7.8-8.2			125/5			Dry, light gray silt with gravel.
			Auger refused					TD = 8.2'	

TEST HOLE LOG

PAGE 1 OF 2

HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter JOB NUMBER ASEV-01 HOLE NUMBER S-39

STATE Washington COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 516 Hawthorne ELEVATION G.S. DATE 07/22/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER Ritch Gibson DRILLING COMPANY Boretec

TOTAL DEPTH 16.5' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ 4.0'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE / TIME	HAMMER BLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4		EVT-	9307 771 4-4.2	0825	5/6 12/6 23/6			Very wet brown silt above 4.0', moist, light gray silt with gravel 4-5.5'.
5								
					34/6			
6			772 6-6.2	0835				Dry as above. EVT-9307-773 (Dup 6-6.2) 0840.
					74/6			Dry as above.
7			774 6.8-7	0845				
8								
9								
			778 9-9.2	0910	34/6 126/4			Dry gravelly, light gravel silt.
10								
							2 gallons water added.	
11								

TEST HOLE LOG

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HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter

HOLE NUMBER S-39

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
11			779 11-11.2		0935	50/6			Moist, light gray, sandy silt, low recovery, not well representative.
							15		
						77/4			
12									
									Auger bouncing at 12.5'.
						32/6			Able to drive spoon through, moist, light gray sandy silt (13'). Silty gravel lense at 12.5-12.8'.
			780 13-13.2		1010	45/6	100		
13									
						60/6			
								1 gallon water added.	
14						60/6			
						35/6			
									Moist, light gray sandy silt at 15', dense, light gray silt with occasional gravels 16-16.5'.
15			781 15-15.2		1015	37/6			
						70/6	100		
						42/6			
16									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-46

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 510 East Marine View Drive ELEVATION G.S. DATE 1-21-93

RECORDED BY V. S. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-515		0930				Topsoil, piece of brick
2"									
6"			9301-516		0935				Brown silt, sandy, gravelly
9"									
1'			9301-517		0940				Topsoil, piece of brick
2'			9301-518		0945				Topsoil, some gravel, brick
3'			9301-519		0950				Topsoil, black clay, brick
4'			9301-520		0955				Topsoil, black clay
5'									
6'			9301-521		1000				Tan sand, silt, gravel, some clay
7'									

TEST HOLE LOG

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter
JOB NUMBER ASEV01
HOLE NUMBER S-46

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 510 E. Marine View Drive
ELEVATION G.S.
DATE 7/21/93

RECORDED BY Sam Billin
DRILL METHOD HSA
DRILLER
DRILLING CO. Boretec

TOTAL DEPTH 16.7'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS (Note bit/auger size) Till @ approximately 6'

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
									0-4" Topsoil with brick fragments 3-4'
									4-5' very wet, loose, brown silt
6		EVT-	9307 758 6-6.2		0900	9/6 19/6	100		Moist, light gray silt
7			759 7-7.2		0905	26/6	100		Moist, light gray, gravelly, sandy silt, EVT 93076-760 Dup at 7-7.2 0910
8						7/6 34/6	30		Sample was 7.5-9'-no effective recovery
9						28/0			

TEST HOLE LOG

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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-46

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 510 Marine View Drive ELEVATION G.S. DATE 7-21-93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER R. Gibson DRILLING CO. Boretec

TOTAL DEPTH 16.7' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS (Note bit/auger size) Till @ approximately 6'

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
9			761 9-9.2		0915	39/6	100		Slightly moist, light gray sandy silt, few gravels
						63/6			Dryer at 10'
10									
11			762 13-13.2		0930	24/6 30/6	100		Slightly moist, light gray silt with occasional fine gravel
12									
13			763 13-13.2		0950	33/6 50/4	100		Dry as above
						54/6	100		
14									
						100/5			
15			764 14.3-15		1030				As above with coarse gravel
								1 gallon water added	
16						111/6			Dry as above with large gravel apparently large cobbles at 16.7. Auger refuseed

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-46

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 510 Marine View Drive ELEVATION G.S. DATE 7-21-93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER R. Gibson DRILLING CO. Boretec

TOTAL DEPTH 16.7' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
17			765 16.5-16.7		1100	100/2	100		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-47

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 502 East Marine View Drive ELEVATION G.S. DATE 1-22-93

RECORDED BY V. S. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 6' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-567		1130				Topsoil, sandy, organic material, brick pieces
2"									
6"			9301-568		1135				Topsoil, sandy, organic material
9"									
1'			9301-569		1140				Gravel, sandy, little silt
2'			9301-570 9301-574 Dupl. of 570		1145 1205				Brown sand, gravelly, little silt, some brick
3'			9301-571		1150				Brown sand, silty, black clay lenses, trace gravel
4'			9301-572		1155				Tan sand, clayey, little gravel, oxidation staining
5'									
6'			9301-573		1200				Light gray sand, silty, clay lenses some organic material
7'									

TEST HOLE LOG

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-47

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 502 E. Marine View Drive ELEVATION G.S. DATE 7-14-94

RECORDED BY J.C. DRILL METHOD H S A DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 11.2' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	7.0 7.2		EVI-9307 710		1100	20/6 50/6	100%		Light grey silt, very dense, small gravel
8'									
9'						50/6	0%		No Sample Recovery Large gravel stuck in spoon shoe
10'	10.0 10.2		EVI-9307- 711		1210	28/6	100%		Light grey silt, dense 1/2" gravel
11'	11.0 11.2		EVI-9307- 712		1325	50/5	100%		Light grey silt, dense 1/2" to 3/4" gravel
12'									Auger Refusal at 11.2' Till from 4.5 to 6.5' very moist, moldable. Mud rings coming off auger.

TEST HOLE LOG

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HYDROMETRICS

HELENA, MONTANA

PROJECT Everett Smelter JOB NUMBER ASEV-01 HOLE NUMBER S-50

STATE Washington COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 528 Hawthorne ELEVATION G.S. DATE 07/21/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER Ritch Gibson DRILLING COMPANY Boretec

TOTAL DEPTH 9.7' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Till @ 4.5'.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	% CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
4		EVT-	9307 766 4-4.2		1330	8/6			Topsoil - moist loam to 4.5'.
						9/6	100		Moist, light gray silt and gravel 4.5-5.5'.
						13/6			
5									
6		EVT-	9307 767 6-6.2		1400	24/6			Apparent cobbles at 6.0'. Slightly moist, light gray silt with occasional gravel.
						26/6	100		
			768 7-7.2		1405	41/6			Dry, light gray silt with occasional gravel.
7									
8			Auger refusal on cobbles at 6.0'. Pulled out of hole and moved off 3.0'. Drilled straight to 9.0'. Added two gallons water.						
9			769 9-9.2		1545	65/6			Dry gravelly, light gray silt, large cobble fragments at 9.1' (not well representative sample).
							30		
						50/1			
			770 9.6-9.7		1605	200/3	100		As above.
			Both auger and split spoon bouncing off same large cobble. Auger refusal at 9.7'.						

TEST HOLE LOG

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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-72
STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT
SITE DESCRIPTION 514 Pilchuck Path
ELEVATION G.S.
DATE 1-20-93
RECORDED BY R. V.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.
TOTAL DEPTH 6'
CASING TYPE AND DESCRIPTION
TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION
REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			ASEV01 9301-500		1345				Topsoil, organic - rich
2"									
6"			9301-501		1350				Topsoil, organic - rich
9"									
1'			9301-502		1355				Brown sand, silty, organic - rich
2'			9301-503		1400				Brown sand, silty, plus gray material (flue dust?)
3'			9301-504		1405				Light brown sand, silty, brick fragments, gray material (flue dust?)
4'			9301-505		1410				Light brown sand, clayey, oxidation rust spots
5'									
6'			9301-506		1415				Gray, silt, sandy, clayey, pebbles
7'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett Smelter

JOB NUMBER ASEV01

HOLE NUMBER S-72 A, B

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 514 Pilchuck Path

ELEVATION G.S.

DATE 7-15-93

RECORDED BY JC

DRILL METHOD H S A

DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 10.0'

CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA

WELL COMPLETION DESCRIPTION NA

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	7.0 7.3		EVT-9307 718		1515	38/6 50/3	100%	1 gallon	Light grey silt, very dense, small gravel
8'									
9'	9.0 9.3		EVT-9307 720		1535	50/5	100%	1 gallon	Light grey silt, very dense, small gravel
10'			Auger Refusal						Till - 5.0' Duplicate 7' sample EVT-9307-719 1600 hrs S-72A - Auger refusal concrete @ 4.5' S-72B - Auger refusal split spoon at 10' Blow counts 50/1" No sample

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-101

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 108 Skyline Drive ELEVATION G.S. DATE 1-21-93

RECORDED BY V. S. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9103-548		1400				Topsoil, organic material, clay
2"									
6"			9103-549 9103-554		1405 1430				Silty sand, some pebbles
9"			Dupl. of		549				
1'			9103-550		1410				Sand, pebbles, silty brown
2'			9103-551		1415				Tan silt, clay, some sand, trace gravel
3'			9103-552		1420				Tan, silt, clayey, some oxidation staining
4'			9103-553		1425				Tan, silt, clayey, sandy
5'									
6'									
7'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-102

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 221 Skyline Drive
ELEVATION G.S.
DATE 1-26-93

RECORDED BY J. S.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-582		1400				Topsoil, organic material, sandy
2"									
6"			9301-583		1405				Brown silt, sandy, small gravels
9"									
1'			9301-584 9301-585 Dupl. of 584		1410 1415				Brown silt, sandy, small gravels
2'			9301-586		1420				Brown silt, sandy, pea gravels - 10%, water encountered
3'			9301-587		1425				Tan, sandy clay
4'			9301-588		1430				Tan, sandy clay
5'									
6'									
7'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-103

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 308 Skyline Drive

ELEVATION G.S.

DATE 2-01-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-638		1220				Topsoil, organic material, brown sandy
2"									
6"			9301-639		1225				Brown sandy silt, small gravels
9"									
1'			9301-640		1230				Brown silty sand, large to small gravels
2'			9301-641 9301-644 Dupl. of 641		1235 1250				Brown silty sand, small gravels
3'			9301-642		1240				Reddish tan silty sand, small gravels oxidation
4'			9301-643		1245				Wet, silty sand, small gravels, tan
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-104

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 512 Winton Avenue ELEVATION G.S. DATE 2-01-93

RECORDED BY J.C. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-645		1330				Brown topsoil, organic material small gravel
2"									
4"									
6"			9302-646		1335				Brown sandy silt, small gravel
9"									
1'			9301-647		1340				Brown silty sand, small gravel
2'			9301-648		1345				Tan silty sand
3'			9302-649		1350				Tan silty sand, small gravels
4'					1355				Refusal, no sample
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-105
STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT
SITE DESCRIPTION 617 Legion Drive
ELEVATION G.S.
DATE 1-21-93
RECORDED BY V. S.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.
TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION
TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION
REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-542	1300					Topsoil, sandy, organic material
2"									
6"			9301-543	1305					Black topsoil, some tan silty clay, organic material
9"									
1'			9301-544	1310					Wood fragments, sandy silt, brown
2'			9301-545	1315					Brown sandy silt, wood fragments, some tan clay
3'			9301-546	1320					Tan sand & gravel
4'			9301-547	1325					Gray sand & gravel
5'									
6'									
7'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-106

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 606 Linden Street

ELEVATION G.S.

DATE 1-22-93

RECORDED BY V. S.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 3.5'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-555		0900				Topsoil, pebbles, brown
2"									
6"			9301-556		0905				Brown silt, gravelly, sandy, some clay
9"									
1'			9301-557		0910				Brown sand, some pebbles, silty Refusal at 2'; moved hole 1' east
2'			9301-558		0915				Brown sand & gravel, some silt, oxidation stains
3'			9301-559		0920				Gray silt, sandy, some pebbles
3.5'			9301-560		0925				Refusal at 3.5', silty clay, pebbles, dark gray
4'									
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-107

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 724 Linden Street

ELEVATION G.S.

DATE 2-05-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-664		1015				Brown organic material, sandy
2"									
6"			9301-665		1020				Brown, silty sand, small gravel
9"									
1'			9301-666		1025				Brown, silty sand, small gravels
2'			9301-667 9301-670 Dupl. of 667		1030 1045				Brown, silty sand, 1/2" - 1/4" gravels
3'			9301-668		1035				Brown, silty sand, small gravels
4'			9301-669		1040				Reddish-brown, silty sand, moist, 1/2"-1/4" gravels
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-108

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION Linden Street

ELEVATION G.S.

DATE 2-05-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-671		1050				Brown organic material, sandy
2"									
6"			9301-672		1055				Brown, silty sand, 3/4" - 1/4" gravels
9"									
1'			9301-673		1100				Light brown silty sand gravels
2'			9301-674		1105				Tan silty clay, moist
3'			9301-675		1110				Tan silty clay, small gravel, moist
4'			9301-676		1115				Light brown silty sand, 1/2" gravel
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-109

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 901 Maple Street
ELEVATION G.S.
DATE 1-22-93

RECORDED BY V. S.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-561		1045				Topsoil, sandy, organic material
2"									
6"			9301-562		1050				Black sand, gravelly, silty
9"									
1'			9301-563		1055				Brown sand, gravelly, little silt
2'			9301-564		1100				Tan, silty clay
3'			9301-565		1105				Tan, sandy silt, little clay
4'			9301-566		1110				Silty clay, tannish-gray, some oxidation stains
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-110

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 812 East Marine View Drive

ELEVATION G.S.

DATE 2-02-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-657		0820				Brown topsoil, organic material, sandy
2"									
6"			9301-658		0825				Brown, silty sand, small gravels
9"									
1'			9301-659		0830				Brown, silty sand, small gravels
2'			9301-660		0835				Brown, silty sand, small gravels
3'			9301-661		0840				Brown to tan sandy silt
4'			9301-662 9301-663 Dupl. of 662		0845 0850				Reddishh-brown sandy silt, small gravels
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-111

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 East Marine View Drive ELEVATION G.S. DATE 1-21-93

RECORDED BY V.S. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics Inc.

TOTAL DEPTH 5' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9302-522		0825				Brown sand, silt, tan clay, organic material
2"									
6"			9302-523		0830				Sand, silt, some ggravel, organic material
9"									
1'			9302-524		0835				Brown silty clay, white sand, brick
2'			9302-525		0840				White sand, brown silt, brick
3'			9302-526		0845				White sand, (crystalline), brick, brown silt
4'			9301-527		0850				Gray sand, silt, brick, dark gray clay pebbles
5'									
6'									No sample collection; could not auger past 5' feet
7'									

TEST HOLE LOG

PAGE 2 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-111

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 East Marine View Drive ELEVATION G.S. DATE 7-15-93

RECORDED BY J.C. DRILL METHOD H S A DRILLER J. Lewis DRILLING CO Boretec

TOTAL DEPTH 11.3' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0									Topsoil, fill material, brown medium sand, silt organic material, small gravel
1'									Multi-colored smelter debris (white, red, grey) brick chips mortar, medium sand
2'						3/6			
						2/6	50%		White crystalline material strong odor
3'						2/6			
						2/6			Brick material, medium sand, silt, brown, white specks, small gravel
4'						8/6			
						2/6			
5'	5.0	EVT9307 714A			0900	1/6	90%		Moist gray, medium sand, silt, black streaks, small gravel, strong odor
						1/6			
6'	6.0					8/6			
						11/6			Moist brown fine sand, silt, black streaks, brick material
7'									

TEST HOLE LOG

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter
JOB NUMBER ASEV01
HOLE NUMBER S-111

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 E. Marine View Drive
ELEVATION G.S.
DATE 7-15-93

RECORDED BY J. C.
DRILL METHOD H S A
DRILLER J. Lewis DRILLING CO. Boretec

TOTAL DEPTH 11.3'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'	6.25 7.25		EVT-9307 714B		0935	50/4	90%		Light grey silt, fine sand, small gravel, dense
8'	8.0 8.5		EVT-9307 715		1055	28/6 50/3	100%		Light grey silt, very dense, small gravel
9'	9.0 9.2		EVT-9307 716		1135	50/5	100%		Light grey silt, very dense, small gravel
10'									
			EVT-9307 717		1145	28/6 50/5	100%		Light grey silt, very dense, small gravel
	10.8								
11'	11.3								Auger refusal at 11.0' Collected samples 2-4' and 5-6' for archivery

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-112

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 523 Pilchuck Path

ELEVATION G.S.

DATE 1-26-93

RECORDED BY J. C.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0 2"			EVT 9301-602		1700				Brown to black organic material, sandy, some small gravel
6"			9301-603		1705				Silty, red (brick color) little clays, some oxidation
9"									
1'			9301-604		1710				Brown silty sand, some red, some oxidation HARD
2'			9301-605		1715				Red silty/(brick), some oxidation, little clays
3'			9301-606 9301-608 Dupl.		1720 1730				Sandy silt, red, some oxidation
4' 5'			9301-607		1725				Brown sandy silt (brick chips) & had 1' void
6' 7'									

TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-113
STATE WA
COUNTY Snohomish
LOCATION T ___ R ___ SEC. ___ TRACT ___
SITE DESCRIPTION 528 Pilchuck Path
ELEVATION G.S. ___
DATE 1-28-93
RECORDED BY J. C.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.
TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION ___
TOTAL DEPTH CASED ___
WELL COMPLETION DESCRIPTION ___
REMARKS ___

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-609		0830				Topsoil, organic material (brick chips), sandy
2"									
6"			9301-610		0835				Brown sandy silt, brick chips, small slag
9"									
1'			9301-611		0840				Brownish-red silts with brick chips
2'			9301-612 9301-615 Dupl.		0845 0900				Brownish-red silts, small gravels, small slag
3'			9301-613		0850				Brown silty sand, small gravels
4'			9301-614		0855				Tan sandy silt, small gravels
5'									
6'									
7'									

TEST HOLE LOG

PAGE 2 OF 3

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter
JOB NUMBER ASEV01
HOLE NUMBER S-113

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 528 East Marine View Drive
ELEVATION G.S.
DATE 7/20/93

RECORDED BY Sam Bittin
DRILL METHOD HSA
DRILLER R. Gipson
DRILLING CO. Boretec

TOTAL DEPTH 15.0'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS (Note bit/auger size) Till @ 6.8'

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
6		EVT	9307 740 6-6.2		850	2/6 2/6	100		Brown, silt with black organic? streaking.
7			741 7-7.2		855	2/6	100		EVT-9307-742 Duplicate of 7-2.2' 1005 Light gray silt with light brown marbelling, moist
8						10/6 26/6	100		Very wet 8-9'
9			743 9-9.2		910	44/6 50/6	100		Very densew, light gray silt, with gravels, slightly moist
10						10/6 39/6	100		
11			744 11-11.2		915	50/6			Dense, Light gray, sandy silt with occasional <1/2" gravel moist
12						38/6 88/6	100		
13			745 12.8-13		0930				As above with sandy silt, Lense at 13', slightly moist

TEST HOLE LOG

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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett Smelter JOB NUMBER ASEV01 HOLE NUMBER S-113

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 528 East Marine View Drive ELEVATION G.S. DATE 7/20/93

RECORDED BY Sam Billin DRILL METHOD HSA DRILLER R. Gibson DRILLING CO. Boretec

TOTAL DEPTH 15.0' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICA ION
13									
14						43/6	100		
						100/6			Dry, dense, light gray silt with occasional gravel
15			746 14.8-15	1000					

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-114
STATE WA
COUNTY Snohomish
LOCATION T
R
SEC.
TRACT
SITE DESCRIPTION 110 Bridgeway
ELEVATION G.S.
DATE 1-26-93
RECORDED BY J. S.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.
TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION
TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION
REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-589		1500				Black/brown topsoil/organic material, sandy, small gravels
2"									
6"			9301-590		1505				Black/brown topsoil/organic material, sandy, small gravels
9"									
1'			9301-591		1510				Brown sandy silt, some oxidation
2'			9301-592		1515				Brown silty sand, small gravels
3'			9301-593		1520				Tan, sandy clay, some oxidation, some water, small gravels
4'			9301-594		1525				Gray silty/clay, small gravels
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER S-115

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 302 Bridgeway
ELEVATION G.S.
DATE 1-22-93

RECORDED BY V. S.
DRILL METHOD Hand Auger
DRILLER J.C.
DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-575		1300				Topsoil, sandy, some organic material, plastic liner
2"									
6"			9301-576		1305				Brown topsoil, sandy, some organic matter
9"									
1'			9301-577 9301-581 Dupl. of 577		1310 1330				Brown topsoil, sandy, silty, some black clay stringers, some pebbles
2'			9301-578		1315				Tan, sandy clay & silt
3'			9301-579		1320				Tan, sandy clay, some oxidation stains
4'			9301-580		1325				Gray silty clay, some sand
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER S-116

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 2909 Whitehorse Trail ELEVATION G.S. DATE 2-01-93

RECORDED BY J. C. DRILL METHOD Hand Auger DRILLER J.C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9301-651		1622				Brown topsoil, organic material, sandy
2"									
6"			9301-652		1625				Brown, tan sandy/silt, small gravels
9"									
1'			9301-653		1630				Brown silty sand
2'			9301-654		1635				Brown silty sand
3'			9301-655		1640				Brown silty clay
4'			9301-656		1645				Brown, silty sand, wet
5'									
6'									
7'									

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER S-117

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 2832 Medora Drive

ELEVATION G.S.

DATE 1-21-93

RECORDED BY V. S.

DRILL METHOD Hand Auger

DRILLER J.C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0 2"			EVT 9301-535		1105				Brown sand, silt, pebbles
6"									
9"			9301-536		1110				Brown sand, pebbles, silty, some organic material
1'			9301-537 9301-541 Dupl. of 537		1115 1135				Brown sand, silty, some clay, some gravel
2'			9301-538		1120				Brown sand, silty, clayey, some orange staining, pebbles
3'			9301-539		1125				Tan sand & silt, clayey, some pebbles
4' 5'			9301-540		1130				Tan silt, sandy, some pebbles
6' 7'									

APPENDIX D

LOGS FOR PHASE II RESIDENTIAL SOIL BORINGS

Summary of Contents of Appendices C, D, and E

Appendix C contains the logs for Phase I/II residential soil borings S-4, S-8, S-13, S-15, S-22, S-27, S-28, S-34, S-36, S-37, S-39, S-46, S-47, S-50, S-72, and S-101 through S-117.

During Phase I, samples were collected at 26 of these locations (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, and S-101 through S-117. During the first round of Phase II, eleven of these locations were revisited (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113), as well as six SAIC locations reinvestigated (S-22, S-34, S-36, S-37, S-39, and S-50). As a result, the logs for borings S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113 are a combination of two sampling efforts which took place approximately 6 months apart. The logs are reflections of individual preferences of the various geologists that have been involved in the logging. Due to their different styles, terminology as well as scales may vary between the two sections of the logs. However, these logs should be considered one continuous log for the purpose of the RI. The logs for the remaining soil borings are the result of single-event investigations. Phase I locations S-101 through S-110, S-112, and S-114 through S-117 were never revisited; logs from the SAIC effort at Phase II first round locations S-22, S-34, S-36, S-37, S-39, and S-50 were not available.

Appendix D contains the logs for Phase II second round residential soil borings S-74, S-83, S-90 through S-97, S-201 through S-209, and S-301 through S-309. These logs all consist of single-event descriptions.

Appendix E contains the logs of deep soil borings B-1, B-2, EV-2A, and EV-2B, and slag borings SL-1, SL-3, and SL-4. These logs all consist of single-event descriptions.

SUMMARY OF TERMINOLOGY USED ON BORING/WELL LOGS

Drilling Methods Used

HSA - Hollow Stem Auger Drilling method. Reported dimension refers to inside diameter of the hollow stem augers used.

Air Rotary - Forward Rotary Drilling method in which air is used to circulate cuttings from the hole.

Hand Auger - Where indicated, shallow borings completed using 4" diameter stainless steel bucket auger

Sample Collection

Split Spoon Samplers - Except in the case of hand augured borings, samples were collected using standard split spoon samplers. One of two sampler types were used:

- Dames and Moore Sampler - 3" ID split spoon used in conjunction with 300 lb. hammer
- Standard 1 3/8" ID split spoon used in conjunction with a 140 lb. hammer

Blow Counts (noted as Hammer Blows on some logs)

Both split-spoon samplers provide standard penetration data (ASTM D1586), reported on the well logs as the number of blows required to drive the split spoon over a 6-inch sampling interval. Eighteen-inch samples were commonly collected at monitoring well and deep boring sites. Six-inch to one-foot samples were collected at some of the shallow borings. In all cases, the reported blow count refers to the number of blows per 6 inch interval unless specifically noted. In instances where blow counts exceeded 50, the spoon was retrieved and the reported blow count is followed by the amount of penetration achieved for that sampling interval (for example 50/5").

Sample

Sample numbers were assigned to individual sampling intervals in the field. In some instances, distinct variations in lithology are reported within a sampling interval and the sample number is followed by an A and B. In these cases, the retrieved sample was separated into two discrete samples at the lithologic break and analyzed separately.

Sample Type

s.s. = split spoon sample as described above
grab = Grab sample off auger flights

Many of the logs include a drilling and sampling methodology in the header information. For sites indicating that a split spoon sampler was used, all samples were collected accordingly unless specifically noted under sample type. For borings completed with a hollow stem auger, all samples are grab samples taken from the auger bucket unless otherwise noted.

Geologic Description

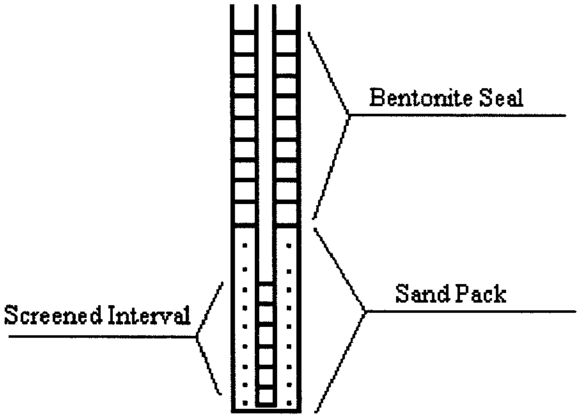
The logs contain field descriptions of soil samples, which generally include color, texture and soil moisture conditions at time of drilling. In some instances, geologic classification and contacts are noted based on interpretation of field data. Where geologic contacts were indistinct due to similarity in appearance, texture, and density, field interpretations were omitted from the logs.

B.O.H. = Bottom of Drilled Hole. In some instances, a sample may have been collected at the bottom of the hole; the sampling depth may therefore be greater than the reported B.O.H.

SWL. = Static Water Level in well at the time of drilling. In some instances, the well may have been allowed to recover prior to static water level measurement. In this case, date is indicated at the time of static water level measurement.

Well Completion Diagrams

In addition to descriptions of well completion, schematic diagrams of well completion are also shown on well logs. The symbols shown on these schematics are defined below:



TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-74

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 215 Medora West of clotheslines

ELEVATION G.S.

DATE 1-11-94

RECORDED BY J. C.

DRILL METHOD S. Spoon

DRILLER Jeff S.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Pancoast Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	268		1335				Dark brown fine sand/silt root material small gravels
		6	269		1340		100%		Dark brown fine sand/silt root material small gravels
12		12	270		1345				Red brown fine sand/silt small gravels
24		24	271		1350				Red brown fine sand/silt small gravels
36		36	272		1355				Red brown fine sand/silt small gravels moist
48		48	273		1400		100%		Grey fine sand/silt small gravels dry

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-83

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 207 Bridgeway Backyard ELEVATION G.S. DATE 1-13-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) D. Smith Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	304		0905	3" ss			Dark brown fine sand/silt root material small gravel
		6	305		0910	2	100%		Dark brown medium to fine sand/small gravel
12		12	306		0915	1			Dark brown medium to fine sand/small gravel
						2			
						4			
24		24	307		0920	2" ss			Dark brown fine sand/silt small gravels black streaks
						4			
36		36	308		0925	4	100%		Dark brown fine sand/silt small gravels black streaks some clay wood debris
						4			
48		48	309		0930	4			Dark brown fine sand/silt small gravels black streaks some clay

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-90

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 232 Bridgeway ELEVATION G.S. DATE 1-12-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Burt Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	274		0830			3" spoon 0-24"	Dark brown clayey silt, some sand organic matter small gravels
		6	275		0835	1			Dark brown silt & sand (fine), trace clay
12		12	276		0840	5		2" spoon 24-48"	
						7			
24		24	277		0845	7			Light brown sand (fine to medium) some silt, small gravels
						11			
36		36	278		0850	20			Medium to coarse sand; brown w/black grains moist
						38			
48		48	279		0855	60			Brown silt, some fine sand, dry small gravels dry
			280		0900	Dup	277 12"		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-91

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 235 Bridgeway

ELEVATION G.S.

DATE 1-12-94

RECORDED BY J. C.

DRILL METHOD S. Spoon

DRILLER Jeff S.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Bates Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	281		0905			3" spoon 0-24"	Dark brown silt some clay, roots
		6	282		0910	1			Brown fine-medium sand, silty, some little roots
12		12	283		0915	2		2" spoon 24-48"	Light brown silty clay, small gravels, little roots
						2			
24		24	284		0920	5			silt, fine sand, small gravels, light brown
						7			
36		36	285		0925	9			Grey-brown silt, fine sand, trace clay
						10			
48		48	286		0930	12			Grey-brown silty clay, trace fine sand/small gravels

TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-92

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 534 East Marine View Drive

ELEVATION G.S.

DATE 1-12-94

RECORDED BY V. S.

DRILL METHOD HSA

DRILLER Jeff C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 14.25'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Powers Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	287		0935			2 1/4" I.D. auger	Black sandy silt, grass & roots
		6"	288		0940	1		4 1/2" O.D.	Brown fine-medium sand, small gravels, brick fragments, some root material
1		12"	289		0945	2		3" spoon 0-2'	Brown silt, fine sand, trace clay
						2			
2		24"	290		0950	2		2" spoon 2'-15' depth	Light brown silt, fine sand, small gravel
						2			
3		36"	291		0955	2			Light brown silt, fine sand, small gravel, w/black silt layer (2")
						3			
4		48"	292		1000	3			Light brown fine sand, some silt, trace small gravel
5		5'				4			
6		6'	293		1005	15			Gray brown fine sand, trace silt/small gravel, dense
						23			
7		7'	294		1010	26			Gray fine sand, little silt, trace small gravel

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-92

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 534 East Marine View Drive ELEVATION G.S. DATE 1-12-94

RECORDED BY V. S. DRILL METHOD HSA DRILLER Jeff C. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 14' 3" CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Powers Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7									
8		8'				24			
9		9'	295		1015	54		added 1.5 gallons drilling water starting at 9'5	Gray-brown-silty fine sand trace small gravel
						60/3"			
10		10'							
						48		added 2 gallons water at 10'	
						81			
11		11'	296		1020				Gray brown fine sand, gravelly, little silt, dense
12		12'							
						18			
13		13'	297		1025	12	30%		Brown silty fine sand wet
14		14'							

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-92

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 534 East Marine View Drive

ELEVATION G.S.

DATE 1-12-94

RECORDED BY V. S.

DRILL METHOD HSA

DRILLER Jeff C.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 14' 3"

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Powers Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
14		14.25	298		1030	60/3"	–		Brown fine sand, stiff, small gravel, dry
15						ns			

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-93

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 610 Hawthorne Front yard ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Willett Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	249		1045	3" ss			Dark brown fine sand/silt root material small gravel
		6	250		1050	2	100%		Red brown fine sand/silt root material small gravel
12		12	251		1055	4			Red brown fine sand/silt root material small gravel
						4			
24		24	252		1100	2" ss			Grey fine sand/silt small gravel moist red streaks
						2			
36		36	253		1105	6	100%		Grey fine sand/silt small gravel moist red streaks
						8			
48		48	254		1110	8			Grey fine sand/silt small gravel moist red streaks

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-94

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 2901 Butler Backyard ELEVATION G.S. DATE 1-13-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) A. Smith Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	310		0935	3" ss			Dark brown fine sand/silt root material small gravels
						1			
		6	311		0940		100%		
12		12	312		0945	1			Red brown fine sand/silt small gravels root material
						3			
24		24	313		0950	4 2" ss			Red brown fine sand/silt small gravels
						1			
36		36	314		0955	1	100%		Red brown fine sand/silt small gravels moist
						1			
48		48	315		1000	4			Light grey fine sand/ silt/small gravels moist
		36	316		1005	Dup	314		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-95

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 3004 Butler Street ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) McClune Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	255		1115	3" ss 3			Medium brown fine sand/silt medium gravels black staining
		6	256		1120	5	100%		Medium brown fine sand/silt medium gravels black staining
12		12	257		1125	4			Red brown fine sand/silt medium gravels moist
						5			
24		24	258		1130	2" ss 9			Red brown fine sand/silt medium gravels moist
						12			
36		36	259		1135	19			Grey fine sand/silt small to medium gravel dry
48		48	260		1140	30			Grey fine sand/silt small to medium gravel dry

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-96

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 704 E. Marine View Drive ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Granger Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	261		1300	3" ss			Dark brown fine sand/silt root material small gravel
		6	262		1305	2	100%		Dark brown fine sand/silt root material small gravel
12		12	263		1310	2			Red brown fine sand/silt root material small gravel
						2			
24		24	264		1315	2 2" ss			Red brown fine sand/silt small gravels
						3			
36		36	265		1320	5			Light grey fine sand/silt red streaks small gravels wet.
						16			
48		48	266		1325	24	100%		Light grey fine sand/silt small gravels dry
		24	267		1330	Dup	264 24"		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-97

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 816 E Marine View Drive East of Driveway

ELEVATION G.S.

DATE 1-13-94

RECORDED BY J. C.

DRILL METHOD S. Spoon

DRILLER Jeff S.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Anderson Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	317		1010	3" ss 1			Dark brown fine sand/silt root material small gravels
		6	318		1015		100%		Red brown fine sand/silt root material small gravels
12		12	319		1020	1			Red brown fine sand/silt root material small gravels
						3			
24		24	320		1025	4 2" ss			Red brown fine sand/silt small gravels
						3			
36		36	321		1030	10			Red brown fine sand/silt small gravels wet.
						15			
48		48	322		1035	25	100%		Light grey fine sand/silt small gravels
		12	323		1040		Dup	319	

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-201

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 48" CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size)

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT-940 340		1400	3" ss			Black silty sand gravels, root material, moist
			341		1405	3	100%		Black silty sand gravels, root material, moist
12"			342		1410	3			Reddish brown medium grained sand, small gravels, dry
						2			
24"			343		1415	3			Reddish brown medium grained sand, small gravels, dry
						3			
36"			344		1420	2" ss 3			Light grey silt, wet, small gravel
							100%		
						7			
48"			345		1425	12			Light grey silt, dry, small gravel

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-202

STATE WA COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. ____ DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 48" CASING TYPE AND DESCRIPTION ----------

TOTAL DEPTH CASED -------- WELL COMPLETION DESCRIPTION -----------

REMARKS (Note bit/auger size) -----------

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			366		1610	3" ss			Brown silty sand, root material, small gravels, wet
			367		1615	1	100%		Brown silty sand, root material, small gravels, wet
12"			368		1620	1			Brown silty sand, root material, small gravels, wet
						2			
24"			369		1625	9			Dark grey silt, dry
						2" ss			
						1			
36"			370		1630	7			Light grey silt, oxydyzed, small gravels, dry
							100%		
						9			
48"			371		1635	12			Light grey silt, dry, small gravels

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-203

STATE WA COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. ________ DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 48" CASING TYPE AND DESCRIPTION ---------

TOTAL DEPTH CASED -------- WELL COMPLETION DESCRIPTION -----------

REMARKS (Note bit/auger size) -----------

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			359		1535	3" ss			Dark brown fine sand/silt, root material, wet, small gravels
			360		1540	2	100%		Dark brown fine sand/silt, root material, wet, small gravels
12"			361		1545	3			Dark brown fine sand/silt, root material, wet, small gravels
						2			
24"			362		1550	2			Dark brown fine sand/silt, root material, wet, large gravels
						6			
36"						2" ss 7			
						12	NO RECOVERY		
48"						17			
			365		1605	Dup	24"		

TEST HOLE LOG

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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-204

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 2315 6th Street Front yard ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) Chase Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	229	0905	3" ss			Light brown fine sand/silt small gravel root material
		6"	230	0910	3	100%		
12		12	231	0915	2			Dark brown fine sand/silt small gravels root material
					3			
24		24	232	0920	3 2" ss			Red brown fine sand/silt small gravels
					3			
36		36	233	0925	2			Light brown medium sand/30% small gravels wet.
					9			
48		48	234	0930	24			Grey fine sand/silt small gravels dry
			235	0935			Dup 233 36"	

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01
JOB NUMBER
HOLE NUMBER S-205

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION 718 Legion Drive Front yard
ELEVATION G.S.
DATE 1-11-94

RECORDED BY J. C.
DRILL METHOD S. Spoon
DRILLER Jeff S.
DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'
CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --
WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Meyers Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	236		0940	3" ss			Dark brown fine sand/silt root material
		6	237		0945	1	100%		Dark brown fine sand/silt root material
12		12	238		0950	3			Dark brown fine sand/silt small gravels
						3			
24		24	239		0955	3 2" ss			Red brown fine sand/silt small gravels
						4	100%		
36		36	240		1000	13			Grey fine sand/silt small gravels moist
						24			
48		48	241		1005	18			Grey fine sand/silt small gravels dry

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-206

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 2720 7th Street ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Everett Housing Authority

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	242		1010	3" ss			Dark brown fine sand/silt small gravels root material
		6	243		1015	2	100%		Dark brown fine sand/silt small gravels root material
12		12	244		1020	3			Dark brown fine sand/silt small gravels
						9			
24		24	245		1025	11 2" ss			Red brown fine sand/silt small gravels
						5	100%		
36		36	246		1030	9			Red brown fine sand/silt small gravels moist
						12			Red brown fine sand/silt small gravels moist
48		48	247		1035	14			Light brown fine sand/silt small gravels
		12"	248		1040			Dup 244 12"	

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-207

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 836-838 Locust Front Yard

ELEVATION G.S.

DATE 1-10-94

RECORDED BY J. C.

DRILL METHOD S. Spoon

DRILLER Jeff S.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4'

CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA

WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) Everett Housing Authority

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	218	1450		3" ss			Dark brown fine sand/silt root material small gravels
		6"	219	1455		3			
							100%		
12"		12"	220	1500		5			Brown fine sand/silt small gravels
						7			Brown fine sand/silt small gravels
24"		24"	221	1505		11 2" ss			Brown fine sand/silt small gravels
									Red brown fine sand/silt small gravels moist
						14			Red brown fine sand/silt small gravels moist
36"		36"	222	1510		8			Light grey fine grained sand/silt small gravels
						14			Light grey fine grained sand/silt small gravels
							100%		
48"		48"	223	1515		25			Light grey fine grained sand/silt small gravels
			224	1520		Dup of	223 48"		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-208

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 926 Maple Front yard ELEVATION G.S. DATE 1-13-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Lindenmuth Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	324	1300		3"ss			Dark brown fine sand/silt root material small gravels
		6	325	1305		2			Dark brown fine sand/silt root material small gravels
							100%		
12		12	326	1310		1			Red brown fine sand/silt root material small gravels
						1			
24		24	327	1315		4 2"ss			Light grey with red spots fine sand/silt small gravels
						8			
36		36	328	1320		16			Light grey with red spots fine sand/silt small gravels moist
						15			
							100%		
48		48	329	1325		18			Light grey with red spots fine sand/silt small gravels dry

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-209

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 1014 E. Marine View Dr. Front yard ELEVATION G.S. DATE 1-13-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 4' CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED -- WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Warren Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	330	1330		3"ss			Dark brown fine sand/silt root material small gravel
		6	331	1335		1			
							100%		
12		12	332	1340		3			Red brown fine sand/silt root material small gravel
						2			
						3			
24		24	333	1345		2"ss 2			Red brown fine sand/silt small gravel moist
36		36	334	1350		2			80% gravels up to 1 1/4" in size 20% fine red brown sand/silt moist
						2	100%		
48		48	335	1355		16			25% gravels up to 3/4" in size 75% red brown fine sand/silt moist

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-301

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 24" CASING TYPE AND DESCRIPTION ---------

TOTAL DEPTH CASED -------- WELL COMPLETION DESCRIPTION -----------

REMARKS (Note bit/auger size) -----------

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			346		1430				Dark brown sandy silt, root material, moist
			347		1435	1	100%		Dark brown sandy silt, root material, moist
12"			348		1440	4			Dark brown fine sand, some silt, small gravels, dry
						3			
24"			349		1445	2			Dark brown fine sand, some silt, small gravels, dry
			350		1450	Dup	of	12"	

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-302

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 24" CASING TYPE AND DESCRIPTION ---------

TOTAL DEPTH CASED --------- WELL COMPLETION DESCRIPTION -----------

REMARKS (Note bit/auger size) -----------

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			351		1455	2			Dark brown fine sand/silt, root material, small gravels, moist
			352		1500	2	100%		Dark brown fine sand/silt, root material, small gravels, moist
12"			353		1505	2			Dark brown fine sand/silt, small gravels, moist
24"			354		1510	3			Dark brown fine sand/silt, small gravels, moist

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV-01 HOLE NUMBER S-303

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION American Legion Memorial Golf Course ELEVATION G.S. DATE 2-16-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 24" CASING TYPE AND DESCRIPTION ---------

TOTAL DEPTH CASED -------- WELL COMPLETION DESCRIPTION -----------

REMARKS (Note bit/auger size) -----------

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			355		1515				Dark brown fine sand/silt, root material, small gravels, moist
			356		1520	2	100%		Dark brown fine sand/silt, root material, small gravels, moist
12"			357		1525	2			Dark brown fine sand/silt, moist
						2			
24"			358		1530	3			Light grey fine sand/silt, small gravels, dry

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-304

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 520 Waverly Front yard North of Drive way ELEVATION G.S. DATE 1-11-94

RECORDED BY J. C. DRILL METHOD S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) Agne Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2"	EVT-9401-225		0845		100%		Dark brown fine sand/silt root material
6"		6"	226		0850	2			Dark brown fine sand/silt small gravel some root material
12"		12"	227		0855	3			Dark brown fine sand/silt small gravels
						3			
24"		24"	228		0900	7			Red brown fine grained sand/silt small gravel

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01

JOB NUMBER

HOLE NUMBER S-305

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION 2404 8th Street Backyard

ELEVATION G.S.

DATE 1-13-94

RECORDED BY J. C.

DRILL METHOD S. Spoon

DRILLER Jeff S.

DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2'

CASING TYPE AND DESCRIPTION --

TOTAL DEPTH CASED --

WELL COMPLETION DESCRIPTION --

REMARKS (Note bit/auger size) Sandstrom Residence

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	299		0840	3" ss			Dark brown fine sand/silt root material small gravels
							100%		
6		6	300		0845	1			Dark brown fine sand/silt root material small gravels
12		12	301		0850	1			Red brown fine sand/silt small gravels
						2			
24		24"	302		0855	4			Red brown fine sand/silt small gravels
		24" X	303		0900	Dup	302		

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-306

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 815 Broadway Center Island of Evergreen Apt. Complex ELEVATION G.S. DATE 1-10-94

RECORDED BY J. C. DRILL METHOD 3" S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) BRCR Associates Evergreen Apt.

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0									Grass root material fine sand/silt
		0-2"	200	1320			100%		
6"		86"	203	1335					Dark brown fine sandy silt/ 3/4" rounded gravel some root material
12"		12"	201	1325					Light brown fine grain sand and silt.
24"		24"	202	1330					Light brown silty sand 10% gravels 3/4" size rounded
			204 ERA P. Polutn\clp Soils LOT	1340 Soils #217					

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-307

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 2731 10 Street By East Door ELEVATION G.S. DATE 1-10-94

RECORDED BY J. C. DRILL METHOD 3" S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) Everett Housing Authority

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	205		1345		100%		Dark brown fine sand/silt root material
6"		6"	206		1350	4			Dark brown fine sand/silt root material
12"		12"	207		1355	11			Light brown fine sand/silt small round gravels (well rounded)
						10			
24"		24"	208		1400	9			Light brown coarse sand and pea gravels
			209		1405	Dup			* Dup of 2"-6" interval

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-308

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 1022 Maple Street Backyard North of Sidewalk ELEVATION G.S. DATE 1-10-94

RECORDED BY J. C. DRILL METHOD 3" S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size)

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	210		1410		100%		Dark brown silty sand root material
6"		6"	211		1415	2			Dark brown fine sand silt, some root material small gravel
12"		12"	212		1420	2			Redish brown fine sandy/silt small gravels
						1			
24"		24"	213		1425	2			Light brown fine grained sand/silt small gravels wet. 1 large 2" gravel rounded

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT ASEV-01 JOB NUMBER HOLE NUMBER S-309

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION 15' 1108 E. Marine View From Front Picture Window ELEVATION G.S. DATE 1-10-94

RECORDED BY J. C. DRILL METHOD 3" S. Spoon DRILLER Jeff S. DRILLING CO. Hydrometrics, Inc.

TOTAL DEPTH 2' CASING TYPE AND DESCRIPTION NA

TOTAL DEPTH CASED NA WELL COMPLETION DESCRIPTION NA

REMARKS (Note bit/auger size) Peterson

DEPTH	GRAPHICAL LOG	WELL COMPLETION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0		0-2	214		1430				Dark brown fine sand/silt root material
							100%		
6"		6"	215		1435	2			Dark brown fine sand/silt root material/small gravels
12"		12"	216		1440	2			Redish brown fine sand/silt small gravels
						3			
24"		24"	217		1445	2			Medium brown fine sand/silt small gravels moist

APPENDIX E

LOGS FOR DEEP SOIL BORINGS AND SLAG BORINGS

Summary of Contents of Appendices C, D, and E

Appendix C contains the logs for Phase I/II residential soil borings S-4, S-8, S-13, S-15, S-22, S-27, S-28, S-34, S-36, S-37, S-39, S-46, S-47, S-50, S-72, and S-101 through S-117.

During Phase I, samples were collected at 26 of these locations (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, and S-101 through S-117. During the first round of Phase II, eleven of these locations were revisited (S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113), as well as six SAIC locations reinvestigated (S-22, S-34, S-36, S-37, S-39, and S-50). As a result, the logs for borings S-4, S-8, S-13, S-15, S-27, S-28, S-46, S-47, S-72, S-111, and S-113 are a combination of two sampling efforts which took place approximately 6 months apart. The logs are reflections of individual preferences of the various geologists that have been involved in the logging. Due to their different styles, terminology as well as scales may vary between the two sections of the logs. However, these logs should be considered one continuous log for the purpose of the RI. The logs for the remaining soil borings are the result of single-event investigations. Phase I locations S-101 through S-110, S-112, and S-114 through S-117 were never revisited; logs from the SAIC effort at Phase II first round locations S-22, S-34, S-36, S-37, S-39, and S-50 were not available.

Appendix D contains the logs for Phase II second round residential soil borings S-74, S-83, S-90 through S-97, S-201 through S-209, and S-301 through S-309. These logs all consist of single-event descriptions.

Appendix E contains the logs of deep soil borings B-1, B-2, EV-2A, and EV-2B, and slag borings SL-1, SL-3, and SL-4. These logs all consist of single-event descriptions.

SUMMARY OF TERMINOLOGY USED ON BORING/WELL LOGS

Drilling Methods Used

HSA - Hollow Stem Auger Drilling method. Reported dimension refers to inside diameter of the hollow stem augers used.

Air Rotary - Forward Rotary Drilling method in which air is used to circulate cuttings from the hole.

Hand Auger - Where indicated, shallow borings completed using 4" diameter stainless steel bucket auger

Sample Collection

Split Spoon Samplers - Except in the case of hand augured borings, samples were collected using standard split spoon samplers. One of two sampler types were used:

- Dames and Moore Sampler - 3" ID split spoon used in conjunction with 300 lb. hammer
- Standard 1 3/8" ID split spoon used in conjunction with a 140 lb. hammer

Blow Counts (noted as Hammer Blows on some logs)

Both split-spoon samplers provide standard penetration data (ASTM D1586), reported on the well logs as the number of blows required to drive the split spoon over a 6-inch sampling interval. Eighteen-inch samples were commonly collected at monitoring well and deep boring sites. Six-inch to one-foot samples were collected at some of the shallow borings. In all cases, the reported blow count refers to the number of blows per 6 inch interval unless specifically noted. In instances where blow counts exceeded 50, the spoon was retrieved and the reported blow count is followed by the amount of penetration achieved for that sampling interval (for example 50/5").

Sample

Sample numbers were assigned to individual sampling intervals in the field. In some instances, distinct variations in lithology are reported within a sampling interval and the sample number is followed by an A and B. In these cases, the retrieved sample was separated into two discrete samples at the lithologic break and analyzed separately.

Sample Type

s.s. = split spoon sample as described above
grab = Grab sample off auger flights

Many of the logs include a drilling and sampling methodology in the header information. For sites indicating that a split spoon sampler was used, all samples were collected accordingly unless specifically noted under sample type. For borings completed with a hollow stem auger, all samples are grab samples taken from the auger bucket unless otherwise noted.

Geologic Description

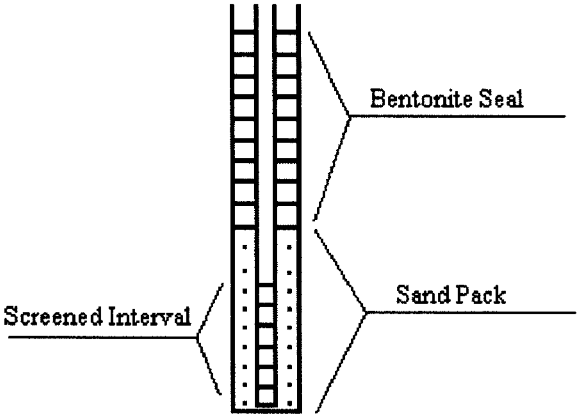
The logs contain field descriptions of soil samples, which generally include color, texture and soil moisture conditions at time of drilling. In some instances, geologic classification and contacts are noted based on interpretation of field data. Where geologic contacts were indistinct due to similarity in appearance, texture, and density, field interpretations were omitted from the logs.

B.O.H. = Bottom of Drilled Hole. In some instances, a sample may have been collected at the bottom of the hole; the sampling depth may therefore be greater than the reported B.O.H.

SWL. = Static Water Level in well at the time of drilling. In some instances, the well may have been allowed to recover prior to static water level measurement. In this case, date is indicated at the time of static water level measurement.

Well Completion Diagrams

In addition to descriptions of well completion, schematic diagrams of well completion are also shown on well logs. The symbols shown on these schematics are defined below:



TEST HOLE LOG

PAGE 1 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER B-1

STATE WA COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION Center of median, west of East Marine View Drive, south of SR529 ELEVATION G.S. ____ DATE 2-01-93

RECORDED BY V. S. DRILL METHOD Hollow stem auger DRILLER J.C. DRILLING CO. Holt Drilling

TOTAL DEPTH 20' CASING TYPE AND DESCRIPTION ____

TOTAL DEPTH CASED ____ WELL COMPLETION DESCRIPTION ____

REMARKS 2 3/8" split spoon

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0									
			EVT 9302-700 9302-708 Dupl. of 9302-700		0800 0840				Topsoil, root material, sandy brown with orange oxidation spots
1'									
2'						2,4,11			Topsoil, organic - rich, root material, silty clay
2.5'			9302-701		0805				Sandy silt, pebbles, grayish-brown, clay pellets (sample)
3'									
4'			9302-702		0810	9,32			Sandy silt, some pebbles, grayish-brown
5'									
6'			9302-703		0815	12,41			Sandy silt, pebbles, gray-brown (sample)
6.75'									Sand, some silt, pebbles, gray (sample)
7'									

TEST HOLE LOG

PAGE 2 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER B-1

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'									
8'			EVT 9302-704		0820	13,50 for 6"			Glacial till, silt, rounded pebbles, sandy, up to 2" diameter Tan, weathered granites (could still be fill material)
9'									
10'			9302-705		0825	20,50 for 5"			Gravelly silt, some sand, grading to sand, some silt, large cobbles (3" diameter) brown to tan, top 2" contained moisture
11'									
12'			9302-706		0830	25,50 for 4"			Gravelly silt, largest pebbles, 1" diameter, tan, little sand
13'									
14'			9302-707		0835	50 for 5 1/2 "			Gravelly silt, oxidation stains near base, some sand, light brown
14.5"									
15'									
16'									

TEST HOLE LOG

PAGE 3 OF 3

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER B-1

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
16'									
17'									
18'									
19'									
20'						20,39			Gravelly silt, some sand, tan-gray
10" 21'			EVT 9302-709	0845					At 20' 10" silty sand & pepper mixture, average grainsize 1 mm, few pebbles (sample)
22'									
23'									

TEST HOLE LOG

PAGE 1 OF 2

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER B-2

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION In median, west of B-1
ELEVATION G.S.
DATE 2-02-93

RECORDED BY V. S.
DRILL METHOD Hollow stem auger
DRILLER J.C.
DRILLING CO. Holt Drilling

TOTAL DEPTH 15'
CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED
WELL COMPLETION DESCRIPTION

REMARKS 2 3/8" split spoon

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0			EVT 9302-720 9302-728 Dupl. of 720		1600 1640				Brown fine sand, some silt (topsoil) Grab sample (moist)
1'									
2'			9302-721		1605	4,21 blows per 6"			9" Brown silt, fine sand, trace clay, trace gravel, damp 3" Gray, light brown silt, light, very fine sand, dry (till) sampled till
3'									
4'			9302-722		1610	16,35			6" gray silt - dry cobble 6" light brown silt, some very fine trace gravel, trace clay - damp sampled light brown sediment
5'									
6'			9302-723		1615	13,35			2" brown silt, trace fine sand, trace clay - some roots, moist 10" gray silt, some very fine sand, trace clay - cobble (till) - dry, sampled till
7'									

TEST HOLE LOG

PAGE 2 OF 2

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER B-2

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE / TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS, DRILLING FLUID, DRILLING RATE, WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'								
8'			EVT 9302-724	1620	18 50/5"			Gray silt, some very fine sand -Dry, thin (<1 cm), light brown layer of very fine sand and silt
9'								
10'			9302-725	1625	20 50/5"			Gray silt, some very fine sand, light gravel - Dry
11'								
12'			9302-726	1630	18 50/4.5"			Gray silt, some very fine sand, light gravel - Dry
13'								
14'			9302-727	1635	27 50/6"			Gray silt, some very fine sand, light gravel - Dry
15'								

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-2A

STATE WA COUNTY Snohomish LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION Pilchuck Path ELEVATION G.S. ___ DATE 2-01-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 20' CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	NA	S-1	Grab	Brown fine-coarse sand, some silt, little gravel, trace clay contains some brick fragments	(Damp)
	11, 4, 4	S-2	S.S.	As above with fragments of brick & slag Trace white oxidation on sediment	
	11, 6, 9	S-3 A B	S.S.	6" as above with increased white & green oxidation 6" (light brown/ grey silt & fine sand little clay, trace gravel	(Damp)
5'	6, 5, 8	S-4	S.S.	Light brown/grey silt, little fine sand, trace clay, trace fine-medium gravel, gravel is subrounded, mixed lithologies	(Damp)
	19, 40, 50	S-5	S.S.	As above	
	21, 39, 50/5"	S-6	S.S.	As above	
10'	36, 50/4 1/2"	S-7	S.S.	As above, with intervals fine-coarse sand & silt	(Dry)
	25, 50/4"	S-8	S.S.	As above	
	21, 44, 47	S-9	S.S.	As above	(Dry)
	18, 42, 50/3"	S-10	S.S.	As above	
15'					
20'	40, 50/3"	S-11	S.S.	As above No well installed	Boring backfilled with bentonite chips cement surface seal B.O.H. @ 20'

TEST HOLE LOG

PAGE 1 OF 1

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER EV-2B

STATE WA

COUNTY Snohomish

LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION Pilchuck Path

ELEVATION G.S. ____

DATE 8-17-93

RECORDED BY B. Thompson

DRILL METHOD H.S.A.

DRILLER S. Hauman

DRILLING CO. Holt Drilling

TOTAL DEPTH 20'

CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0'					
	NA	S-1	Grab	Dark brown, silty sand & gravel	
	10, 2, 2	S-2	S.S.	6" as above with brick fragments 6" light gray silt, some sand to gravel some mottling, orange oxidation staining	
5'	2, 6, 13	S-3	S.S.	Light brown fine--coarse silty sand, some brick fragments, decreasing silt with depth	
	7, 11, 14	S-4	S.S.	Light brown fine silty sand interlayered with light-brown medium sand trace gravel [moist]	
	8, 18, 30	S-5	S.S.	Light brown fine--very fine sand, trace silt [damp]	
10'					
	18, 47, 50/3"	S-6	S.S.	Very light brown silt & fine sand trace medium, coarse sand & gravel [dry]	
	24, 47, 50/3"	S-7		As above with some oxidation/ staining along partings	
15'	23, 49, 50/3"	S-8		As above - mottled oxidation staining	
	24, 50/5"	S-9		Grey silt and very fine sand trace coarser sand, little gravel no oxidation	B.O.H. = 20' sampled to 21.5' Backfilled boring with cuttings and bentonite chips
	23, 41, 50/4"	S-10		Light brown - fine--medium sand some silt, little gravel, some oxidation staining along irregular partings	
20'					
	34, 50/3"	S-11		As above	

TEST HOLE LOG

PAGE 1 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER SL-1

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION On median between Kraft Mill access road and East Marine View Drive ELEVATION G.S. DATE 2-04-93

RECORDED BY V. S. DRILL METHOD air rotary DRILLER J.C. DRILLING CO. Holt Drilling

TOTAL DEPTH 31' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS Slag boring, 2 3/8" split spoon

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0				1100					Sand & gravel, road fill, some woodchips
4"									Sand, gravelly, trace silt & clay, brown (fine-medium sand)
1'									
2'									
3'									
4'									
5'									
6'									
7'									

TEST HOLE LOG

PAGE 2 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-1

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'									
8'			EVT 9302-853		0920				Sand, silty, trace gravel, woodwaste, dark brown-gray, trace clay in lenses, some brick fragments
9'									
10'									
11'									
12'									
13'									
14'									Very wet silt (mud), gray
15'									
16'									Dry again, silty sand, trace gravel, gray, trace brick fragments, occasional plant material, trace clay

TEST HOLE LOG

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-1

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
16'									
17'									
18'									
19'									
20'									
21'									
22'									Sandy silt and clay, little gravel, some slag, brick, gray
23'									
24'									
25'									

TEST HOLE LOG

PAGE 4 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-1

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
25'									
26'									
27'			EVT 9302-852						Slag collected for 4'
28'									
29'									
30'									
31'									End of hole
32'									
33'									
34'									

TEST HOLE LOG

PAGE 1 OF 7

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-3

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION On embankment east of Kraft Mill access road

ELEVATION G.S.

DATE 2-04-93

RECORDED BY V. S.

DRILL METHOD air rotary

DRILLER J.C.

DRILLING CO. Holt Drilling

TOTAL DEPTH 60'

CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED

WELL COMPLETION DESCRIPTION

REMARKS Slag boring, 2 3/8" split spoon

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMER BLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0				1400					Pavement
2"									Medium fine sand, trace silt, gravel brown, trace slag
1'									
2'									
3'									
4'									
5'									
6'									Dark gray silty sand, little gravel, trace brick fragments, trace clay
7'									

TEST HOLE LOG

PAGE 2 OF 7

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'									
8'									
9'									
10'									Clayey sand, some gravel, gray, brick fragments
11'									
12'									Silty sand, brick fragments, trace gravel, plant fragments
13'			EVT 9302-860		1400				
14'									
15'									Fine sand, silty brown, brick fragments, plant material, intermittent gravel
16'									

TEST HOLE LOG

PAGE 3 OF 7

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
16'									
17'									
18'									
19'									
20'									
21'									
22'									
23'									
24'									
25'									

TEST HOLE LOG

PAGE 4 OF 7

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
25'									
26'									
27'									
28'									Medium-fine sand, silty, intermittent gravel, brown, no brick
29'									
30'									
31'									
32'									
33'									
34'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
34'									
35'									Sand, silty, little gravel, brick fragments, brown
36'									
37'									
38'									
39'									
40'									
41'									
42'									
43'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
43'									
44'									
45'									
46'									
47'									Gravelly sand
48'									Could not get sample - not enough air pressure Slag, mixed with gravel, woodwaste Water
49'									
50'									
51'									
52'									

TEST HOLE LOG

HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Everett RI/FS
JOB NUMBER ASEV01
HOLE NUMBER SL-3

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
52'									
53'									
54'									
55'			EVT 9302-851						Slag, mixed with gravel, woodwaste, Slag sample from 55' - 60'
56'									
57'									
58'									
59'									
60'									End of hole.
61'									

TEST HOLE LOG

PAGE 1 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER SL-4

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION On Kraft Mill access road near interchange with East Marine View Drive ELEVATION G.S. DATE 2-04-93

RECORDED BY V. S. DRILL METHOD air rotary DRILLER J.C. DRILLING CO. Holt Drilling

TOTAL DEPTH 34' CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

REMARKS Slag boring, 2 3/8" split spoon

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
0									Pavement
2"					0920				Medium-fine sand, some silt, brown, trace little gravel, some slag, brick, trace clay (lenses)
1'									
2'									
3'									
4'									
5'									
6'									
7'									

TEST HOLE LOG

PAGE 2 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS JOB NUMBER ASEV01 HOLE NUMBER SL-4

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
7'									Uniform, fine sand, brown
8'									
9'									Sand, gravelly, rounded pebbles, brown
10'									Fine-medium sand, little gravel, brown, little silt
11'									
12'									
13'									
14'									
15'									Gray, clayey silt, little sand
16'									

TEST HOLE LOG

PAGE 3 OF 4

HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-4

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
16'									
17'									
18'			EVT 9302-855		1025				Dark gray silty clay, brick fragments, little sand
19'									
20'									Sandy silt, little gravel, gray, trace clay, brick fragments
21'									
22'									Gray silt, sandy, trace clay, intermittent gravel, some wood, brick fragments
23'									
24'									
25'									

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Everett RI/FS

JOB NUMBER ASEV01

HOLE NUMBER SL-4

DEPTH	GRAPHICAL LOG	WELL ELEVATION	SAMPLE	SAMPLE TYPE	TIME	HAMMERBLOWS	PERCENT CORE RECOVERY	NOTES ON: WATER LEVELS DRILLING FLUID DRILLING RATE WELL COMPLETION	DESCRIPTION AND CLASSIFICATION
25'									
26'									
27'									
27.5'									Slag
28'			EVT 9302-850						Slag sample colllected from 28 to 34'
29'									
30'									
31'									
32'									
33'									
34'									End of hole.

APPENDIX F

LOGS FOR MONITORING WELLS

LEGAL DESCRIPTIONS OF MONITORING WELLS
EVERETT SMELTER SITE

Well	Township	Range	Section
EV-1	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-3	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-4A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-5	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-6A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-7A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-8A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
EV-9A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
MW-1	29 N.	5 E.W.M.	N.E.¼ SEC. 17
MW-2	29 N.	5 E.W.M.	S.E.¼ SEC. 8
MW-3	29 N.	5 E.W.M.	S.E.¼ SEC. 8
MW-4A/B	29 N.	5 E.W.M.	S.E.¼ SEC. 8
MW-5	29 N.	5 E.W.M.	S.E.¼ SEC. 8
WP-1	29 N.	5 E.W.M.	S.E.¼ SEC. 8

SUMMARY OF TERMINOLOGY USED ON BORING/WELL LOGS

Drilling Methods Used

HSA - Hollow Stem Auger Drilling method. Reported dimension refers to inside diameter of the hollow stem augers used.

Air Rotary - Forward Rotary Drilling method in which air is used to circulate cuttings from the hole.

Hand Auger - Where indicated, shallow borings completed using 4" diameter stainless steel bucket auger

Sample Collection

Split Spoon Samplers - Except in the case of hand augured borings, samples were collected using standard split spoon samplers. One of two sampler types were used:

- Dames and Moore Sampler - 3" ID split spoon used in conjunction with 300 lb. hammer
- Standard 1 3/8" ID split spoon used in conjunction with a 140 lb. hammer

Blow Counts (noted as Hammer Blows on some logs)

Both split-spoon samplers provide standard penetration data (ASTM D1586), reported on the well logs as the number of blows required to drive the split spoon over a 6-inch sampling interval. Eighteen-inch samples were commonly collected at monitoring well and deep boring sites. Six-inch to one-foot samples were collected at some of the shallow borings. In all cases, the reported blow count refers to the number of blows per 6 inch interval unless specifically noted. In instances where blow counts exceeded 50, the spoon was retrieved and the reported blow count is followed by the amount of penetration achieved for that sampling interval (for example 50/5").

Sample #

Sample numbers were assigned to individual sampling intervals in the field. In some instances, distinct variations in lithology are reported within a sampling interval and the sample number is followed by an A and B. In these cases, the retrieved sample was separated into two discrete samples at the lithologic break and analyzed separately.

Sample Type

s.s. = split spoon sample as described above
grab = Grab sample off auger flights

Many of the logs include a drilling and sampling methodology in the header information. For sites indicating that a split spoon sampler was used, all samples were collected accordingly unless specifically noted under sample type. For borings completed with a hollow stem auger, all samples are grab samples taken from the auger bucket unless otherwise noted.

Geologic Description

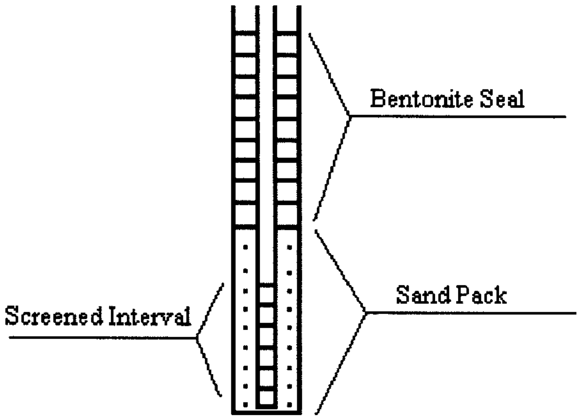
The logs contain field descriptions of soil samples, which generally include color, texture and soil moisture conditions at time of drilling. In some instances, geologic classification and contacts are noted based on interpretation of field data. Where geologic contacts were indistinct due to similarity in appearance, texture, and density, field interpretations were omitted from the logs.

B.O.H. = Bottom of Drilled Hole. In some instances, a sample may have been collected at the bottom of the hole; the sampling depth may therefore be greater than the reported B.O.H.

SWL. = Static Water Level in well at the time of drilling. In some instances, the well may have been allowed to recover prior to static water level measurement. In this case, date is indicated at the time of static water level measurement.

Well Completion Diagrams

In addition to descriptions of well completion, schematic diagrams of well completion are also shown on well logs. The symbols shown on these schematics are defined below:



TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER MW-1

STATE WA COUNTY Snohomish LOCATION T ___ R ___ SEC. ___ TRACT ___

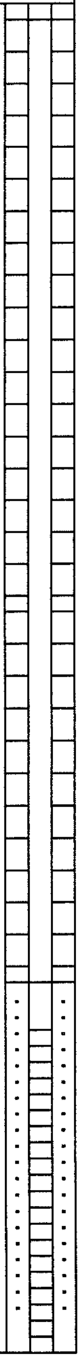
SITE DESCRIPTION Burlington Northern property ELEVATION G.S. 15.23 DATE 2-03-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 21 CASING TYPE AND DESCRIPTION 4 1/4 ID Hollow Stem Augers

Dames & Moore Sampler, completed with 2" PVC well casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	NA	S-1	Grab	4" Brown silt & very fine-fine sand, some gravel 6" light brown silt, some very fine-fine sand (damp)		Flush mount steel protective casing cement to grade
	7, 13, 22	S-2	S.S.	Light brown silt, little fine sand, trace gravel	FILL	2" locking expansion cap Bentonite chips from 1.5' - 15'
	7, 14, 20	S-3	S.S.	Light brown/yellow-grey silt, little fine sand, trace fine gravel, traces of red & yellow oxidation		
5'	8, 17, 20	S-4	S.S.	Light brown/grey silt, little fine sand trace grey, trace clay, little fine sand, interlayers		
	10, 22, 50/5 1/2	S-5 A B	S.S.	Light brown/grey silt, little fine sand, little coarse-fine gravel, Irregular lense of fine sand (damp)		
	22, 36, 33	S-6	S.S.	Grey, light brown silt, little fine sand, little gravel, gravel is subrounded, highly weathered surfaces, dark brown inclusion		
10'	12, 22, 33	S-7	S.S.	Grey/light brown silt & fine sand little gravel, trace clay	TILL	
	15, 27, 28	S-8	S.S.	Grey/light brown silt & fine sand Yellow & red oxidation of gravel surface		
	7, 21, 25	S-9	S.S.	Grey/light brown silt & fine sand little gravel		
	15, 23, 27	S-10	S.S.	Light brown/grey fine(+)-coarse(-) sand, some silt, trace fine gravel		
15'	No data	S-11	S.S.	Light brown fine sand, little silt, trace coarse sand, trace gravel (moist)		2" x 5' SCH 40 PVC flush threaded well screen from 16' to 21' with factory cut 0.020" slots Backfilled with #20 silica sand
	9, 18, 16	S-12	S.S.	Light brown fine sand, little silt, trace gravel (wet)		PVC end cap
	2, 8, 15	S-13	S.S.	Light brown fine sand, very well sorted		
20'	6, 14, 24	S-14	S.S.	Light brown fine-medium sand, trace coarse gravel		B.O.H. @ 21'
21'						



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER MW-2

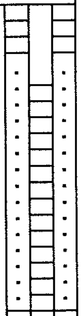
STATE WA
COUNTY Snohomish
LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION Burlington Northern property
ELEVATION G.S. 10.53
DATE 4-13-93

RECORDED BY B. Thompson
DRILL METHOD H.S.A.
DRILLER M. Hickman
DRILLING CO. Holt Drilling

TOTAL DEPTH B.O.H. = 10.0'
Sampled to 11.5' well set @ 9.0'
CASING TYPE AND DESCRIPTION 4 1/4" 1D Hollow Stem Augers
completed with 2" SCH 40 PVC casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	NA	S-1	Grab	Silty gravel		Flush mount steel protection casing, locking expansion cap
	2, 3, 2	S-2	S.S.	6" orange/brown silty gravel 6" grey/brown gravelly silt with some wood fragmemts		1' concrete surface seal
	1, 1, 1	S-3	S.S.	Dark brown organic silt with brick fragments, glass & trace metal		1' bentonite pellets
5'	1, 1, 2	S-4	S.S.	Dark brown organic silt, little gravel		Sand pack from 2' to 9'
	50/6"	S-5	S.S.	Log		2" SCH 40 PVC casing with flush threaded joints
	8, 17, 6	S-6	S.S.	Black wood, trace glass, brick organic silt	FILL	2" SCH 40 PVC well screen from 2.5' to 9'with 0.020" factory cut slots & PVC end cap
	3, 1, 1	S-7	S.S.	same as above with grey/brown silt, some organics in lower end of spoon		Well set @ 9'
10'	3, 3, 2	S-8	S.S.	Grey/brown silt, some organics metal fragments in wash in top of spoon Sampled to 11.5'	SILT ?	
15'						
20'						



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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER MW-3

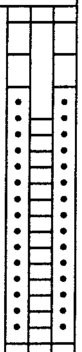
STATE WA
COUNTY Snohomish
LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION Burlington Northern property
ELEVATION G.S. 8.43
DATE 4-12-93

RECORDED BY B. Thompson
DRILL METHOD 4 1/4" ID HSA
DRILLER M. Hickman
DRILLING CO. Holt Drilling

TOTAL DEPTH B.O.H. @ 10'
Sampled to 11.5' well set @ 9'
CASING TYPE AND DESCRIPTION 4 1/4" 1D Hollow Stem Augers
Completed with 2" PVC well casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	NA	S-1	Grab	Brown silty sand & gravel	TOP SOIL	Flush mount steel protective casing locking expansion cap
	3, 4, 5	S-2	S.S.	Grey/brown fine-coarse sand		1' concrete surface seal
	4, 4, 4	S-3	S.S.	Grey/brown fine, coarse, silty sand to coarse, coarse, silty sand (wet)	SAND	1' bentonite pellets
5'	4, 3, 2	S-4	S.S.	Same		sand pack from 2' to B.O.H.
	1, 2, 1	S-5	S.S.	No recovery		Heaving sand Add ~5 gallons water
	1, 0, 1	S-6	S.S.	Grey/brown fine-coarse sand trace wood fragments		2" SCH 40 PVC casing with flush threaded joints
10'	1, 0, 1	S-7A S-7B	S.S.	6" same 6" grey/brown clayey silt with some organics		2" SCH 40 PVC well screen 0.020" factory cut slots & PVC end cap
	1, 0, 1	S-8	S.S.	Same	SILT?	Well set @ 9.0'
15'						
20'						



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER MW-4A

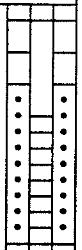
STATE WA
COUNTY Snohomish
LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION Burlington Northern property
ELEVATION G.S. 8.71
DATE 4-12-93

RECORDED BY B. Thompson
DRILL METHOD H.S.A.
DRILLER M. Hickman
DRILLING CO. Holt Drilling

TOTAL DEPTH 7.0'
CASING TYPE AND DESCRIPTION 4 1/4" 1D Hollow Stem Augers
Well completed with 2" PVC casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0				See MW-4B for sampling descriptions	Flush mount steel protective casing, locking expansion cap 1' concrete surface seal 1' bentonite pellets Sand pack from 2' to B.O.H. 2" SCH 40 PVC casing with flush threaded joints
5'					2" SCH 40 PVC well screen from 2.5' tp 7.0'
				B.O.H. @ 7.0'	0.020" slot size, PVC end cap Well set @ 7.0'
10'					
15'					
20'					



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER MW-4B

STATE WA

COUNTY Snohomish

LOCATION T R SEC.

TRACT

SITE DESCRIPTION Burlington Northern property

ELEVATION G.S.

DATE 4-12-93 to 4-13-93

RECORDED BY B. Thompson

DRILL METHOD H.S.A.

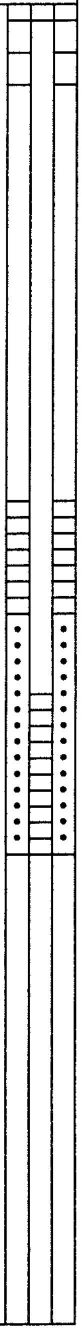
DRILLER M. Hickman

DRILLING CO. Holt Drilling

TOTAL DEPTH 26.0'

CASING TYPE AND DESCRIPTION 8 1/4" ID HSA to 13', 4 1/4" ID HSA to 26'
Well completed with 2" SCH 40 PVC casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0					TOP SOIL	Flush mount, steel protective casing with cement surface seal
	NA	S-1	Grab	Dark brown silty sand & gravel trace wood debris		
	4, 5, 7	S-2	S.S.	Brown/grey fine-coarse sand		
	1, 4, 4	--	S.S.	Brown/grey medium-very coarse sand (wet)	SAND	Bentonite pellets From 1 - 2'
5'	2, 1, 2	S-3	S.S.	Grey coarse-very coarse sand		Bentonite slurry From 2' - 16'
	1, 1, 1	S-4	S.S.	6" grey fine-coarse sand 3" grey/dark brown sand, some woody organics 1/2" brown silt clay 1/2" dark brown peat	SILT	[Heaving sand below peat] [~20 gallons of water added]
	1, 0, 1	S-5	S.S.	No recovery		2" SCH 40 PVC casing (flush joint threaded)
10'	1, 0, 0	S-6	S.S.	Grey clayey silt, some peaty organics in thin discontinuous layers		
	1, 0, 1	S-7	S.S.	Same		Pulled augers & set 12" ID steel casing @ 13' Backfilled with bentonite slurry & readvanced augers through casing
	1, 0, 1	S-8	S.S.	Same		
	1, 0, 1	S-9	S.S.	Same		Bentonite pellets 16-19'
15'						Sand pack from 19' to 26'
	1, 1, 1	S-10	S.S.	Grey silt, little clay, trace organics		2" x 5' SCH 40 PVC well screen with factory cut 0.020" slots & PVC end cap well set @ 26'
					?	
20'					DEEP SAND	
	4, 10, 13	S-11	S.S.	Grey very fine sand		
	6, 13, 10	S-12	S.S.	Grey very fine sand with 3" medium-coarse sand		
				Not sampled due to running sands		
25'						
				B.O.H. @ 26'		
30'						
35'						
40'				Notes: 12-inch steel casing removed after well completion		



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER MW-5

STATE WA COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

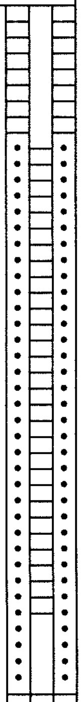
SITE DESCRIPTION Burlington Northern property ELEVATION G.S. 8.12 DATE 4-13-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER M. Hickman DRILLING CO. Holt Drilling

TOTAL DEPTH B.O.H. = 10' Well set @ 9'

CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Auger Completed with 2" SCH 40 casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	Grab	S-1	Grab	Silty sand & gravel	TOP SOIL	Flush mount steel protective casing, locking expansion cap
	27, 8, 5	S-2	S.S.	12" brown fine sand, trace silt 6" brown medium-coarse sand (wet)	SAND	1' concrete surface seal 1' bentonite pellets Sand pack from 2.0' to 9'
	1, 2, 3	S-3	S.S.	12" brown medium-coarse sand, trace gravel 3" grey medium-coarse sand, trace gravel		2" SCH 40 PVC casing (flush threaded joints)
	4, 5, 6	S-4	S.S.	12" grey/brown medium sand 6" grey/brown fine sand, little silt		2" SCH 40 PVC well screen from 2.5' to 9' with 0.020" factory cut slots & PVC end caps
5'	3, 5, 6	S-5	S.S.	Grey medium-coarse sand, trace very coarse sand		
	1, 0, 1	S-6	S.S.	No recovery		
	1, 0, 1	S-7	S.S.	6" grey coarse sand 3" brown silt, some fibrous, woody organics		
10'	1, 0, 0	S-8	S.S.	Brown clayey silt, some organics	SILT	Well set @ 9'
				B.O.H. @ 10' Sampled to 11.5'		
15'						
20'						



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-1

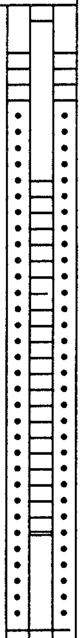
STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION S R 529 ELEVATION G.S. 112.90 DATE 1-19-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER M. Hickman DRILLING CO. Holt Drilling

TOTAL DEPTH 19'(boring) CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers Dames & Moore Sampler, completed with 2" PVC well casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0					
	6, 16, 28	S-1	S.S.	4" dark brown, organic silt & fine sand 6" brown sand & silt, trace gravel, trace clay	Flush mount, steel protective casing cemented to grade locking expansion cap
	20, 25, 23	S-2	S.S	Light brown/grey fine sand, some silt, trace gravel (damp) Gravel is subrounded, mixed lithologies	2" SCH 40, flush threaded PVC well casing 2' seal-bentonite chips
5'	10, 28, 50/5 1/2"	S-3	S.S	Light brown/grey fine sand & silt trace fine gravel (damp)	2" x 10' SCH 40, flush threaded well screen; 0.020" factory cut slots
	7, 24, 29	S-4	S.S	As above	Backfilled with #20 silica sand
	19, 50/5 3/4"	S-5	S.S	As above with some faint stratification	
10'	35, 50/4 1/4"	S-6	S.S	As above (wet)	
	6, 28, 30	S-7	S.S	As above, with some oxidation/ staining (damp)	
	12, 50/5"	S-8	S.S	As above	
15'	11, 50/5"	S-9	S.S	As above (dry)	Threaded PVC end cap Well set @ 15'
	9, 50/4"	S-10	S.S	As above (dry)	B.O.H. @ 19'
20'					



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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-3

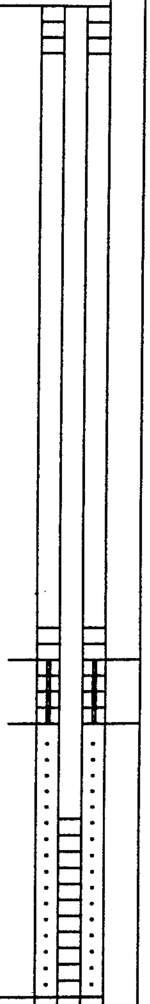
STATE WA COUNTY Snohomish LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION East Marine View Drive ELEVATION G.S. 56.85 DATE 1-22-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER M. Hickman DRILLING CO. Holt Drilling

TOTAL DEPTH 55' CASING TYPE AND DESCRIPTION Drilled with 4 1/2" ID Hollow Stem Augers
Dames & Moore Sampler; well completed with 2" PVC casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
25'	9, 39, 50/4"	S-12	S.S.	As above with little clay	TILL	
				Drilling rate increased Augers advancing smoothly		
30'	6, 11, 10	S-13	S.S.	Light brown fine-medium sand	FLUVIAL	Well annulus grouted up to 25' starting to lose grout at least 25'
35'	12, 12, 17	S-14	S.S.	Light brown fine-coarse sand (damp) 2" light brown silt, some clay (oxidized along laminations) (dry)		
	8, 22, 26	S-15	S.S.	2 light brown silt, some clay light brown fine-coarse sand (damp)	SAND	
40'	12, 15, 18	S-16	S.S.	As above		2" SCH 40 flush-threaded PVC casing
45'	24, 41, 50/5"	S-17	S.S.	Light brown, very coarse sand, little fine-medium sand (damp)	FLUVIAL SAND	2' seal - bentonite pellets
50'	23, 30, 40	S-18	S.S.	Light brown, fine sand (wet)		2" x 5' SCH 40, flush-thread PVC well screen with 0.020" factory cut slots; backfilled with #20 silica sand, PVC end cap
55'				No sample, running sands		B. O. H. @ 55'
60'						
65'						



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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER EV-3
STATE WA
COUNTY Snohomish
LOCATION T ___ R ___ SEC. ___ TRACT ___
SITE DESCRIPTION East Marine View Drive
ELEVATION G.S. 56.85
DATE 1-22-93
RECORDED BY B. Thompson
DRILL METHOD H.S.A.
DRILLER M. Hickman
DRILLING CO. Holt Drilling
TOTAL DEPTH 55'
CASING TYPE AND DESCRIPTION Drilled with 4 1/2" ID Hollow Stem Augers Dames & Moore Sampler; well completed with 2" PVC casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.	
0	-	-	-	4" asphalt, 6" concrete		Flush mount, steel protective casing cemented to grade
				3" brown gravel light clay		Locking expansion plug in top of PVC
	12, 29, 21	S-1 A B		3" dark brown (resinous)fine gravel 6" grey/brown sand & gravel some silt		
	9, 8, 4	S-2	S.S.	6" grey/brown sand & gravel, some silt 7" dark brown very coarse sand 3" orange/brown fine sand, little, silt, trace fine gravel(moist)	FILL	2" Sch 40, Flush-threaded PVC well casing
5'	8, 4, 4	S-3	S.S.	As above (moist)		
	8, 20, 17	S-4	S.S.	6" as above 6" gray/brown silt and fine sand light fine gravel, trace clay (dry)		
	4, 19, 18	S-5	S.S.	As above with light fine-coarse gravel, red oxidized surface staining (dry)		
	5, 10, 12	S-6	S.S.	As above		
10'	3, 11, 13	S-7	S.S.	As above	Spun	augers, no water
	7, 42, 50/3"	S-8	S.S.	As above with trace coarse sand		
	29, 45, 34	S-9	S.S.	As above		
15'	18, 24, 30	S-10	S.S.	As above with fine-coarse sand		
20'	20, 50/6"	S-11	S.S	As above	TILL	Back filled with bentonite chips hydrated with water

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER EV-4A

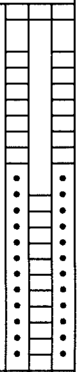
STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION Weyerhaeuser access road
ELEVATION G.S. 57.96
DATE 1-21-93

RECORDED BY B. Thompson
DRILL METHOD H.S.A.
DRILLER M. Hickman
DRILLING CO. Holt Drilling

TOTAL DEPTH 11'
CASING TYPE AND DESCRIPTION

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0 5' 10'				See EV-4B for geologic description	Flush mount, steel protective casing cemented to grade locking expansion cap 2" SCH 40 PVC flush-threaded casing 2' seal of bentonite chips from 2-4' 2" x 5' SCH 40 PVC well screen with 0.020" factory cut slots Backfilled with #20 silica sand PVc end cap
	3, 2, 0	S-1	S.S.	Blue/grey fine sand, some silt some clay, trace gravel and wood debris	B.O.H. @ 11' (Augered to 11' sampled to 12.5')
15'					
20'					



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER EV-4B

STATE WA

COUNTY Snohomish

LOCATION T R SEC. TRACT

SITE DESCRIPTION Weyerhaeuser access road

ELEVATION G.S. 57.32

DATE 1-20-93, 1-21-93

RECORDED BY B. Thompson

DRILL METHOD H.S.A.

DRILLER M. Hickman

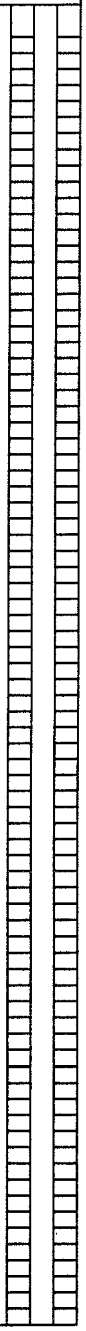
DRILLING CO. Holt Drilling

TOTAL DEPTH 60'

CASING TYPE AND DESCRIPTION 4 1/2" Hollow Stem Auger

Dames & Moore Split Spoon Sampler Well completed with 2" SCH 40 PVC

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	4, 4, 8	S-1	S.S.	3" dark brown organic silt & sand 10" brown fine sand, some silt, trace gravel	FILL	Flush mount, steel protective casing cemented to grade 2" locking expansion cap in PVC casing
	4, 11, 7	S-2	S.S.	Dark brown fine sand, some silt, little clay, little gravel		
	5, 6, 8	S-3	S.S.	As above with some wood debris		
5'	4, 8, 7	S-4	S.S.	Brown fine sand, trace silt, trace fine gravel		2" SCH 40 PVC flush-threaded casing
	7, 5, 4	S-5	S.S.	As above (damp)		
	3, 3, 4	S-6	S.S.	Brown/grey fine sand, trace silt (moist)		Well annulus grouted from 2' to 49'
10'	2, 2, 1	S-7 A B	S.S.	Grey fine sand (wet) underlain by 3" dark brown organic peat layer	3	
	3, 2, 2	S-8	S.S.	Grey fine-medium sand, & silt, some clay, little gravel (wet)	MARSH	
	12, 6, 8		S.S.	No recovery		
	6, 8, 8		S.S.	No recovery		
15'	3, 4, 3, 5	S-9	S.S.	Blue/grey silt and fine sand interlayered with silt & clay trace slag (moist)		
	3, 4, 3, 5	S-10	S.S.	As above, no slag fragments		
20'	3, 4, 14, 16	S-11	S.S.	Above, intermixed with woody detrital material		
	23, 50/4 1/2"	S-12	S.S.	As above, contained isolated cobble		
	27, 50/4 1/2"		S.S.	As above		
25'	37, 50/5 1/2"	S-13	S.S.	Light brown/grey silt & sand some fine gravel, trace clay, gravel is subrounded with mixed lithologics (dry) -cobbles/boulders encountered	TILL	
30'	32, 43, 50 1/2"	S-14	S.S.	As above		
				- 31' drilling rate increase Augers advancing smoothly	3	
35'	30, 33, 30	--	S.S.	Recovered small amount of light brown/grey fine sand & large cobble	FLUVIAL	
40'	12, 17, 22	S-15	S.S.	Light brown fine sand very well sorted (dry)		



TEST HOLE LOG

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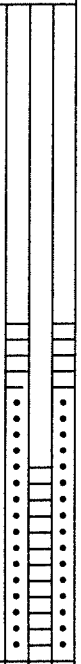
HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER EV-4B
STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT
SITE DESCRIPTION
ELEVATION G.S.
DATE 1-20-93 to 1-21-93
RECORDED BY B. Thompson
DRILL METHOD
DRILLER
DRILLING CO.
TOTAL DEPTH
CASING TYPE AND DESCRIPTION

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
40'					2" SCH 40 PVC flush-threaded casing well annulus grouted from 49' to surface
45'	25, 50/6"	S-16	S.S.	Light brown fine sand (dry) (very well sorted)	
50'	25, 22, 23	S-17		As above (damp)	2 foot seal - bentonite chips
55'	8, 29, 27	S-18		Brown fine-medium sand 3" brown silt, some clay (damp)	FLUVIAL SAND 2" x 5' SCH 40 PVC well screen with factory cut 0.020" slots Backfilled with #20 silica sand
	18, 39, 42	S-19		Brown fine sand (wet)	
					PVC end cap
60'				No sample, running sands	B.O.H. @ 60'



TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER EV-5

STATE WA

COUNTY Snohomish

LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION Weyerhaeuser property

ELEVATION G.S. 10.50

DATE 2-2-93

RECORDED BY B. Thompson

DRILL METHOD H.S.A.

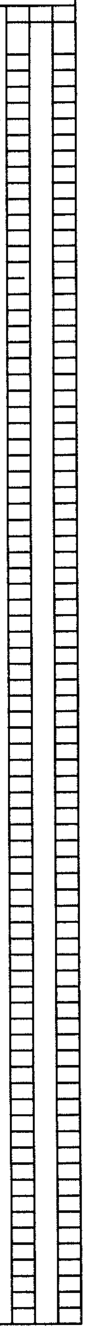
DRILLER S. Hauman

DRILLING CO. Holt Drilling

TOTAL DEPTH 30'

CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers Dames & Moore Sampler, completed with 2" PVC well casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0		S-1	Grab	Brown sand & gravel (wet) some organic silt & roots	FILL?	Flush mount steel proective casing cemented to grade
	4, 7, 11	S-2	S.S.	6" blue/grey silt & clay trace fine sand, some oxidation along bedding planes 6" blue/grey fine-medium sand, light silt trace clay (moist)		2" SCH 40 PVC flush-threaded casing
	5, 4, 5	S-3	S.S.	9" as above with trace gravel 3" brown fine sand & silt trace clay, some wood/organic debris	MARSH	Well annulus sealed with bentonite chips from 1.5 to 21 ft
5'	2, 3, 3	S-4	S.S.	Mottled brown/grey sand & silt, some clay (moist)		
	1, 1, 1	S-5	S.S.	Brown silt & clay with abundant organic debris		
	1, 0, 1	S-6	S.S.	3" black peat 9" grey/brown silt & clay with some organic debris (~30%)		
10'	0, 1, 1	S-7		As above (moist)		
	1, 0, 1	S-8		As above (wet)		
	1, 0, 1	S-9		Grey clay, some silt, little organic material (wet)		
	1, 0, 1	S-10		As above		
15'						
	1, 0, 1	S-11		As above		
	1, 1, 1	S-12		As above (trace organics)		
20'						



TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER EV-5

STATE WA

COUNTY Snohomish

LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION Weyerhaeuser property

ELEVATION G.S. 10.50

DATE 2-2-93

RECORDED BY B. Thompson

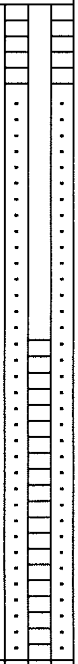
DRILL METHOD H.S.A.

DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 30'

CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers Dames & Moore Sampler, completed with 2" PVC well casing

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
20'	2, 1, 1	S-13	S.S.	Grey fine sand & silt, little clay	MARSH	#20 silica sand pack from 21 to 30 ft. 2" x 5' SCH 40 PVC flush threaded well screen with 0.020" factory cut slots PVC end up
25'	2, 3, 2	S-14	S.S.	Grey fine sand, very well sorted	FLUVIAL	
30'				B.O.H. @ 30 ft (not sampled due to running sands)		
35'						
40'						



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-6A

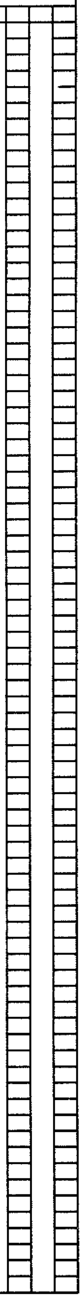
STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION Weyerhaeuser access road ELEVATION G.S. 57.55 DATE 8-17-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 54.5' CASING TYPE AND DESCRIPTION 4 1/4" ID Hollow Stem Augers

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION Sampler: 2 3/8" ID Split Spoon/300 lb. hammer Top of PVC: 57.13

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0'	8, 8, 8	S-1	S.S.	Orange--brown, fine--medium sand, trace gravel	Flush mount, water-tight, protective casing with concrete surface seal 
	4, 3, 4	S-2		Brown, gray silty fine sand, trace clay, trace coarse sand & organic debris	2" ID SCH 40 PVC casing with flush--thread joints
				Brown fine--medium sand, some gravel, silty intervals as above with trace clay	
5'	4, 4, 4	S-3			6% Grout from 1.5' to 39'
10'	6, 6, 5	S-4		Orange to brown fine sand, trace gravel, trace silt, mottled coloring	
15'	2, 4, 5	S-5		Blue-gray clayey silt, some fine sand, trace gravel, brick fragments & wood, some darker brown mottling	
20'	6, 8, 5	S-6		Blue-gray to brown silty fine sand, trace clay, abundant brick fragments	
25'	2, 3, 5	S-7		Light brown to gray, silty fine sand, little gravel, trace clay, trace brick fragments [moist] --change in drilling rate	fill
30'	6, 5, 4	S-8		Black angular, gravel-sized slag fragments [dry]	slag
35'	12, 14, 23	S-9		As above, but includes more finely crushed slag component	
39'					Bentonite chips from 39'-42'

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-6A

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

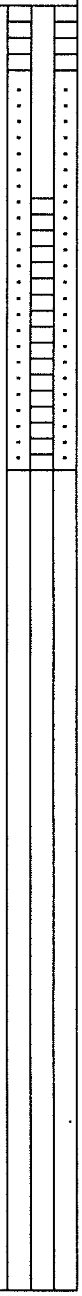
SITE DESCRIPTION ELEVATION G.S. DATE 8-17-93

RECORDED BY DRILL METHOD DRILLER DRILLING CO.

TOTAL DEPTH CASING TYPE AND DESCRIPTION

TOTAL DEPTH CASED WELL COMPLETION DESCRIPTION

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
40'					
	11, 17, 15	S-10		Black slag fragments as above	
					slag
45'					
	12, 1, 2	S-11		Gravel-sized slag fragments, oxidized surfaces, minimal recovery [dry]	
				Drill rods dropped at ~ 1 foot before encountering slag again Drilling easier at ~48'	
50'					▼ ATD
	2, 1, 3	S-12		Blue-gray fine--medium silty sand, trace well rounded gravel trace roots, minor oxidation staining	
					silt 10' screen set @ 54.5' 020 slots PVC end cap
55'	3, 6, 15	S-13		As above, no oxidation or roots siltier and drier at base of spoon one larger well-rounded piece of gravel in spoon	Completion Concrete surface seal Grout 1'--39' Chips 39'--42' Sand 42'--54.5'



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-6B

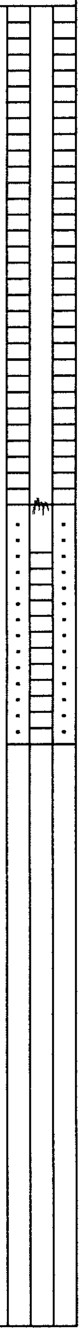
STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION Weyerhaeuser access road ELEVATION G.S. 57.47 DATE 8-24-93

RECORDED BY Rens Verburg DRILL METHOD Air Rotary DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 67.5' CASING TYPE AND DESCRIPTION 9 5/8" OD Casing keyed into silt layer at 60'
8" casing to completion Top of PVC: 57.11

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
				See log EV-6A for description of shallow soils	Flush mount, water-tight protective casing with concrete surface seal 2" ID SCH 40 PVC casing with flush-thread joints
50'				Driller estimate: silt from ~ 50 to 53'	Seal hole before continuing below 56.5'
55'	6, 5, 8	S-14		Recovery 30%, wet gravel-size black slag & well-rounded gravel	
				At ~56.5': blue-gray fine--medium silt, some sand and gravel, root fragments	
60'					Set casing at 60'
	6, 13, 15	S-15		Blue-gray fine--medium sandy silt 61-61.5': sand % increases	
	10, 15, 24	S-16		Blue-gray fine--medium silty sand, trace gravel, poorly sorted	
65'					
	20, 36, 50/4	S-17	A B	67-68' Blue-gray fine--medium sand, well sorted	Cement: 0-2.5' Bentonite: 2.5-60' Sand: 60-67.5' Screen: 62.5-67.5'
				68-68.5' Dense blue-gray sandy silt, silt contains stringers of blue-gray fine--medium sand	



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER EV-7A

STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT

SITE DESCRIPTION Located at base of slope, east of ditch
ELEVATION G.S. 11.71
DATE 8-16-93

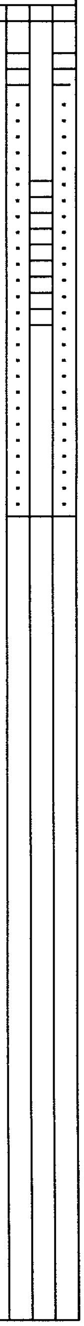
RECORDED BY B. Thompson
DRILL METHOD H.S.A.
DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 15'
CASING TYPE AND DESCRIPTION 4 1/4" ID Augers

SWL = 2.12' (8-17-93)

Top of PVC: 11.41

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0					
	6, 18, 50/2"	S-1	S.S.	Brown organic loam overlying gray fine-coarse gravel & cobbles rounded to subangular	Flush mount protective with locking expansion cap
	31, 22, 18	S-2	S.S.	Gray/brown silty fine-coarse sand & gravel. Little fine granular slag & brick fragments underlain by 3"- Gray, green clayey silt, some fine gravel [damp]	
5'	18, 14, 15	S-3	S.S.	6" brown silty fine-medium sand some gravel, brick fragments & wood	2" SCH 40 PVC flush thread H.S.A.
	20, 14, 14	S-4		6" black gravel-sized slag fragments [wet] Black fine-coarse gravel-sized slag very angular [wet]	ATD 2" x 5' SCH 40 Screen 0.020" slots set @ 10 ft
	15, 19, 12	S-5		As above	
10'					
	6, 5, 6	S-6		As above (only ~ 10% recovery)	
	3, 3, 3	S-7		Black granular fine-medium sand size slag with little coarser slag 3" brown silt & fine sand with some slag & wood fragments	
15'	2, 2, 2	S-8		Brown clayey silt abundant fibrous woody matter	Cement: 0' - 1.5' Bentonite: 1.5' - 3' Sand: 3' - 15'
20'					



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HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-7B

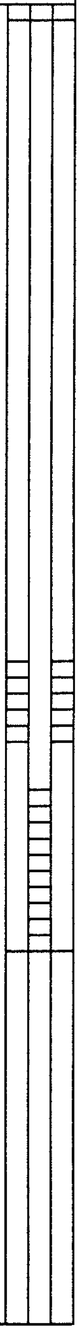
STATE WA COUNTY Snohomish LOCATION T ____ R ____ SEC. ____ TRACT ____

SITE DESCRIPTION Located at base of slope, east of ditch ELEVATION G.S. 11.72 DATE 8-20-93

RECORDED BY B. Thompson DRILL METHOD Air rotary DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 29' CASING TYPE AND DESCRIPTION 8 5/8" ID Steel casing keyed into silt layer
6" casing to completion Top of PVC: 11.30

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0				See EV-7A for description of shallow soils	Flush mount - water tight protective casing concrete surface seal locking expansion cap
5'					2" SCH 40 PVC riser with flush thread joints
10'					
15'	10, 21, 30	S-9		Slag	Note: Samples S-9 and S-10 were collected inside casing. Depths may not be accurate. Slag-silt contact appeared to be ~ 13 ft based on ease of driving casing
	2, 3, 3	S-10		Gray-green silt (suspect)	
20'					
	3, 9, 13	S-11		6" gray-green silt 6" gray fine--medium sand	8 5/8" casing set @ 18'
25'				Depth of bottom of silt ~ 23 ft	2" x 5' PVC screen with 0.020" slots
	2, 2, 2	S-12		Light-brown fine-medium sand	
30'					Grout: 1' - 20' Bentonite Pellets: 20' - 22' Sand Pack: 22' - 29' Screened Interval: 24' - 29'



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-8A

STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

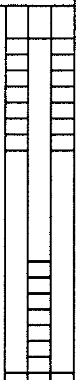
SITE DESCRIPTION South edge of slab (formerly rock wool bldg) ELEVATION G.S. 12.07 DATE 8-16-93

RECORDED BY B. Thompson DRILL METHOD Hollow Stem Auger DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 11' CASING TYPE AND DESCRIPTION 4 1/4" ID Augers Top of PVC: 11.78

SWL = 2.50' (8-17-93) 2 3/8" ID Split Spoon

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION		NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0						
	3, 5, 7	S-1	S.S.	6" dark brown-black peat 8" brown fine--coarse silty sand, some gravel	fill	Flush mount, water tight protective casing with concrete surface seal
	4, 7, 11	S-2	S.S.	Black medium--coarse sand [slag] very well rounded grains		Locking expansion cap Bentonite chips from 1.5--4 ft ▼ ATD
5'	7, 14, 24	S-3	S.S.	Black fine--coarse gravel-sized slag fragments very angular		
	25, 18, 13	S-4	S.S.	Same as above [wet]	slag	Sand pack (#20 silica sand) from 4--11 ft
	10, 13, 18	S-5	S.S.	Same as above		2" x 5' well screen 0.020" slot size set @ 11 ft
10'				6" as above 4" gray/brown silt with fibrous root matter		
	11, 4, 5	S-6	S.S.			PVC End Cap
					silt	
15'						
20'						



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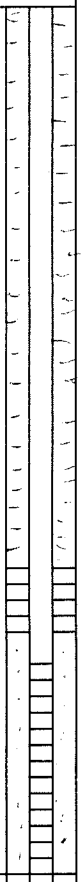
HYDROMETRICS
TACOMA, WASHINGTON

PROJECT Asarco Everett
JOB NUMBER ASEV01
HOLE NUMBER EV-8B
STATE WA
COUNTY Snohomish
LOCATION T R SEC. TRACT
SITE DESCRIPTION
ELEVATION G.S. 11.61
DATE 8-18-93
RECORDED BY B. Thompson
DRILL METHOD Air Rotary with casing
DRILLER S. Hauman
DRILLING CO. Holt Drilling
TOTAL DEPTH 26.5'
CASING TYPE AND DESCRIPTION 9 5/8" O.D. Steel casing Top of PVC: 11.07

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0					
5'					
10'				See samples from 8A for lithologic description of shallow soils	
15'					Grout from 1.5' to 16.5'
	2, 2, 3	S-7	S.S.	Gray-green silt with fibrous roots and wood debris	
	2, 3, 3	S-8	S.S.	As above with 2" layer of fine-medium sand	2 1/2' bentonite pellets
20'				Sand in cuttings at ~ 20 ft	Sand pack from 19 - 26'
					2" x 5' SCH 40 PVC screen with .020" Factory cut slots (20.8' - 25.8')
	2, 2, 3	S-9	S.S.	Gray fine sand; very well sorted	
	2, 3, 3	S-10	S.S.	Gray fine--medium sand, trace coarse sand	Well set at 26' PVC End Cap
					B.O.H. @ 26.5'
				Note: Used about 25 gallons of water to set casing due to running sands	



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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett JOB NUMBER ASEV01 HOLE NUMBER EV-9A

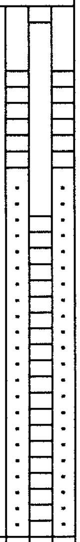
STATE WA COUNTY Snohomish LOCATION T R SEC. TRACT

SITE DESCRIPTION Located ~ 112 ft north of Benson Shed ELEVATION G.S. 12.95 DATE 8-16-93

RECORDED BY B. Thompson DRILL METHOD H.S.A. DRILLER S. Hauman DRILLING CO. Holt Drilling

TOTAL DEPTH 16' CASING TYPE AND DESCRIPTION 4 1/4" 1D Augers

Static 3.35' (8-17-93) Top of PVC: 12.69

DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0	1, 1, 2	S-1		Brown woody loam; trace gravel	Flush mount, Steel Protective Casing cemented to grade locking expansion cap 
	11, 18, 15	S-2		Gray-brown silty fine--coarse sand & gravel	
5'	7, 12, 20	S-3		Gray-brown silty fine--coarse sand & gravel mixed with gray-green clayey silt & black, well rounded fine-medium sand, chaotic assemblage	
	2, 3, 4	S-4		Black fine(+)--coarse(-) sand (slag) very well rounded, sheen on lower 3", no odor	2" x 10' SCH 40PVC screen with 0.20" slots set at 16'
	5, 7, 7	S-5		As above with trace of coarser slag fragments One large wood chip Visible sheen, no odor [wet]	
10'	6, 5, 3	S-6		As above, minimal recovery	
	5, 3, 2	S-7		Black--fine(+)--coarse(-) sand (slag) very well rounded	PVC slip cap riveted on end of screen
15'	4, 2, 2	S-8		As above	
	2,2,2	A S-9B		5" as above 12" gray-green silt, some fine sand fibrous woody organic	B.O.H. @ 16' sampled to 17.5' Cement: 0 - 1.5' Bentonite: 1.5 - 4' Sand: 4' - 16'
20'					

TEST HOLE LOG

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HYDROMETRICS

TACOMA, WASHINGTON

PROJECT Asarco Everett

JOB NUMBER ASEV01

HOLE NUMBER EV-9B

STATE WA

COUNTY Snohomish

LOCATION T ___ R ___ SEC. ___ TRACT ___

SITE DESCRIPTION ___

ELEVATION G.S. 13.09

DATE 8-23-93

RECORDED BY R. Verburg

DRILL METHOD Air rotary

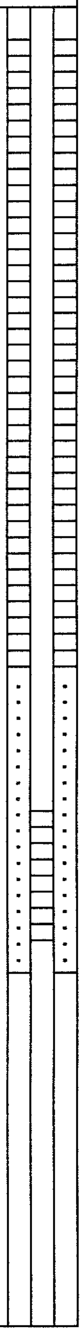
DRILLER S. Hauman

DRILLING CO. Holt Drilling

TOTAL DEPTH 28.5'

CASING TYPE AND DESCRIPTION 8 5/8" ID Steel casing keyed into silt layer at 18
6" casing to completion Top of PVC: 12.52

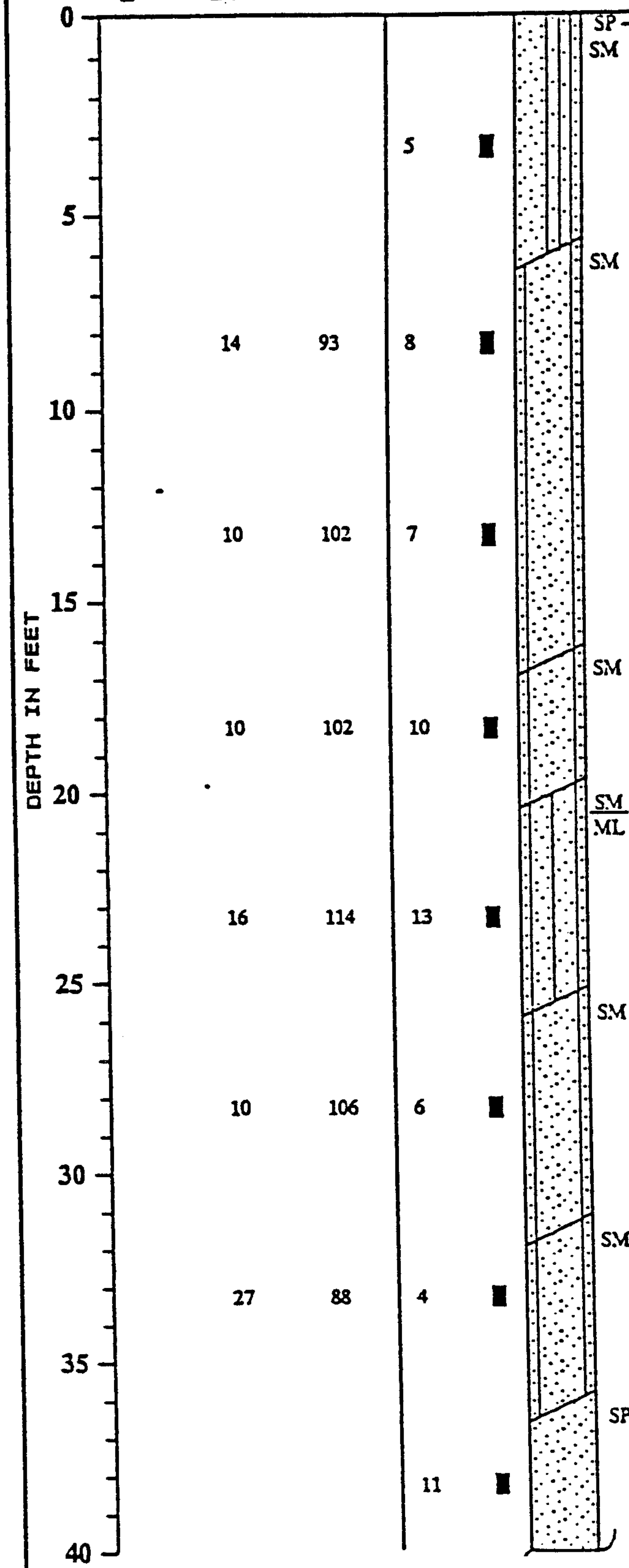
DEPTH	BLOW COUNT	SAMPLE #	SAMPLE TYPE	GEOLOGIC DESCRIPTION	NOTES ON: WATER LEVELS, DRILLING WELL COMPLETION, ETC.
0				See EV-9A for description of shallow soils	Flushmount - water tight protective casing concrete surface seal locking expansion cap
5'					2" SCH 40 PVC riser with flush-thread joints
10'					
15'					Set casing at 18'
	2, 2, 2	S-10		Gray silt, some fine sand, fibrous wood, H_2S smell	
20'					
	2, 2, 5	S-11	A B	6" as above, root material at interface with 12" gray medium sand, well sorted, trace gravel	Cement: 0 - 17' Bentonite: 17' - 20' Sand: 20' - 28.5' Screen: 23.5' - 28.5'
25'				26' gravel with wood fragments	
	4, 4, 5	S-12		Light brown, silty sand, some rounded gravel and pebble, (~1") poorly sorted	



BORING B-1

TEST DATA

Lab Tests	Moisture Content (%)	Dry Density (pcf)	Blow-Count	Samples
			5	■
	14	93	8	■
	10	102	7	■
	10	102	10	■
	16	114	13	■
	10	106	6	■
	27	88	4	■
			11	■



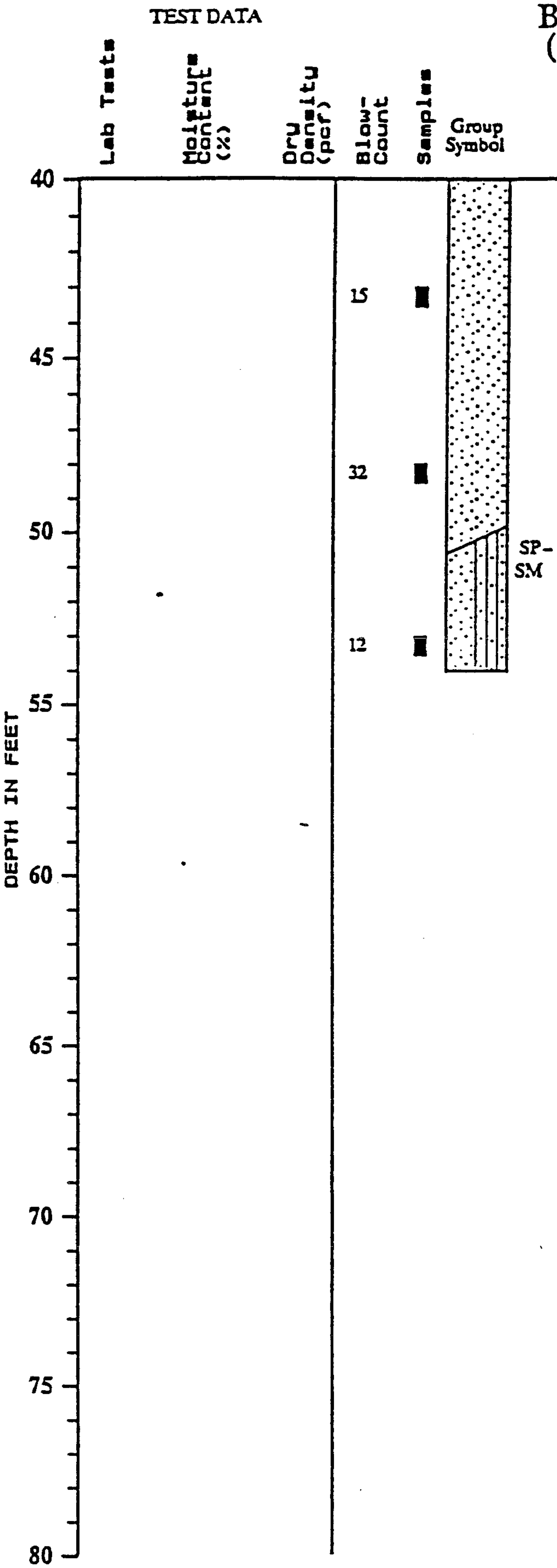
DESCRIPTION

Surface Elevation (ft.): 58.0

Group Symbol	Description
SP - SM	Brown fine sand with silt and a trace of roots (loose, dry to moist) (fill)
SM	Dark brown silty fine sand with occasional coarse sand, gravel and organic matter (loose, moist) (fill)
SM	Gray silty fine sand with a trace of coarse sand, gravel and slag chips (loose, moist) (fill) (moderate sheen on sample)
SM/ML	Grayish-brown silty fine sand to silt with fine sand, occasional coarse sand and gravel (medium dense/stiff, moist) (fill) (slight sheen)
SM	Dark brown silty fine sand with slag chips (loose, moist) (fill)
SM	Reddish-brown silty fine sand with slag chips (coarse sand to gravel-sized) (very loose to loose, moist to wet) (fill)
SP	Dark gray slag (sand and gravel size) (loose to medium dense, dry)(fill)

Log of Boring

BORING B-1
(Continued)



DESCRIPTION

SP-SM Grayish-brown fine to medium sand with silt and occasional gravel (medium dense, wet)

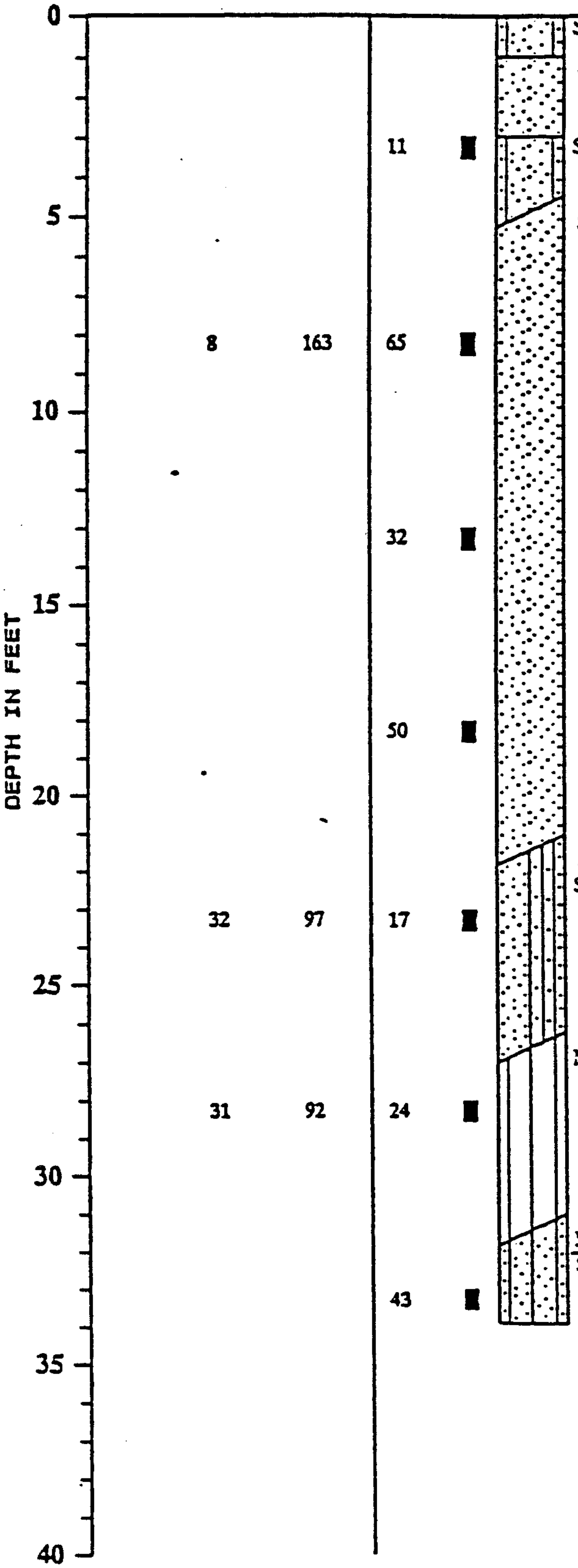
Boring completed at 54.0 feet on 07/23/90
Piezometer installed to 54 feet
Ground water encountered at a depth of 51 feet during drilling

BORING B-2

TEST DATA

Lab Tests	Moisture Content (%)	Dry Density (pcf)	Blow-Count	Samples
			11	■
	8	163	65	■
			32	■
			50	■
	32	97	17	■
	31	92	24	■
			43	■

DEPTH IN FEET



DESCRIPTION

Surface Elevation (ft.): 16.0

Group Symbol	Description
SM	Brown silty fine sand with gravel, bricks and roots (loose, dry) (fill)
SP	Dark gray slag (medium to coarse sand sized) (loose, moist) (fill)
SM	Dark gray silty fine sand with occasional coarse sand, gravel, slag and roots (loose, wet) (fill) (slight sheen on sample)
SP	Dark gray slag (sand, gravel and cobble-sized) (dense, wet) (fill)
SP-SM	Dark brown fine to medium sand with silt and a trace of organic matter (medium dense, wet)
ML	Gray silt with a trace of fine sand and occasional wood fragments (stiff, wet)
ML/SM	Gray interbedded silt and silty fine sand with occasional lenses of fine sand (very stiff/dense, wet)

Boring completed at 34.0 feet on 07/23/90
Piezometer installed to 34 feet
Ground water encountered at a depth of 1 foot during drilling

Log of Boring

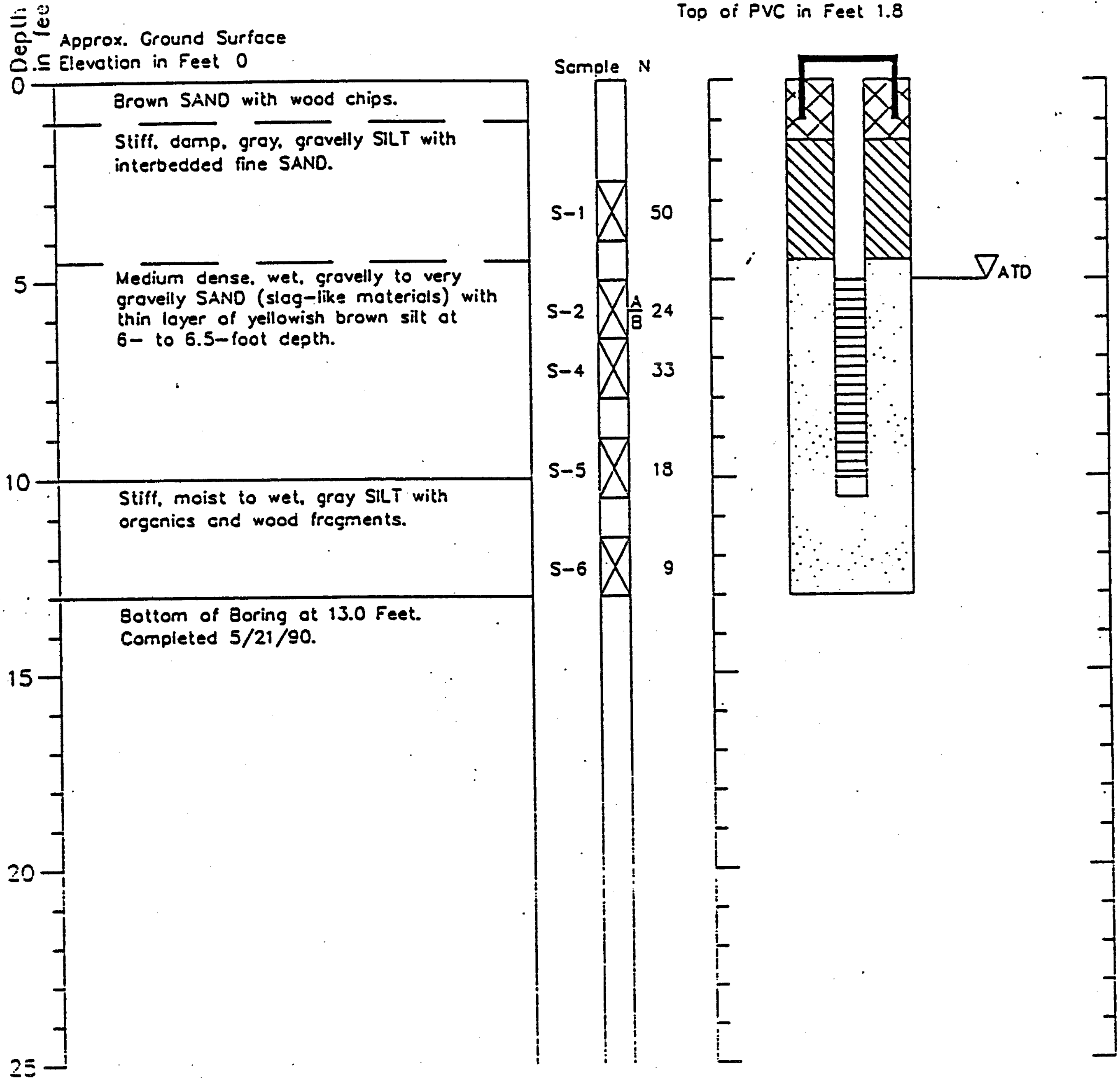
Boring Log and Construction Data for Monitoring Well WP-1

Geologic Log

Monitoring Well Design

Casing Stickup in Feet 1.8
Top of PVC in Feet 1.8

Approx. Ground Surface Elevation in Feet 0



0 to approx. 1 ft: Brown SAND with wood chips.

Approx. 1 to 4.5 ft: Stiff, damp, gray, gravelly SILT with interbedded fine SAND.

Approx. 4.5 to 10 ft: Medium dense, wet, gravelly to very gravelly SAND (slag-like materials) with thin layer of yellowish brown silt at 6- to 6.5-foot depth.

10 to 13 ft: Stiff, moist to wet, gray SILT with organics and wood fragments.

Bottom of Boring at 13.0 Feet. Completed 5/21/90.

Sample	N
S-1	50
S-2 A/B	24
S-4	33
S-5	18
S-6	9

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.

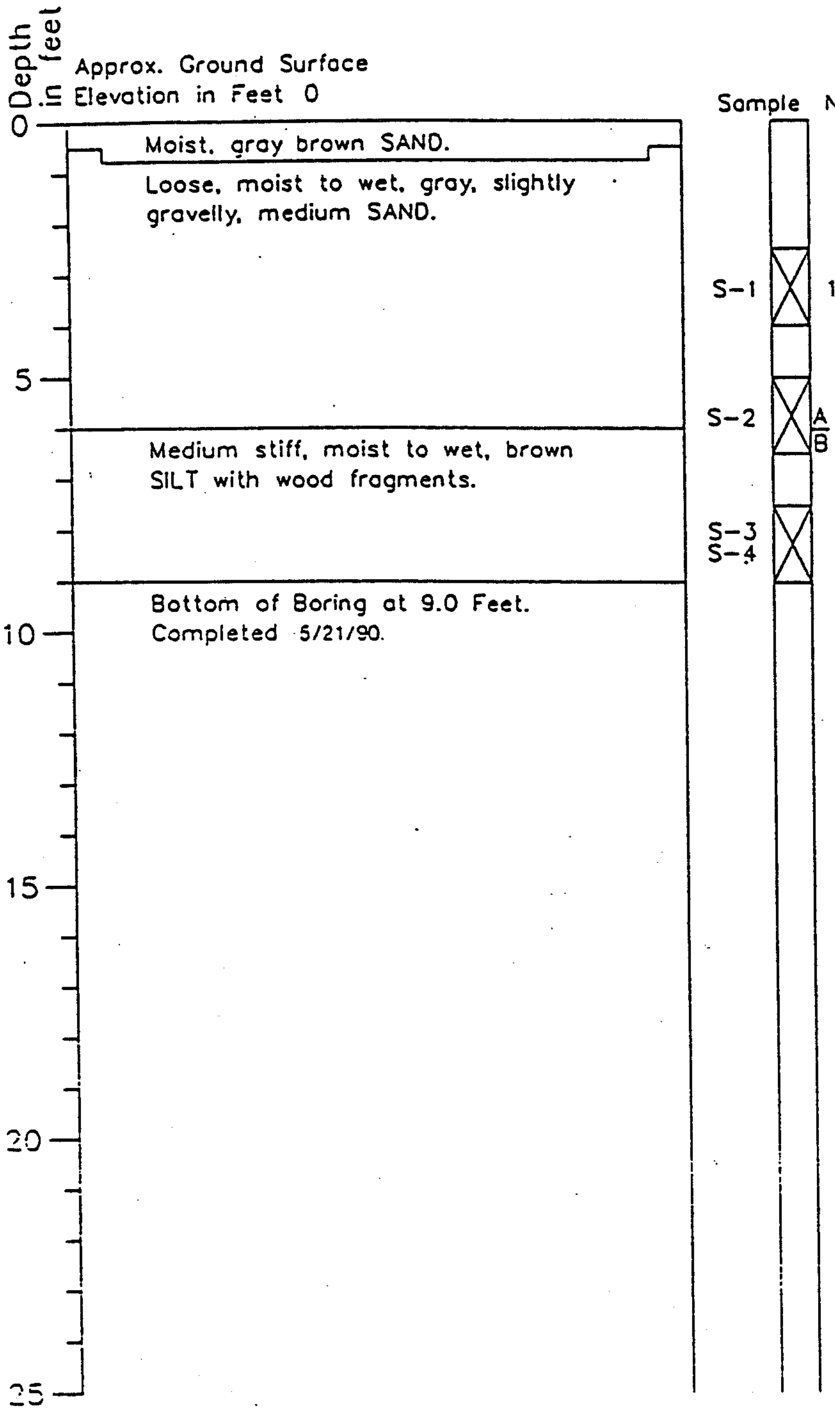
HARTCROWSER

J-2395-06 5/90

Boring Log and Construction Data for Monitoring Well HC-24

Geologic Log

Approx. Ground Surface Elevation in Feet 0



Moist, gray brown SAND.

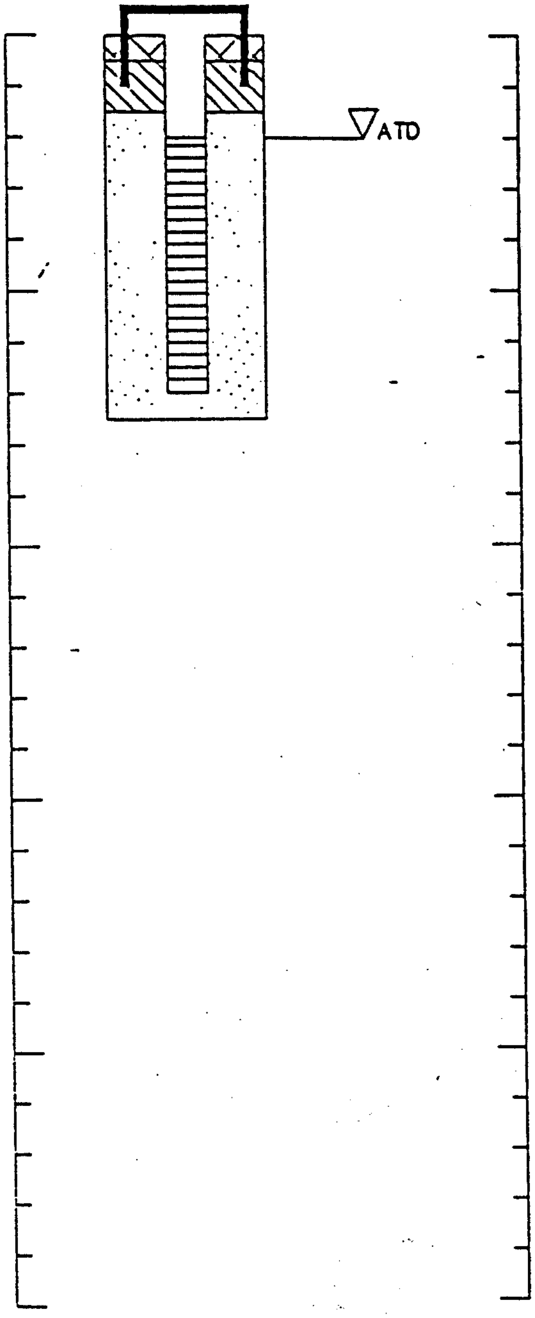
Loose, moist to wet, gray, slightly gravelly, medium SAND.

Medium stiff, moist to wet, brown SILT with wood fragments.

Bottom of Boring at 9.0 Feet.
Completed 5/21/90.

Monitoring Well Design

Casing Stickup in Feet 2.1
Top of PVC in Feet 2.10



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.

HARTCROWSER
J-2395-06 5/90
Figure A-4

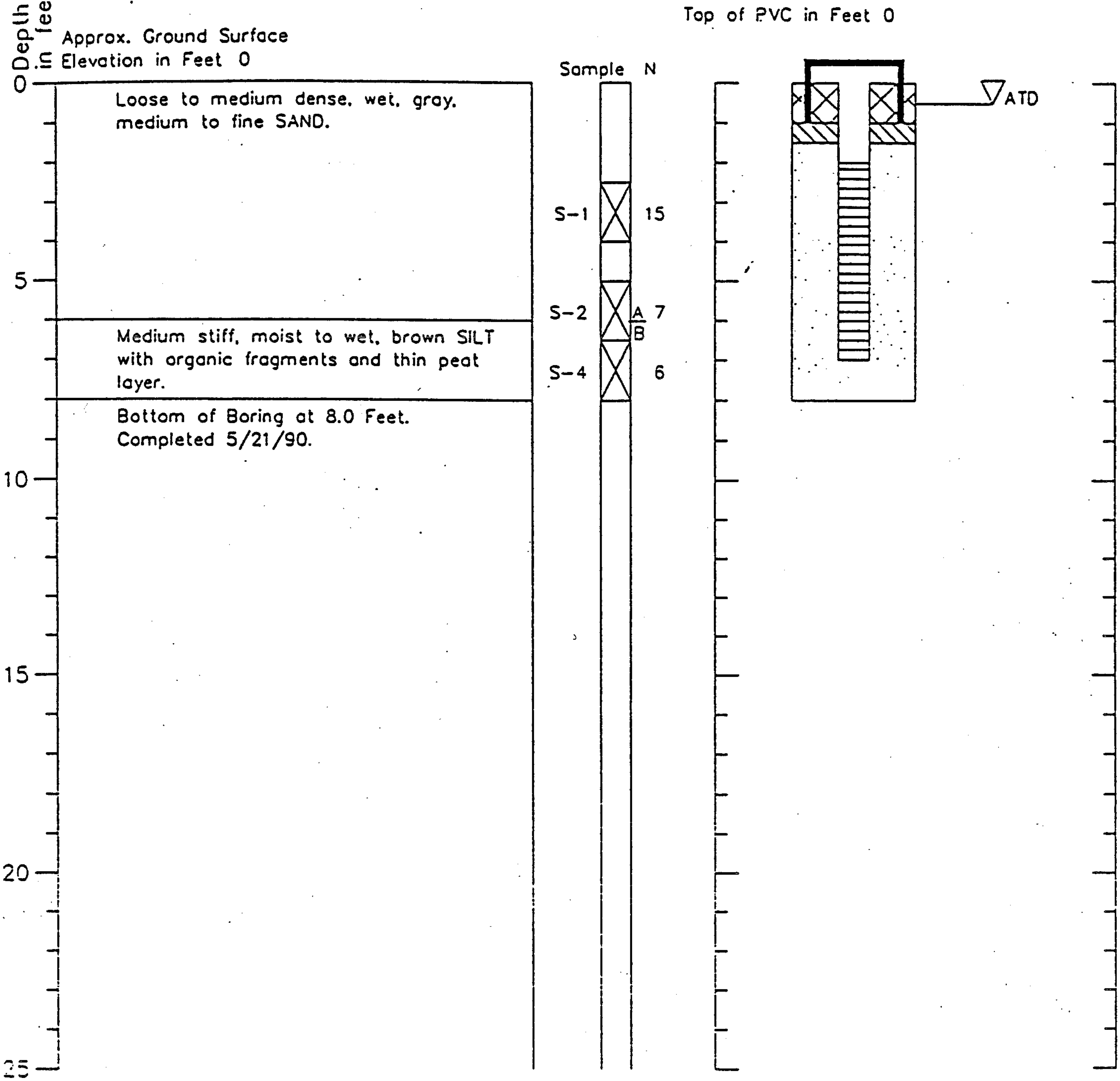
Boring Log and Construction Data for Monitoring Well HC-25

Geologic Log

Monitoring Well Design

Casing Stickup in Feet 2.0
Top of PVC in Feet 0

Approx. Ground Surface
Elevation in Feet 0



Loose to medium dense, wet, gray, medium to fine SAND.

Medium stiff, moist to wet, brown SILT with organic fragments and thin peat layer.

Bottom of Boring at 8.0 Feet.
Completed 5/21/90.

Sample	N
S-1	15
S-2 A/B	7
S-4	6

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-2395-06 5/90

Figure A-5

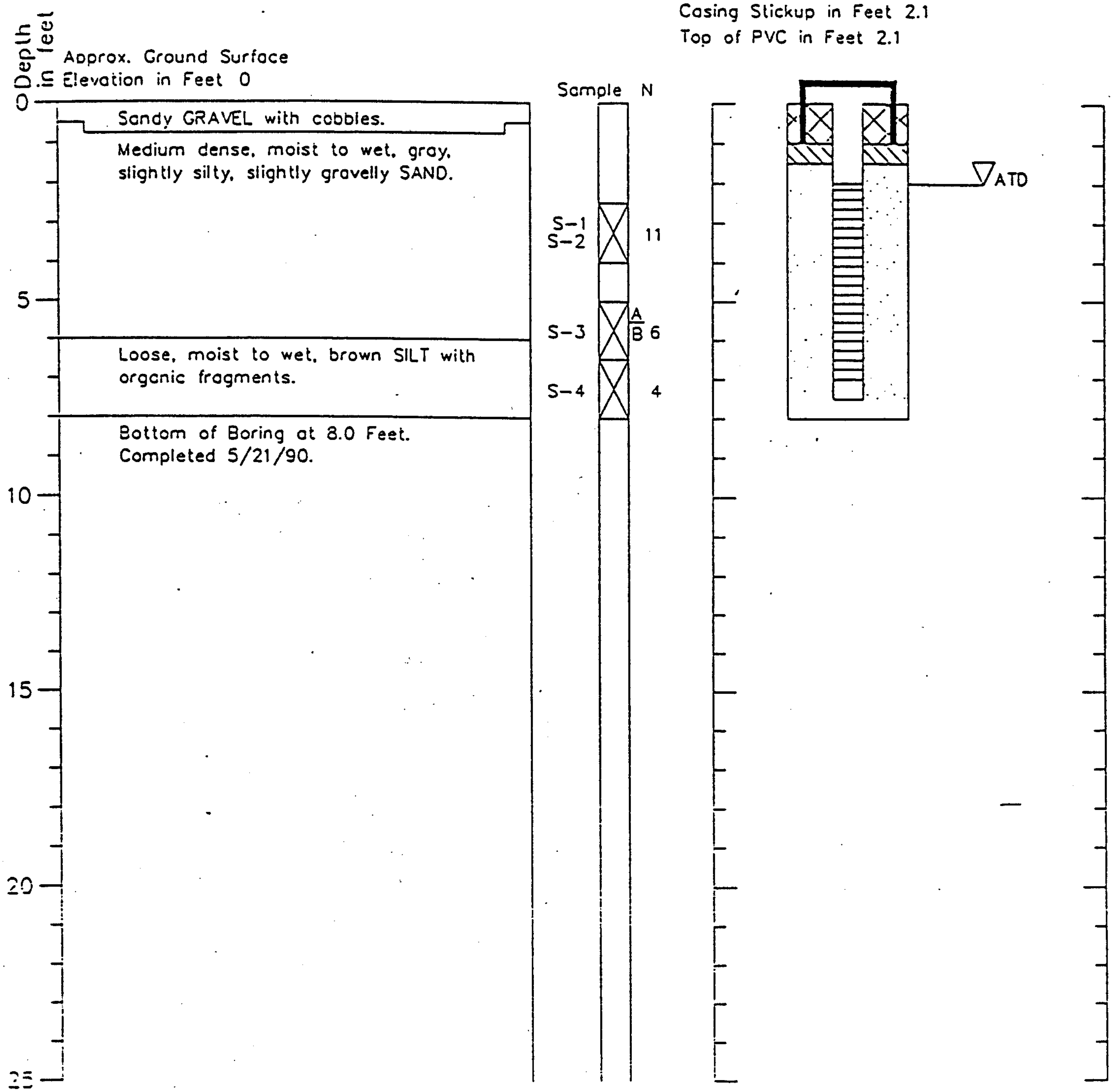
Boring Log and Construction Data for Monitoring Well HC-26

Geologic Log

Monitoring Well Design

Casing Stickup in Feet 2.1
Top of PVC in Feet 2.1

Approx. Ground Surface
Elevation in Feet 0



Sandy GRAVEL with cobbles.

Medium dense, moist to wet, gray, slightly silty, slightly gravelly SAND.

Loose, moist to wet, brown SILT with organic fragments.

Bottom of Boring at 8.0 Feet.
Completed 5/21/90.

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-2395-06 5/90

Figure A-6

APPENDIX G

SURVEYING DATA, SLUG TEST DATA, GRAIN SIZE ANALYSES, AND PERMEABILITY TEST RESULTS

SURVEYING DATA MONITORING WELLS
EVERETT SMELTER SITE

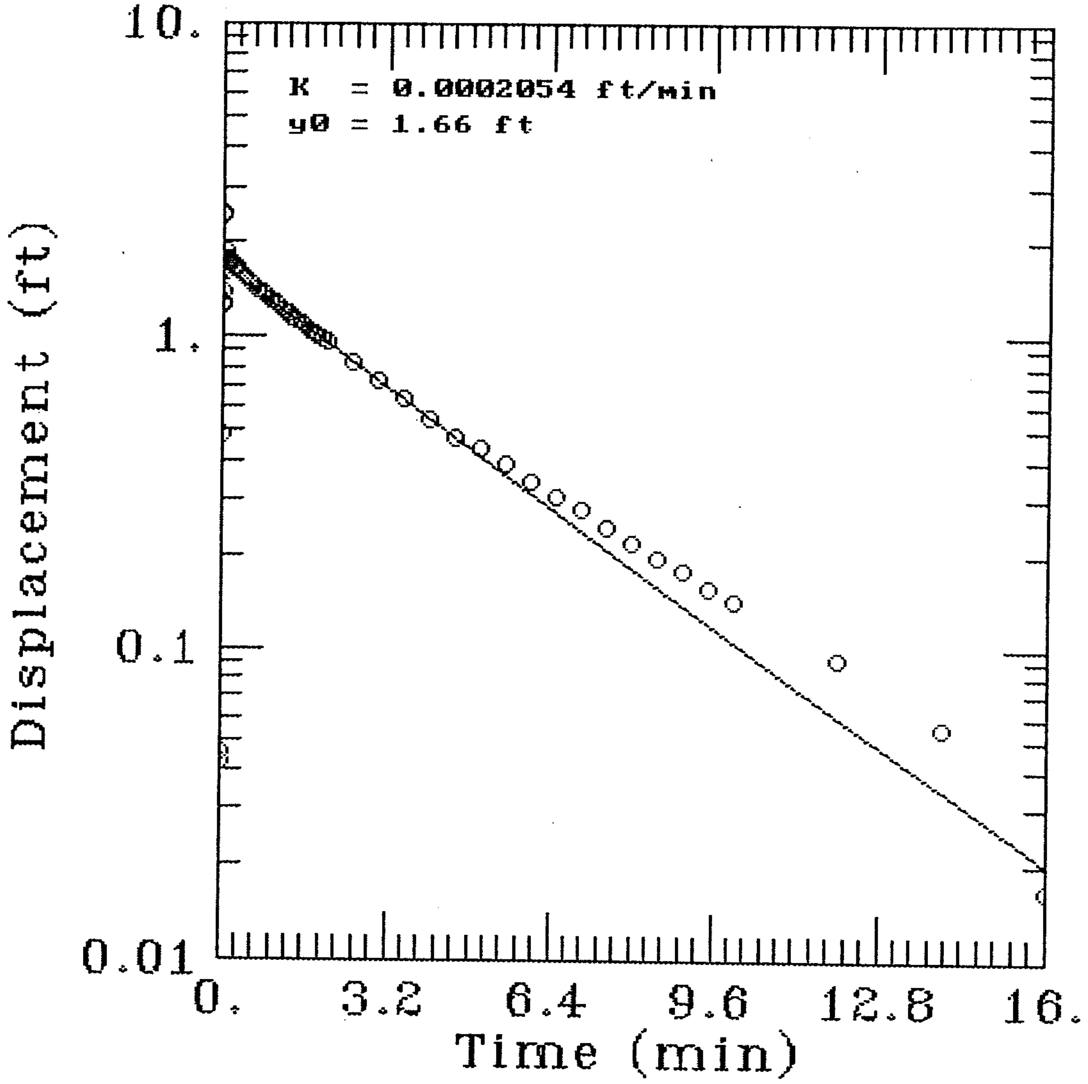
MONITORING WELL	COORDINATES NORTH	EAST	ELEVATIONS TOP OF PVC
WP-1	29895.4	10169.4	14.43
EV-1	29412.1	9025.9	112.38
EV-3	29689.9	9921.9	56.64
EV-4A	29975.9	9921.9	57.56
EV-4B	29987.9	9919.3	57.10
EV-5	30280.9	10148.1	10.30
MW-1	27835.8	10489.1	15.03
MW-2	29100.2	10681.3	10.32
MW-3	29672.2	10507.0	8.13
MW-4A	29992.3	10428.7	8.34
MW-4B*	29984.0	10423.3	8.79
MW-5	29565.2	10852.2	7.67
MW-6A	29944.3	10001.6	57.13
MW-6B	29950.5	10003.7	57.11
MW-7A	29970.4	10133.5	11.41
MW-7B	29977.8	10134.4	11.30
MW-8A	29985.8	10203.7	11.78
MW-8B	29978.6	10203.7	11.07
MW-9A	29851.0	10174.1	12.69
MW-9B	29858.1	10171.0	12.52

* Abandoned due to irrepairable damage

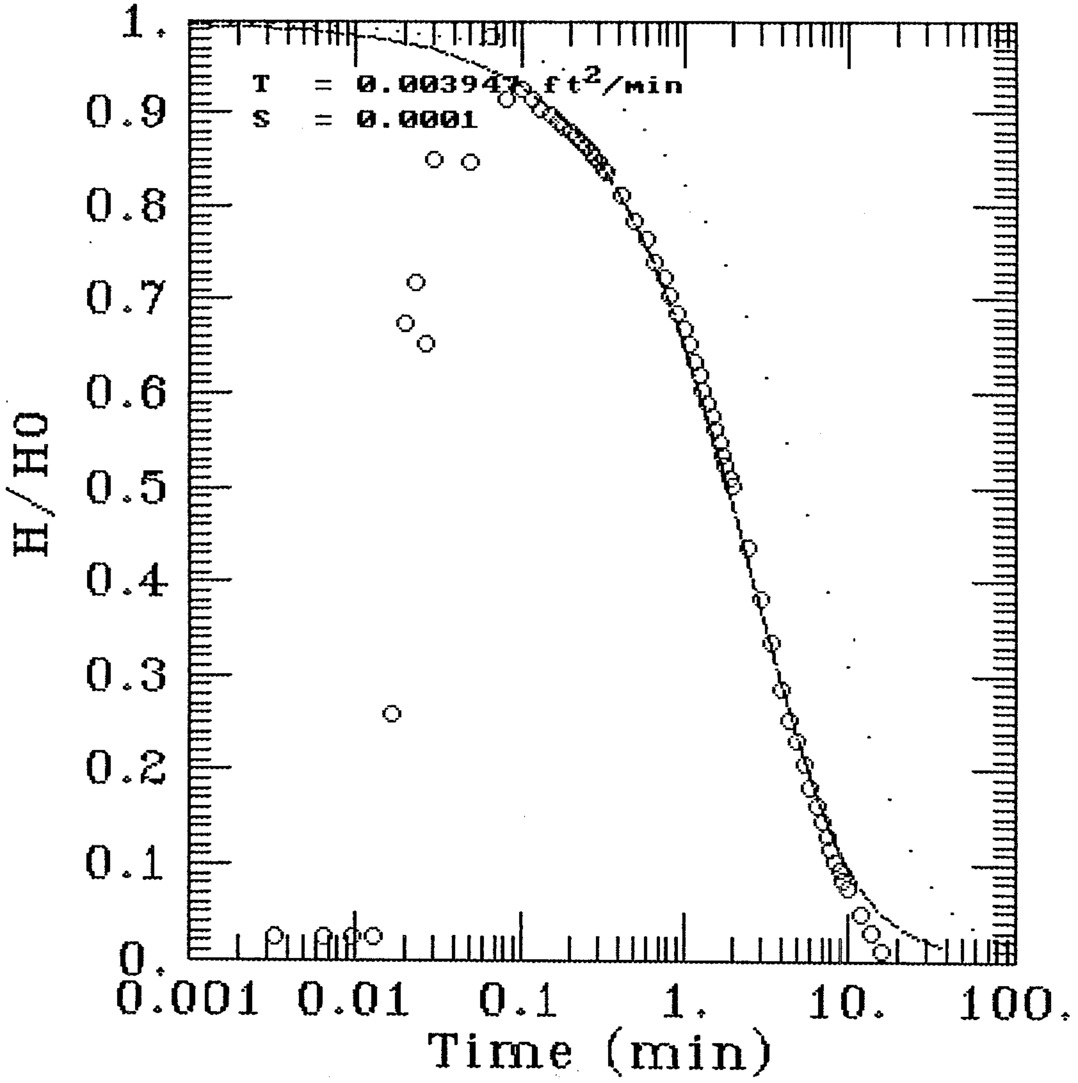
SLUG TEST DATA

4-21-93

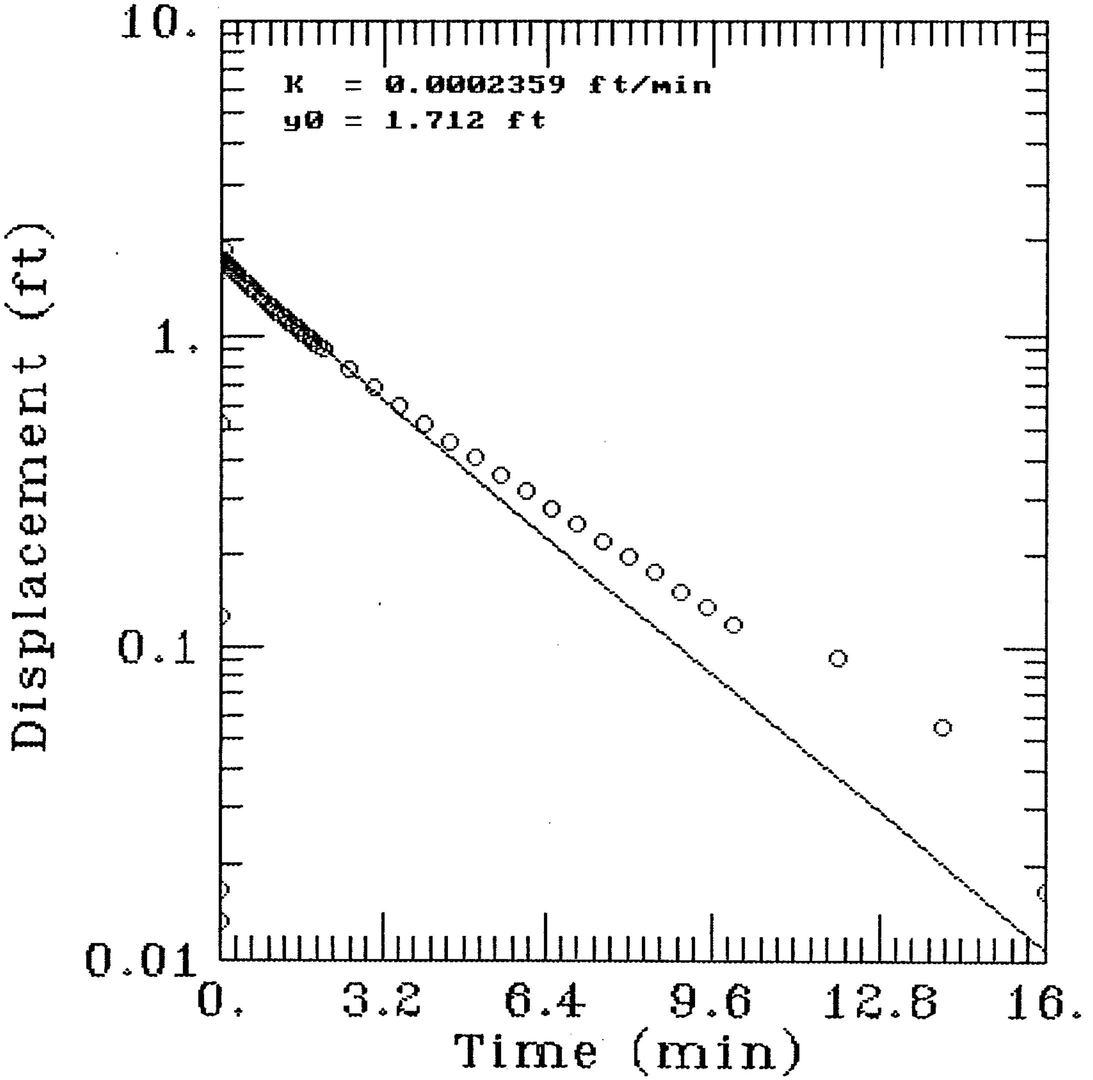
EV-1 Slug Test Results - Test #1



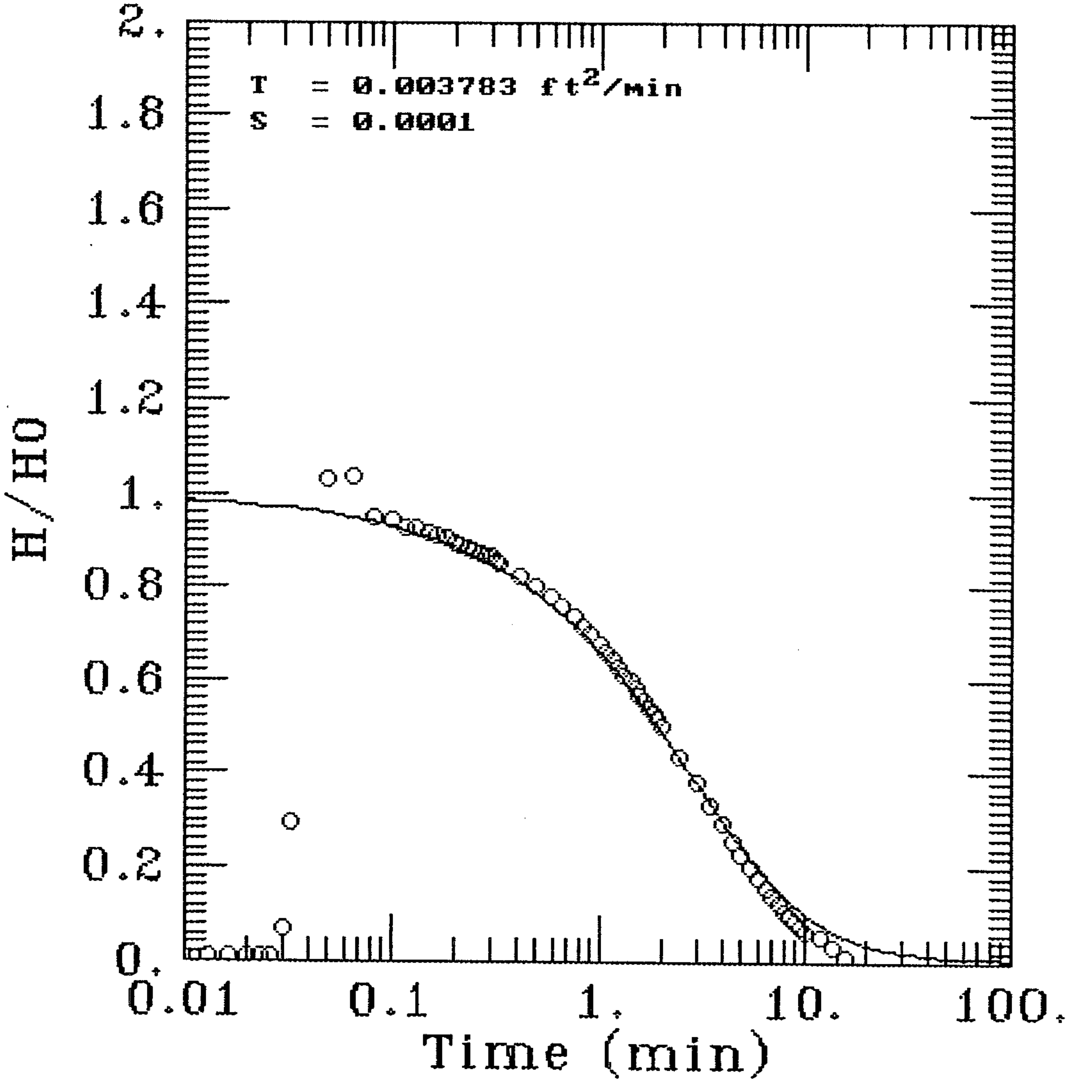
EV-1 Slug Test Results - Test #1



EV-1 Slug Test Results - Test #2

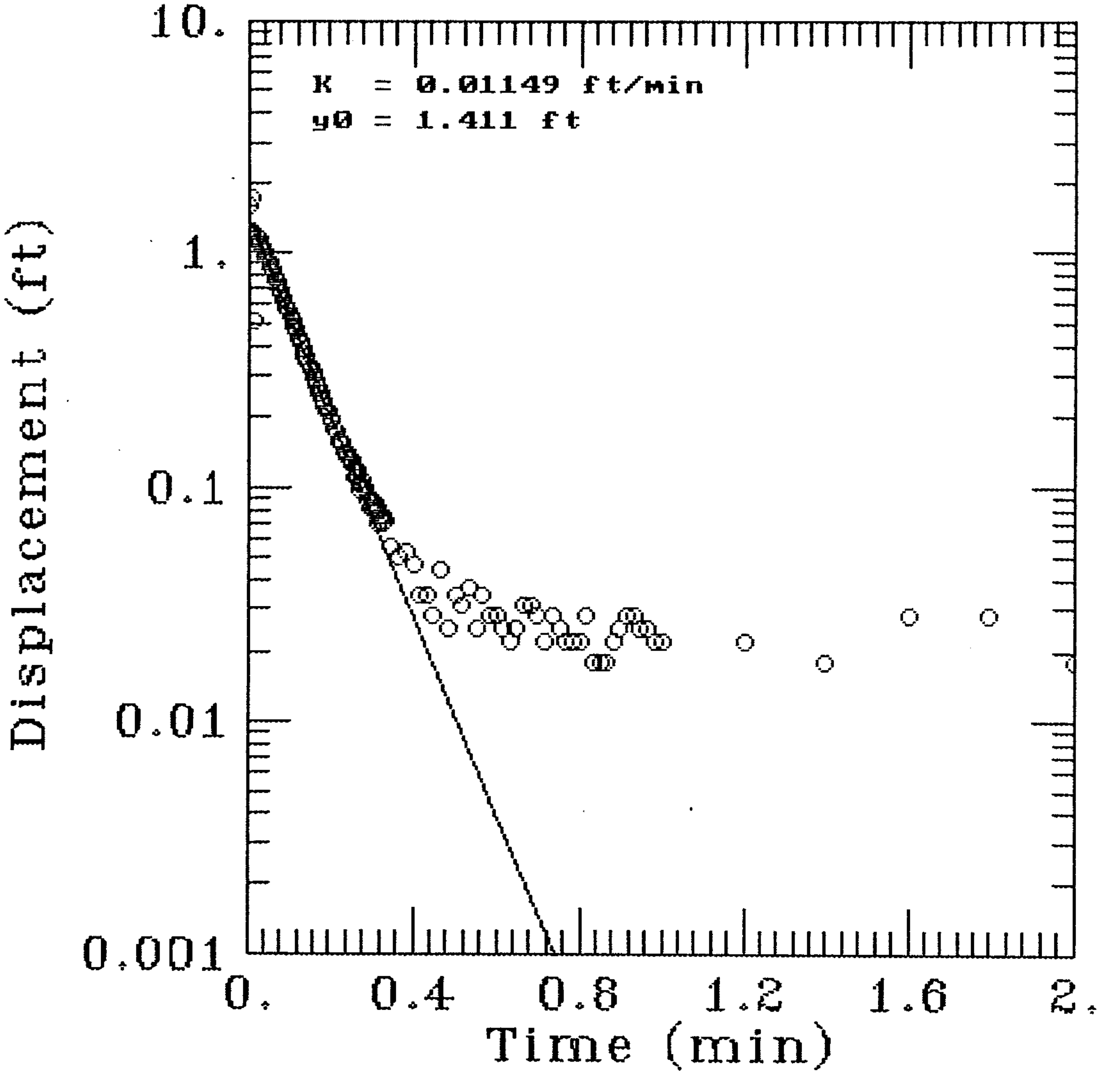


EV-1 Slug Test Results - Test #2

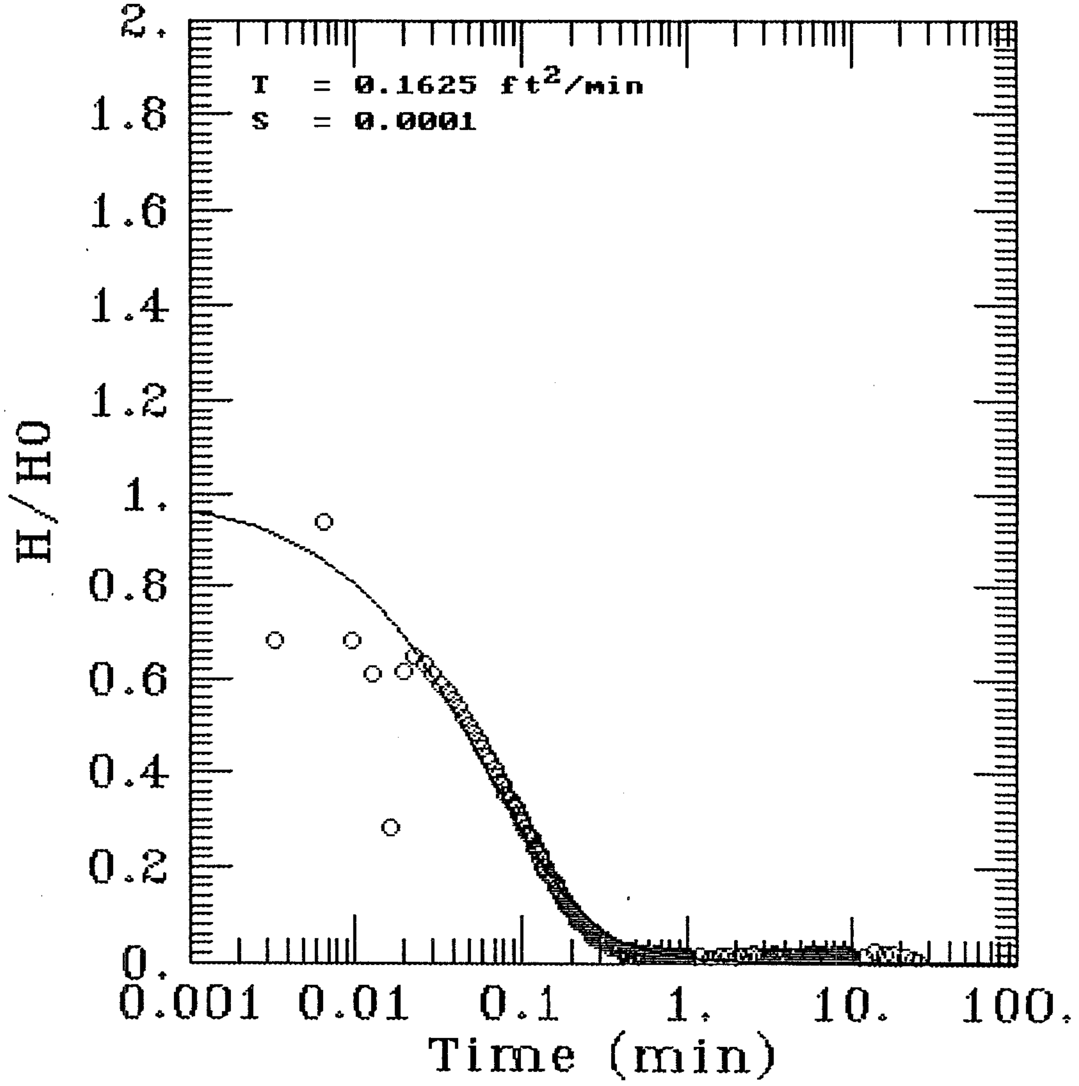


4-21-93

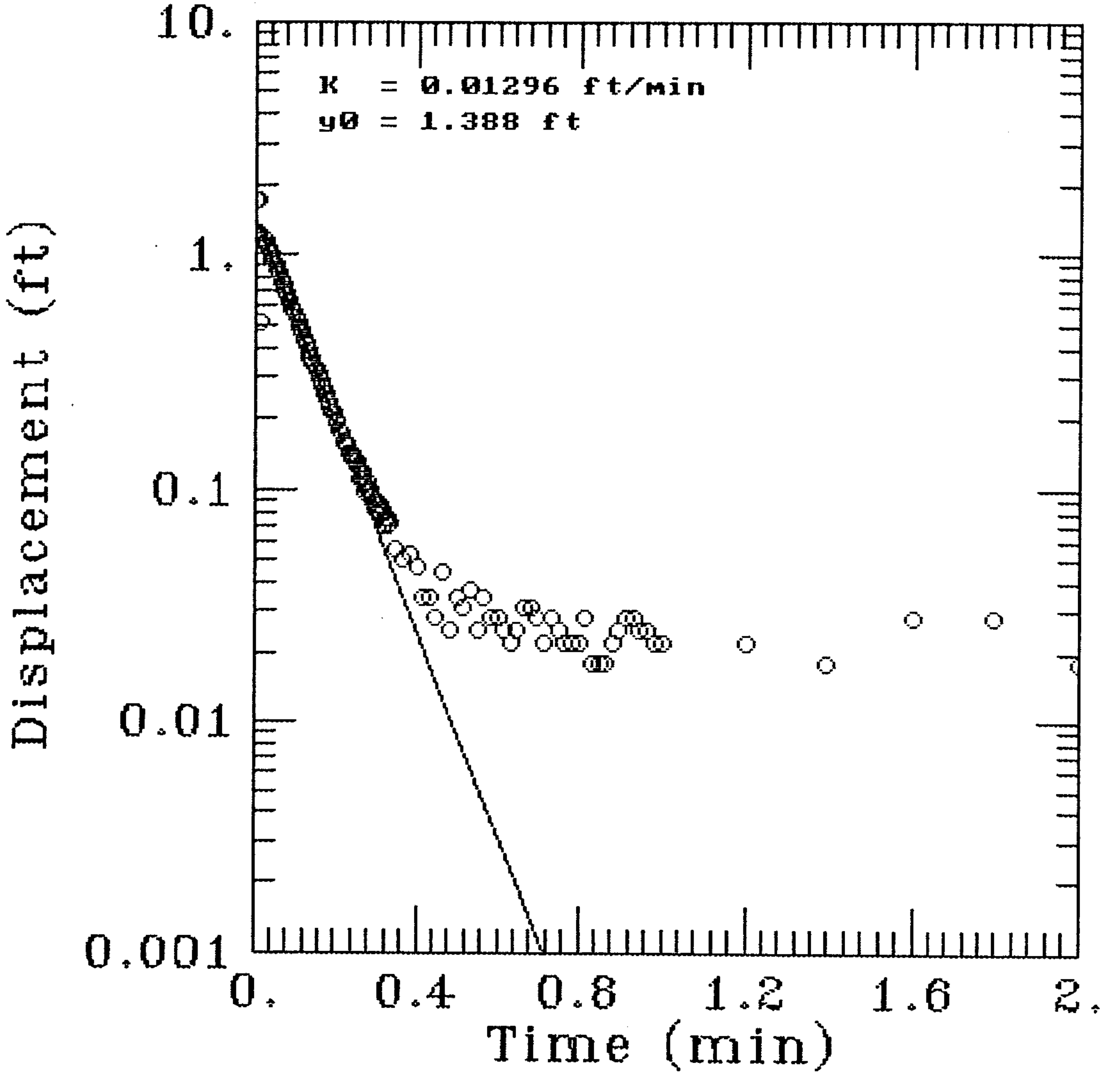
EV-3 Slug Test Results - Test #1



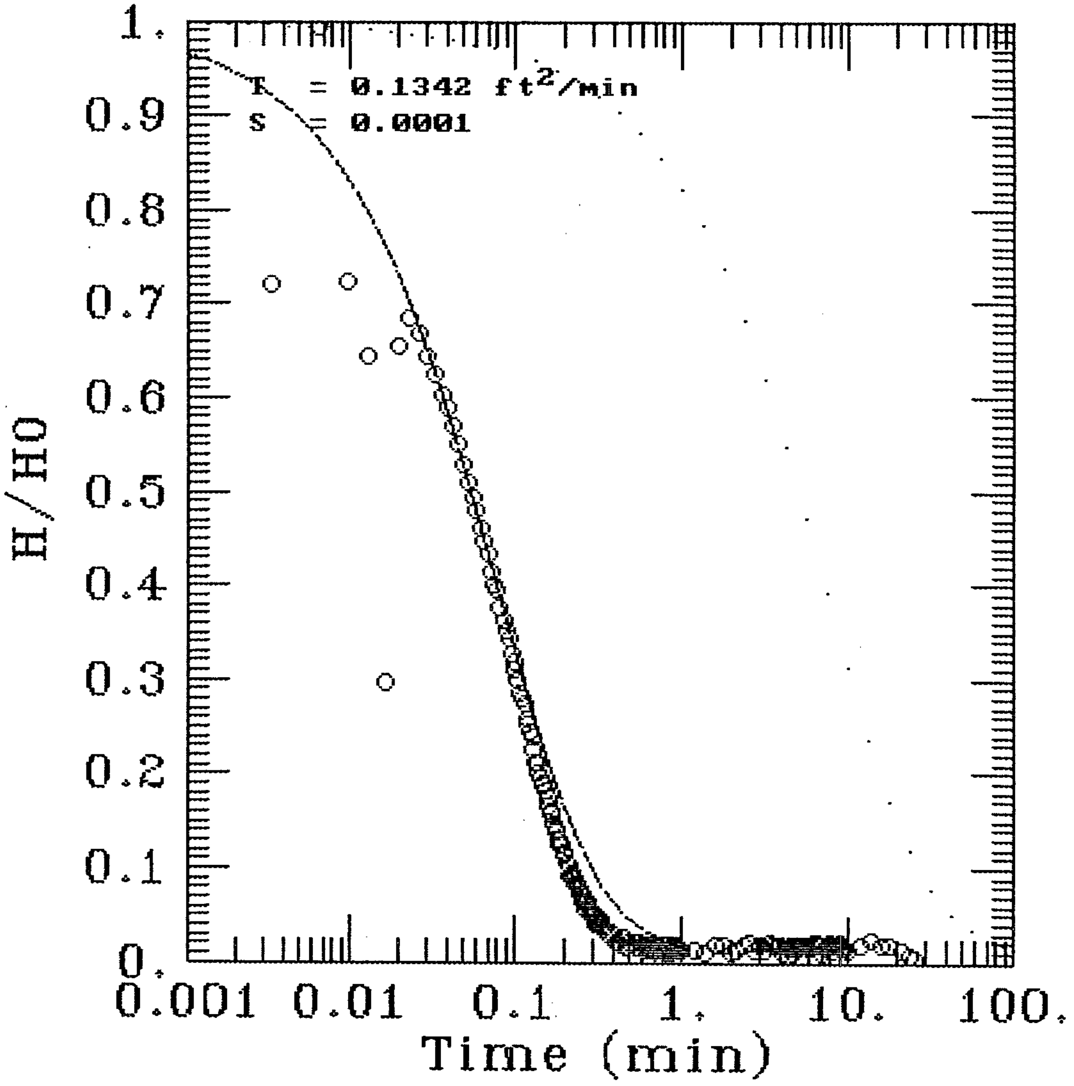
EV-3 Slug Test Results - Test #1



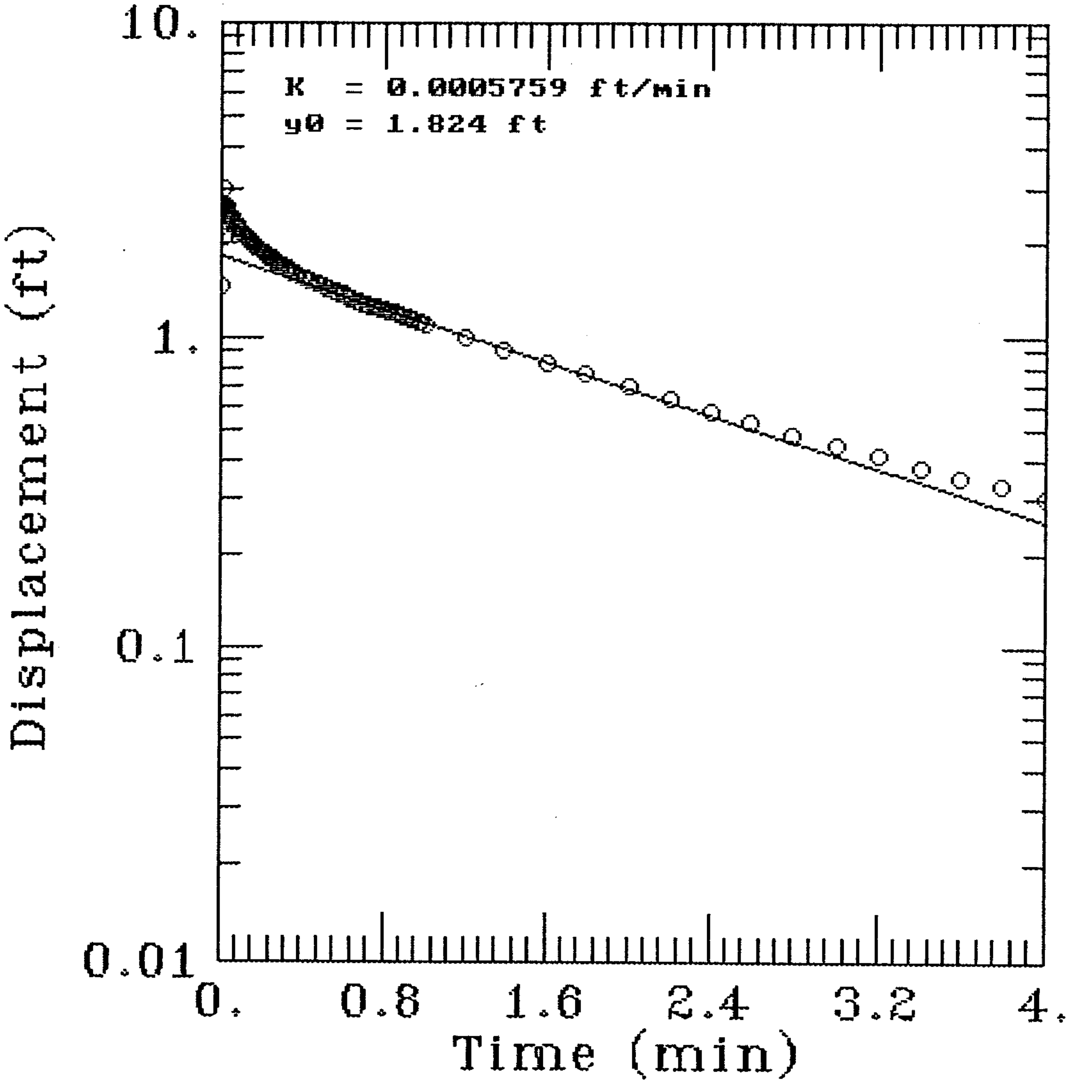
EV-3 Slug Test Results - Test #2



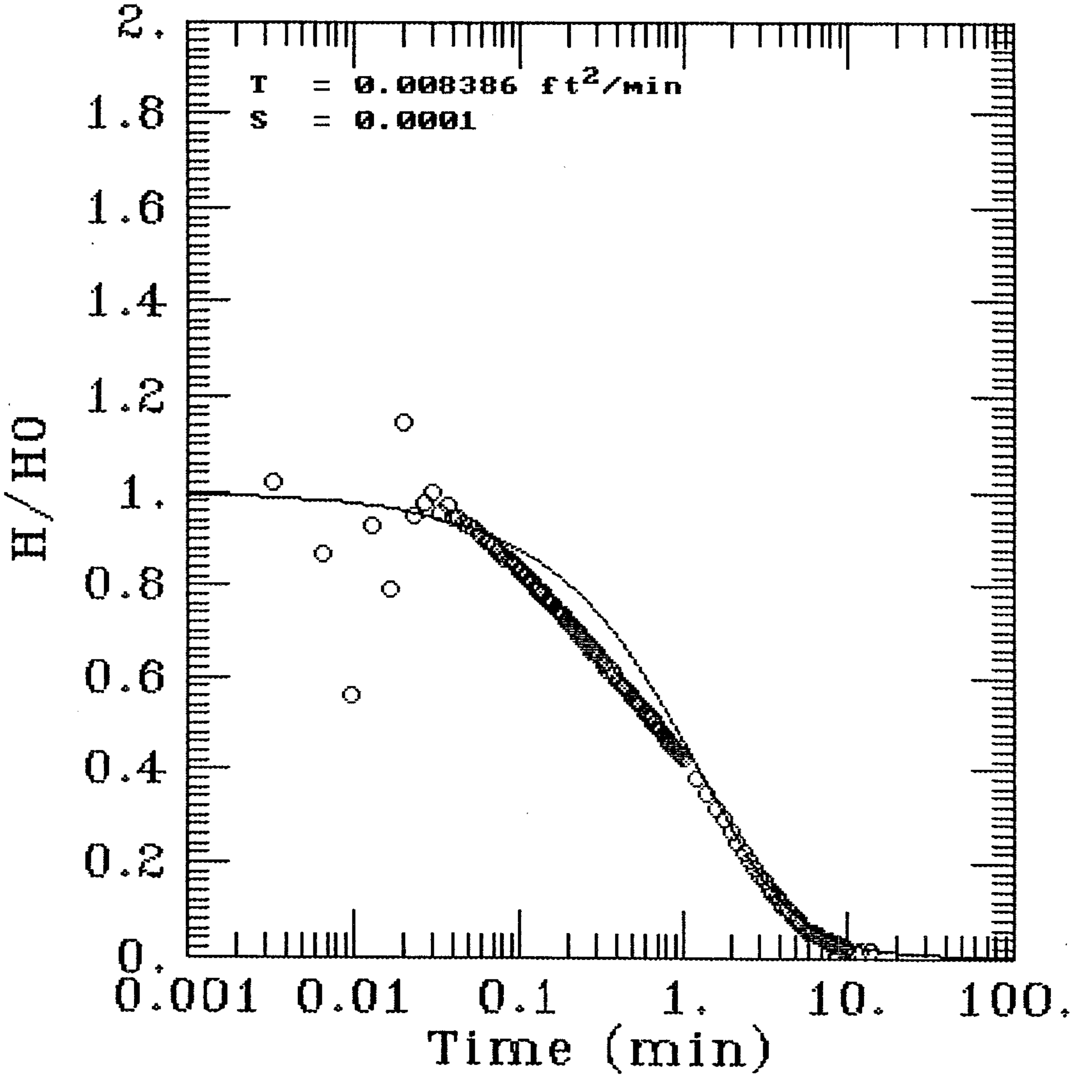
EV-3 Slug Test Results - Test #2



EV-4B Slug Test Results – Test #1

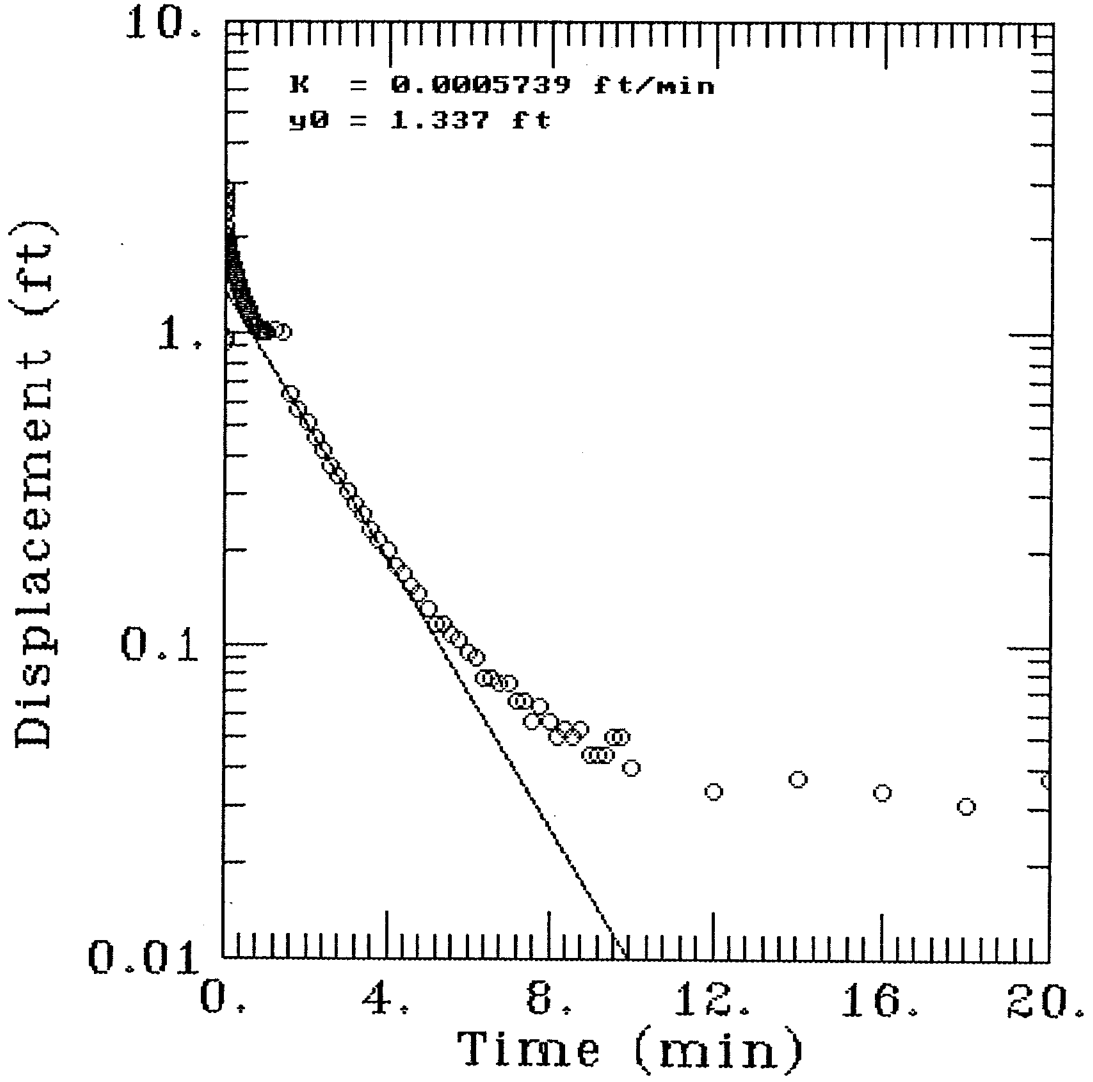


EV-4B Slug Test Results - Test #1

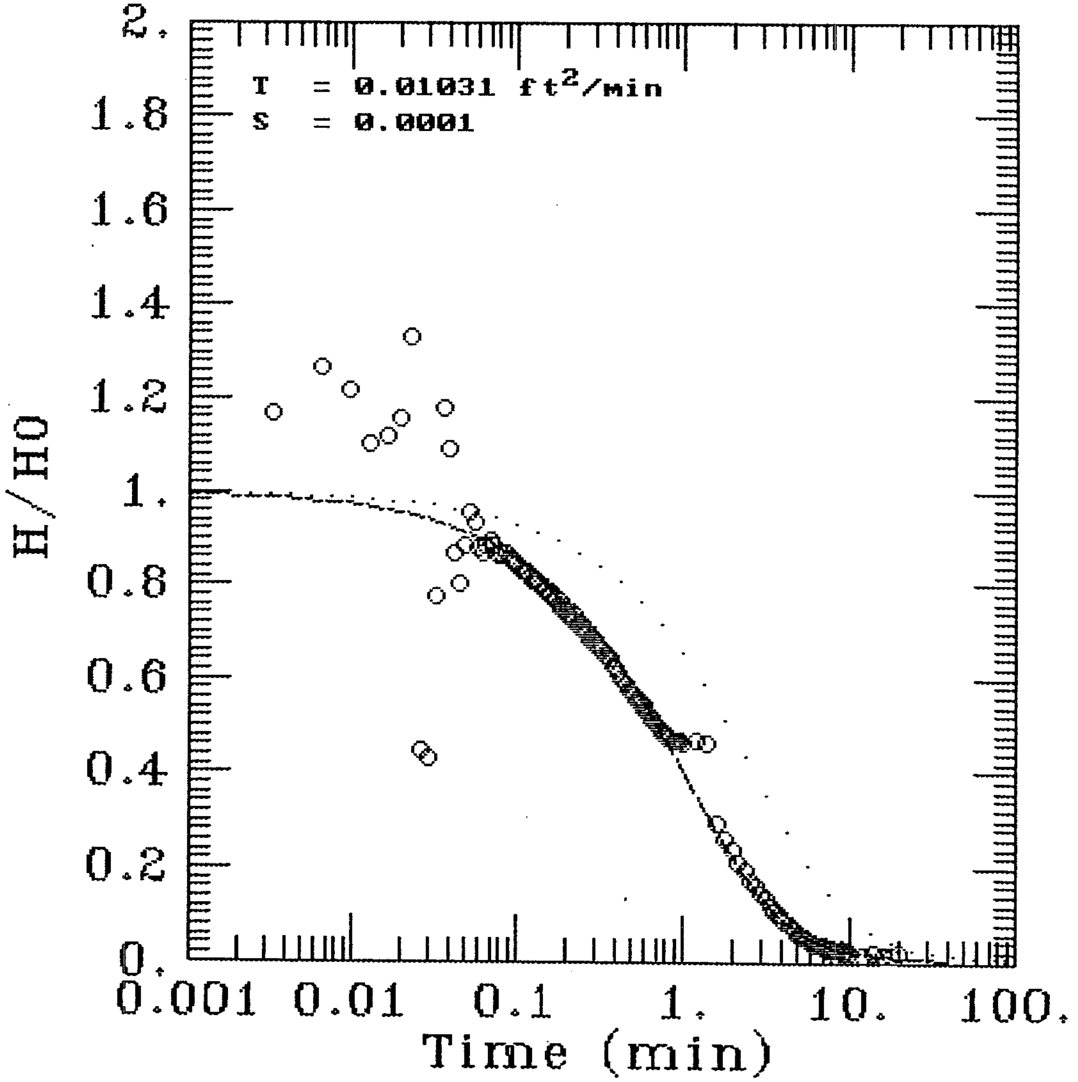


4-21-93

EV-4B Slug Test Results – Test #2

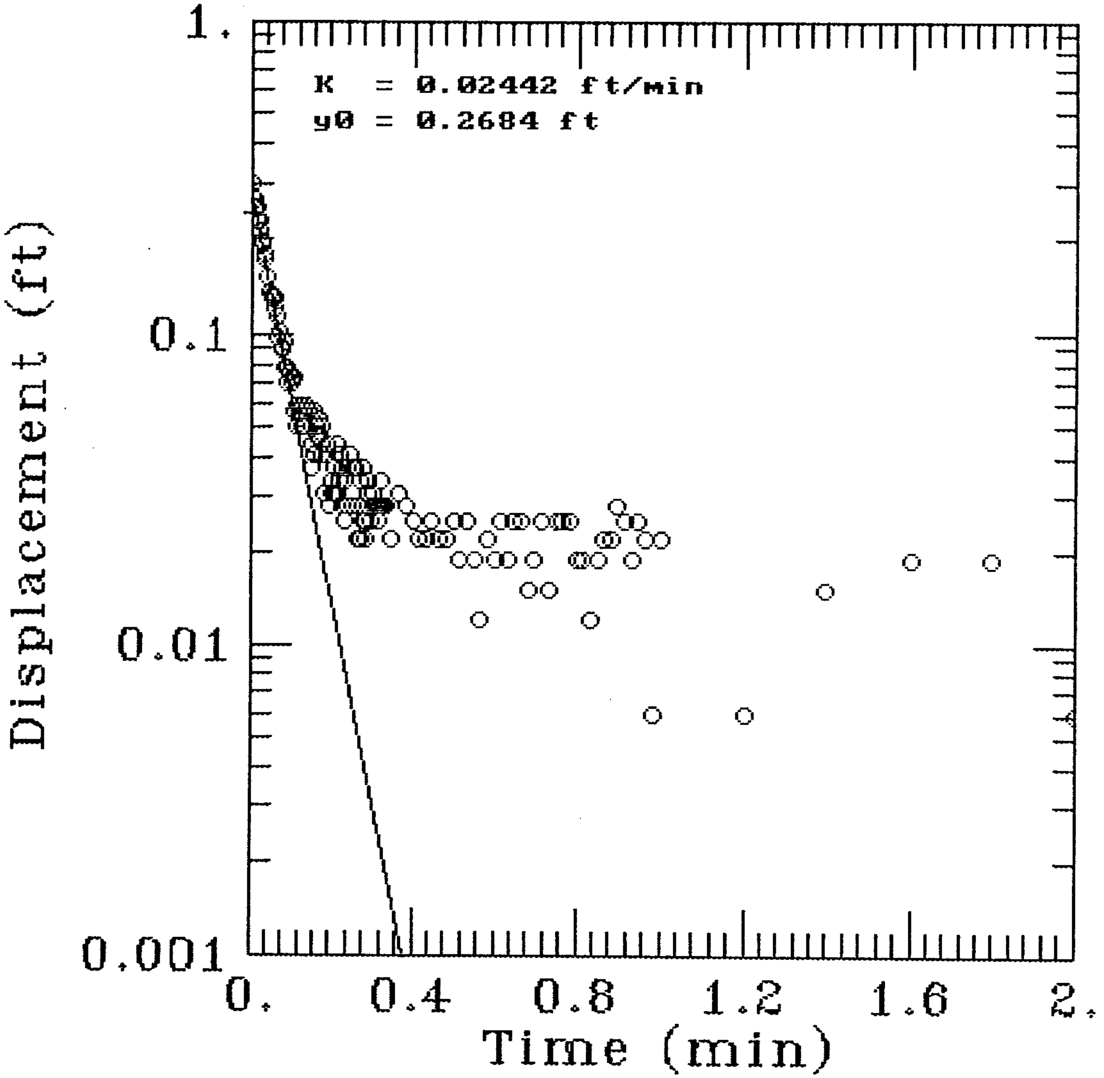


EV-4B Slug Test Results - Test #2

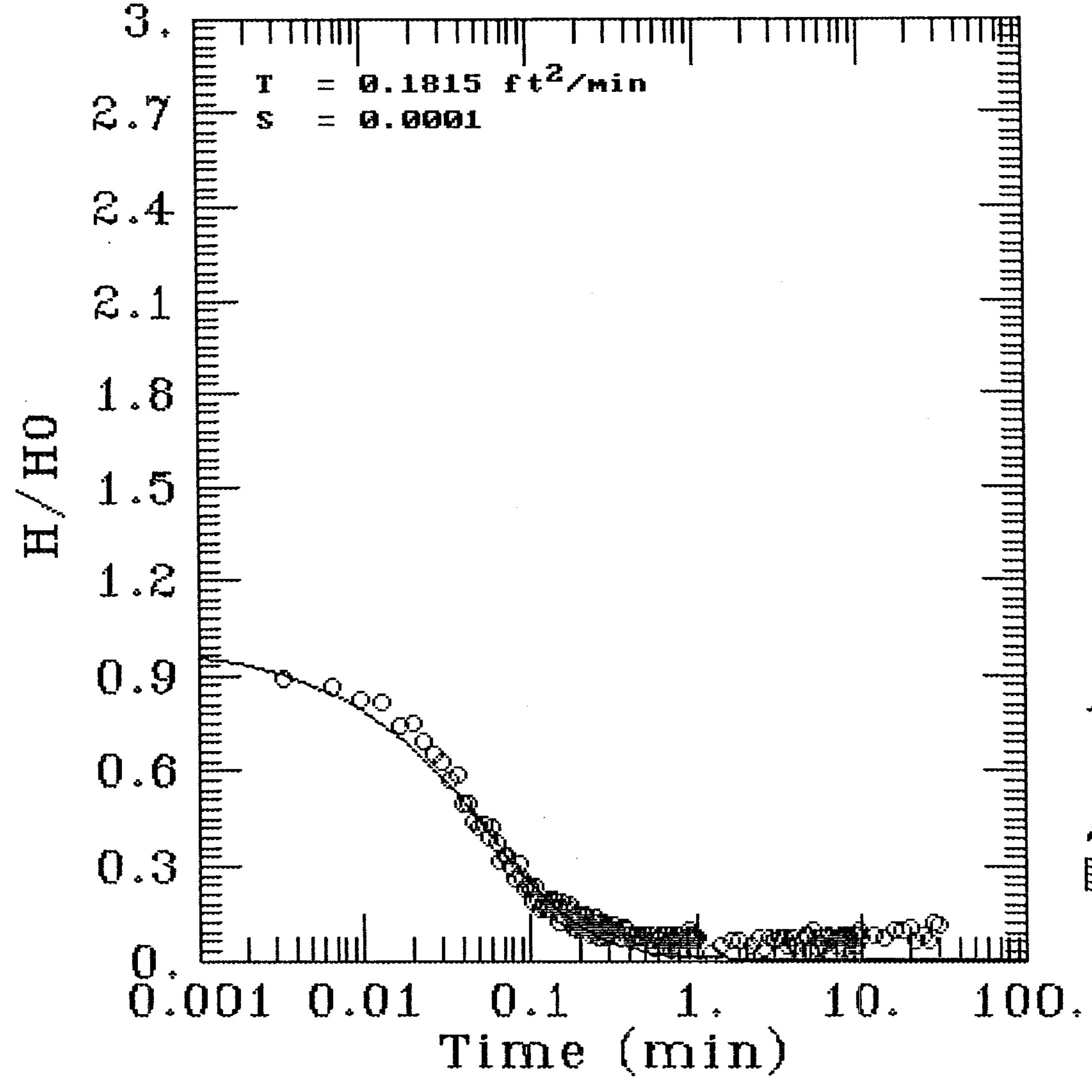


4-21-93

EV-5 Slug Test Results - Test #1



EV-5 Slug Test Results - Test #1

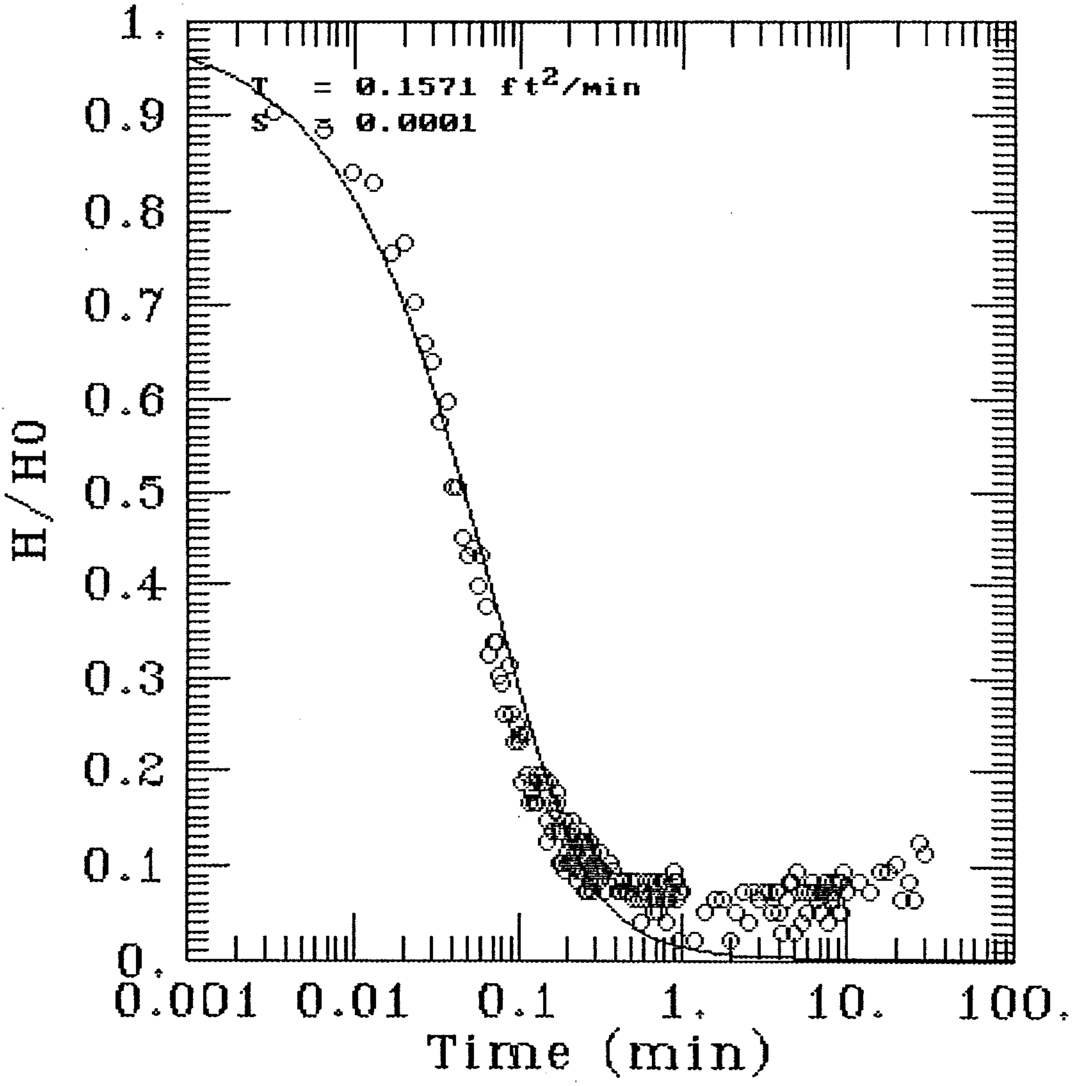


AQTESOLV

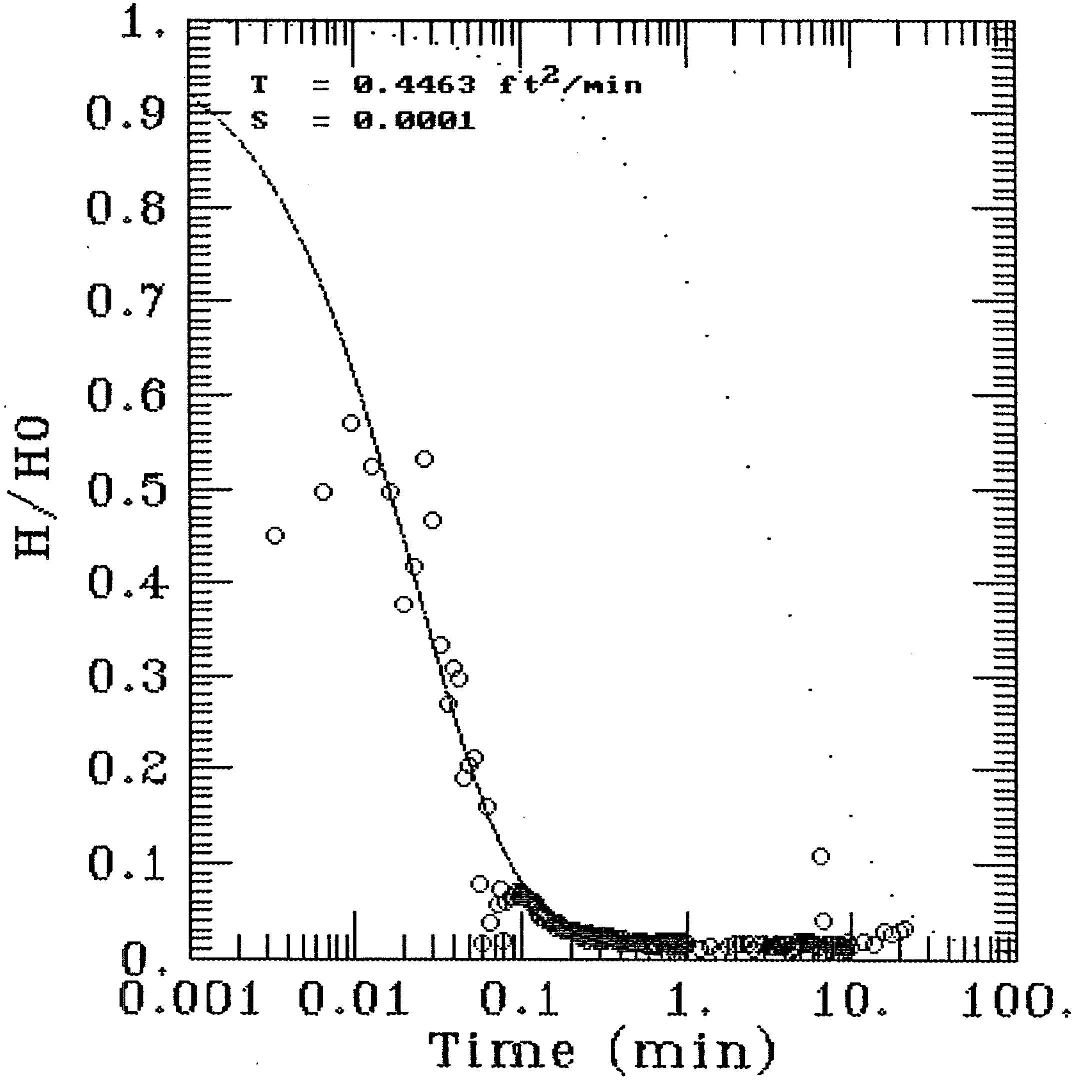
GERAGHTY
& MILLER, INC.

Modeling Group

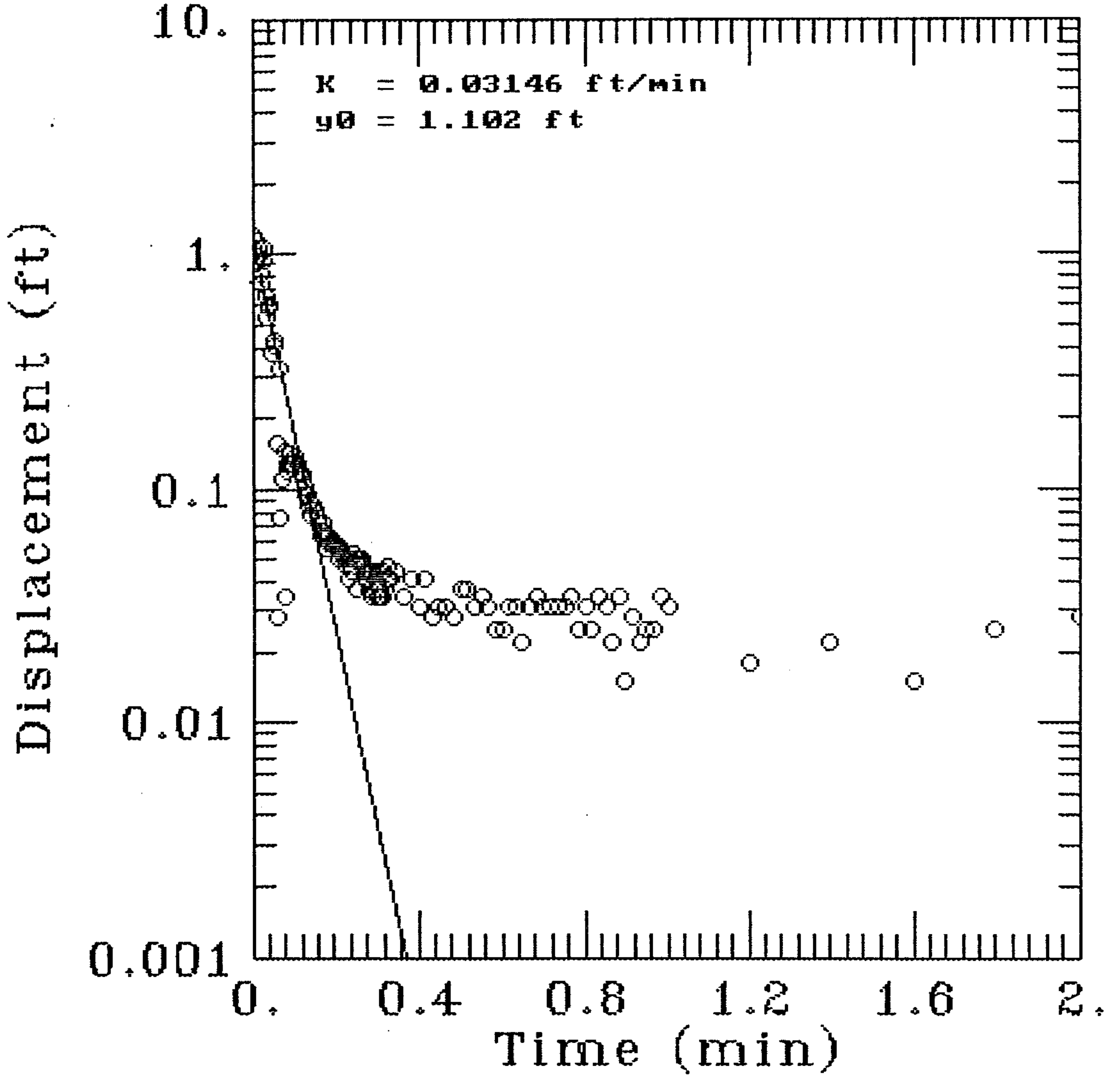
4-21-93


EV-5 Slug Test Results - Test #1

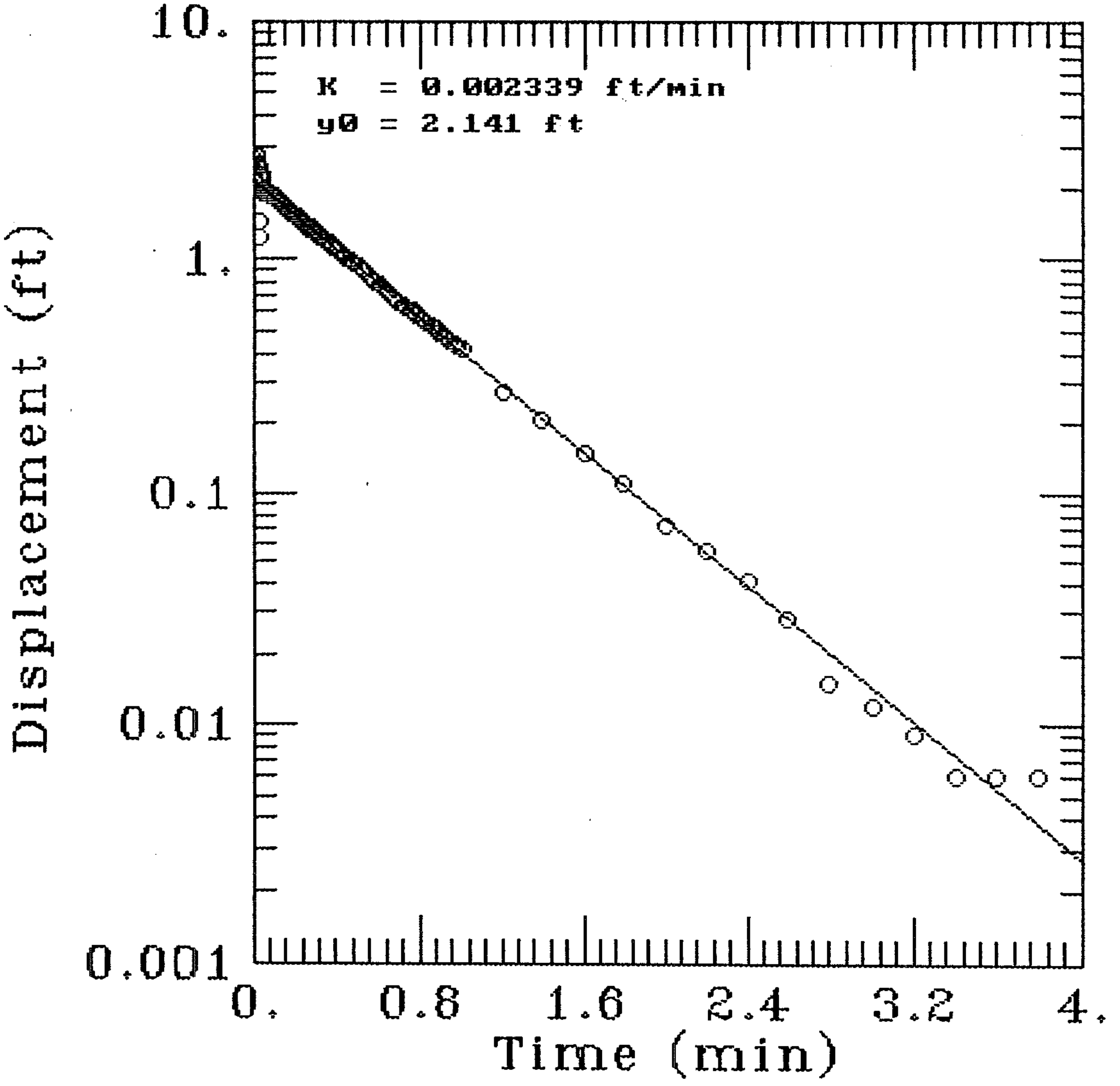
EV-5 Slug Test Results - Test #2



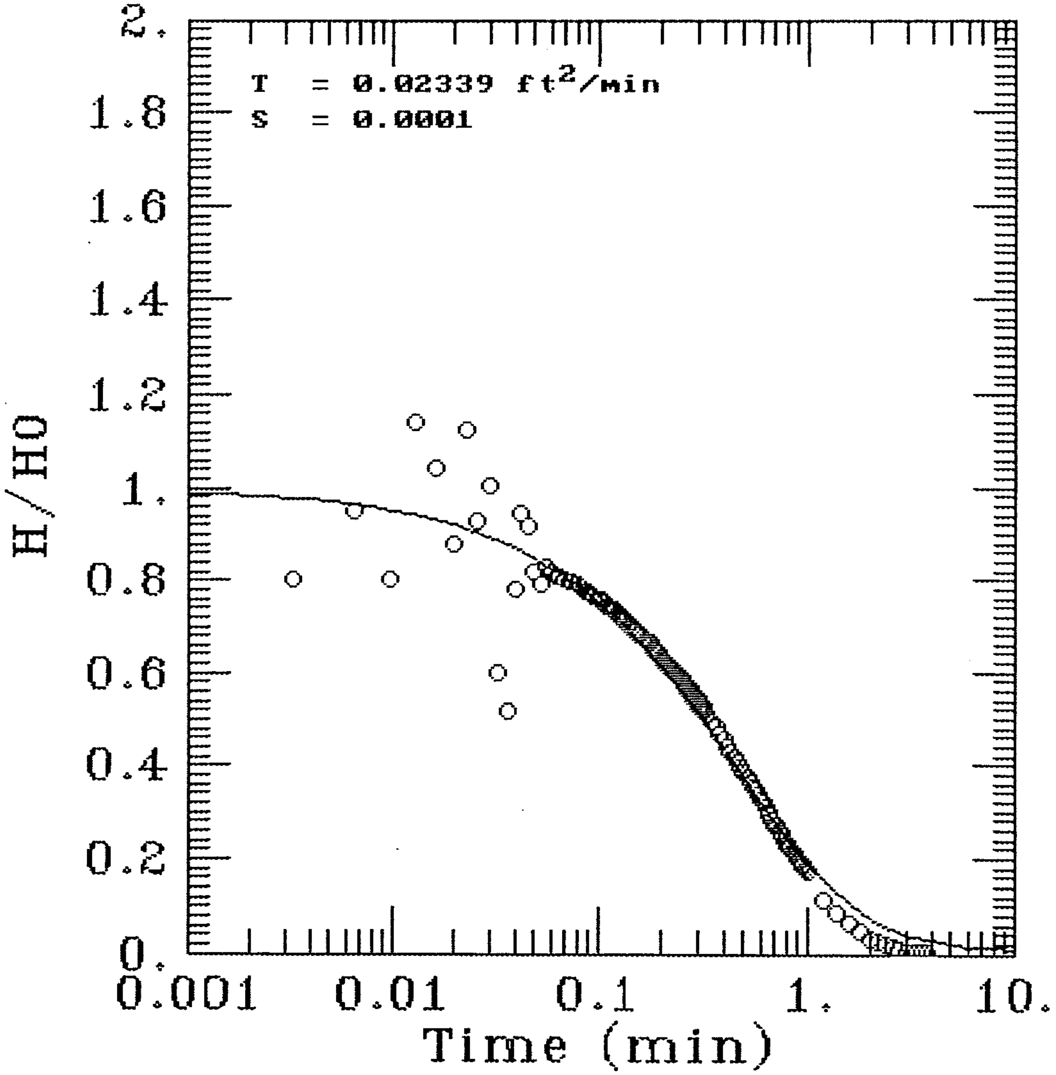
EV-5 Slug Test Results - Test #2



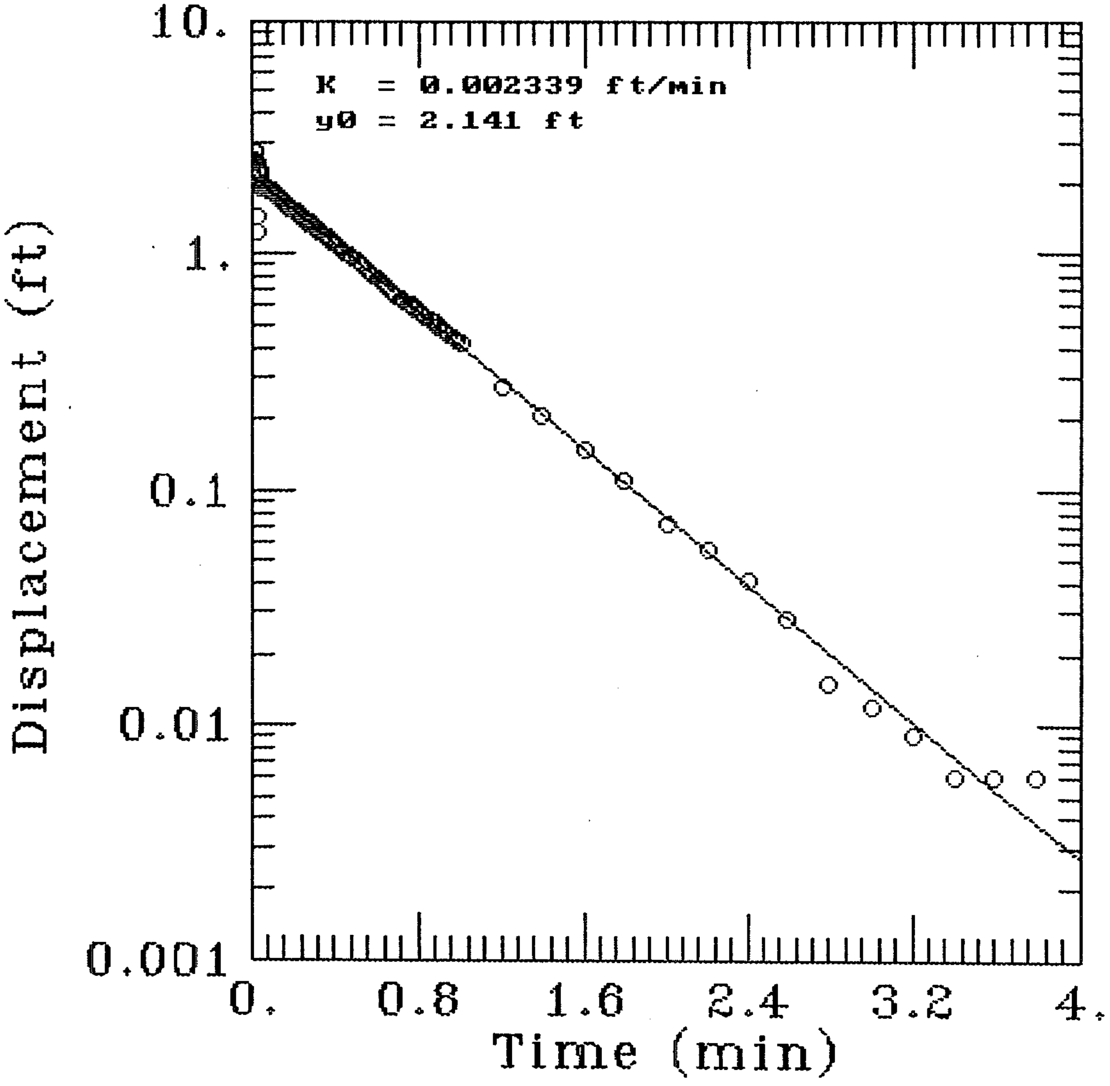
MW-1 Slug Test Results - Test #1



MW-1 Slug Test Results - Test #1

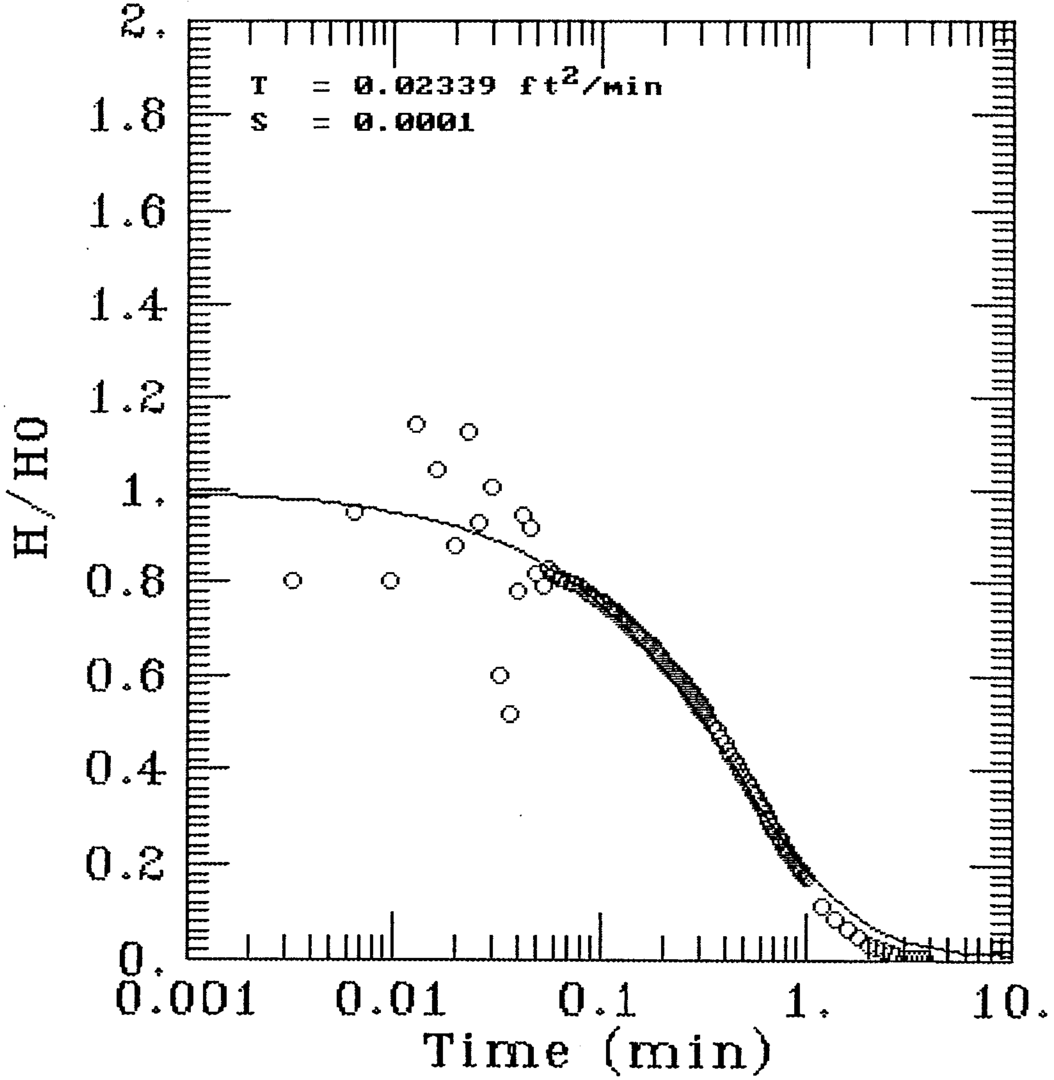


MW-1 Slug Test Results - Test #2

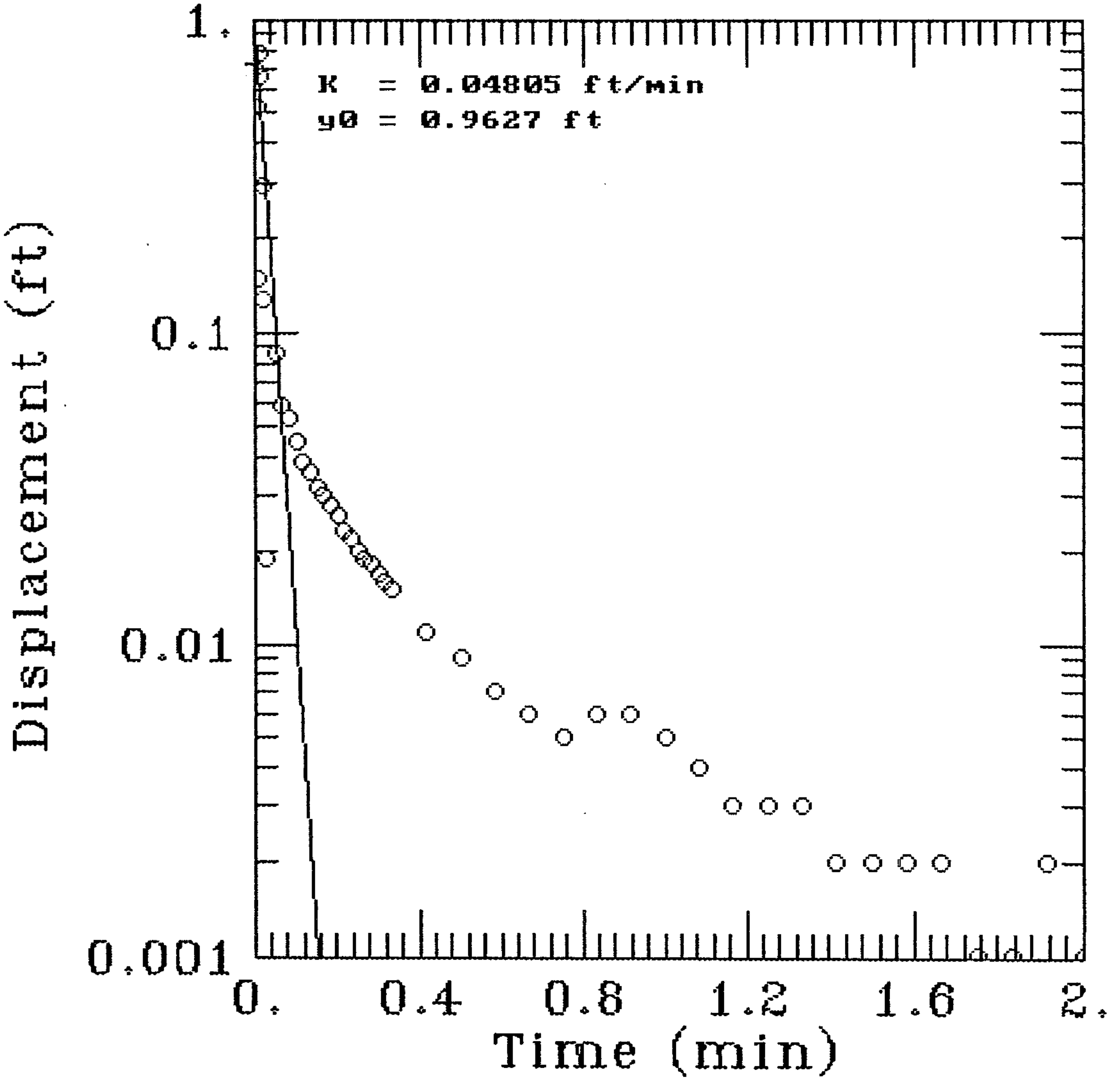


4-21-15

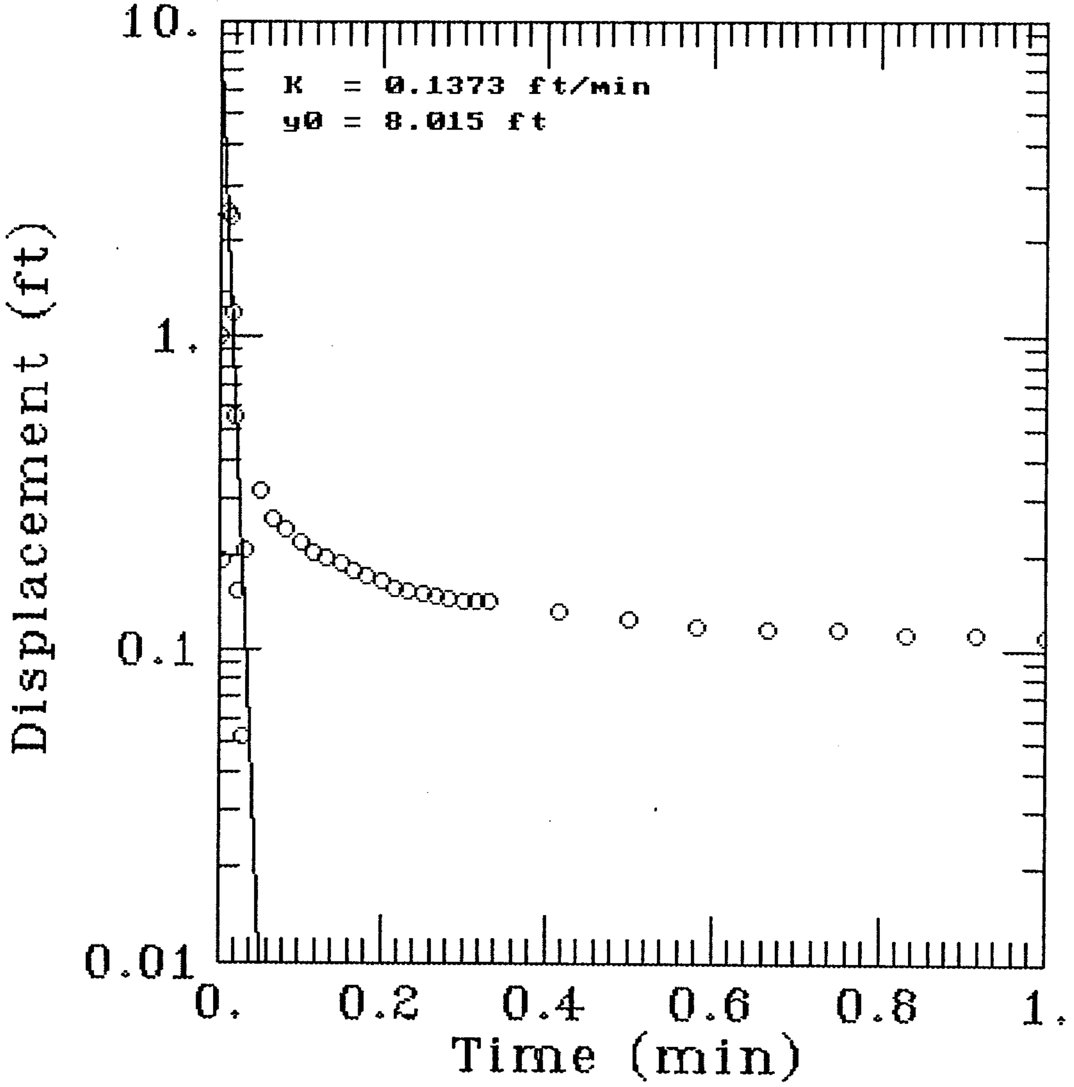
MW-1 Slug Test Results - Test #2



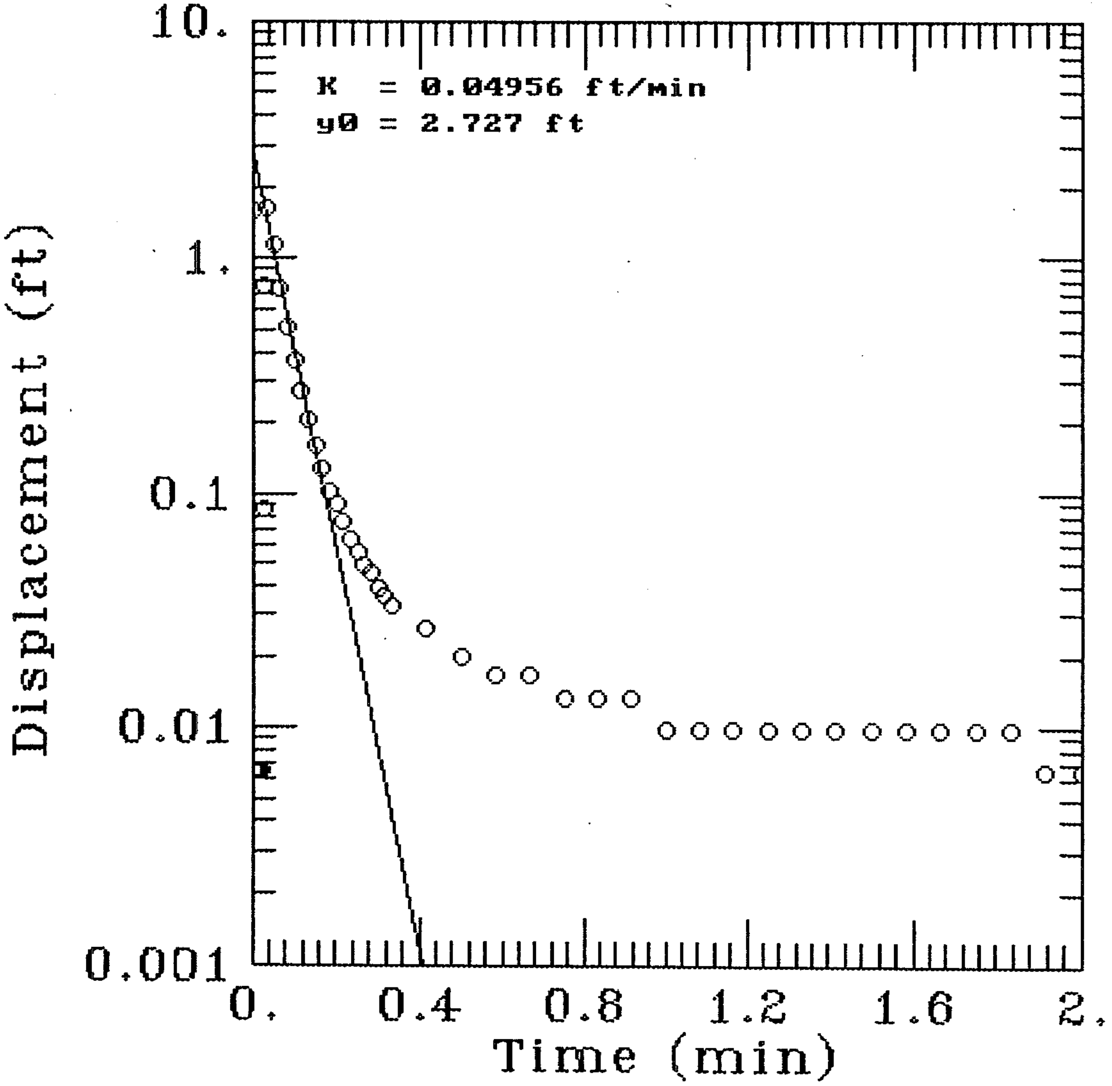
MW-2 Slug Test Results - Test #1



MW-2 Slug Test Results - Test #2

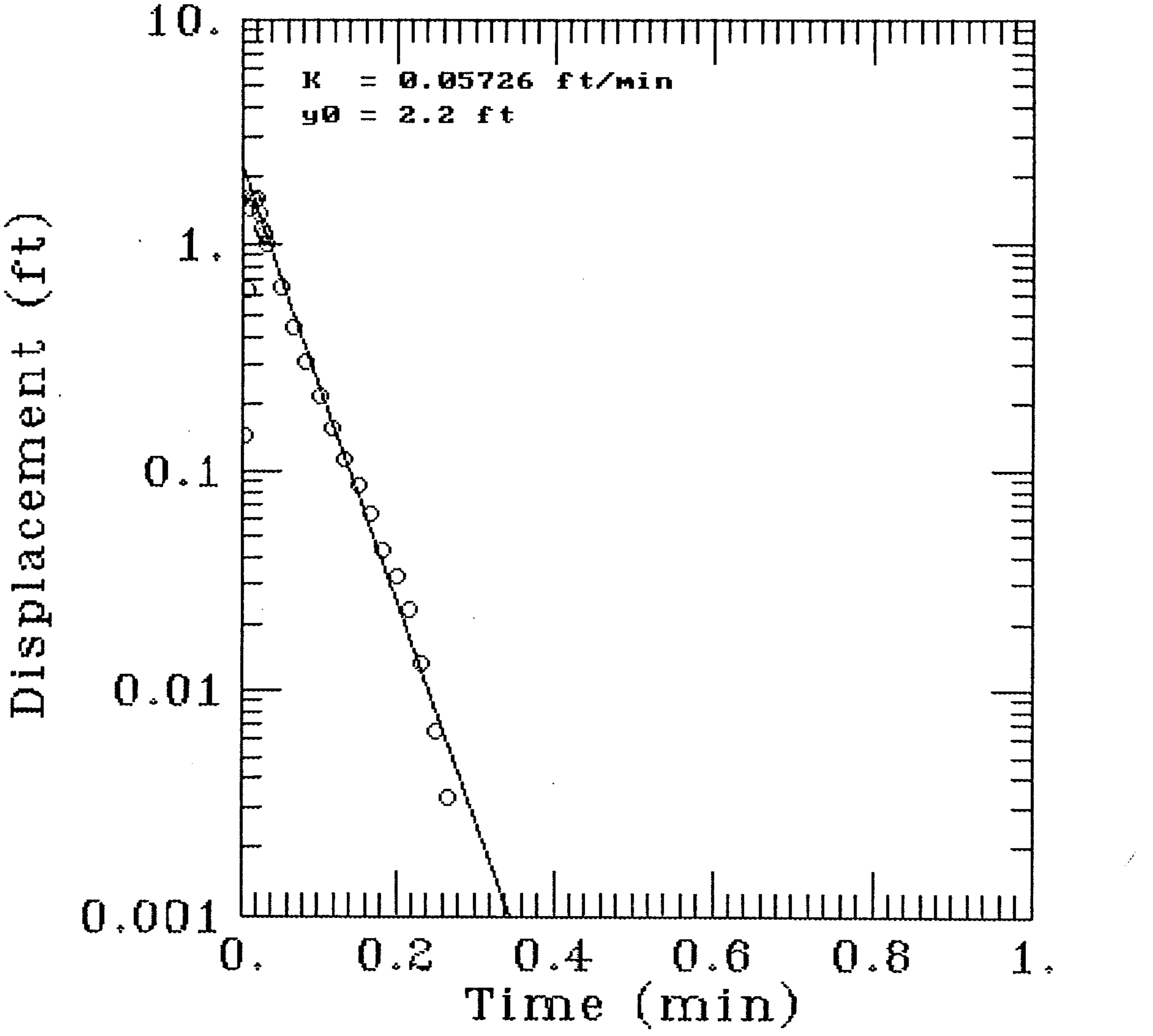


MW-3 Slug Test Results - Test #1

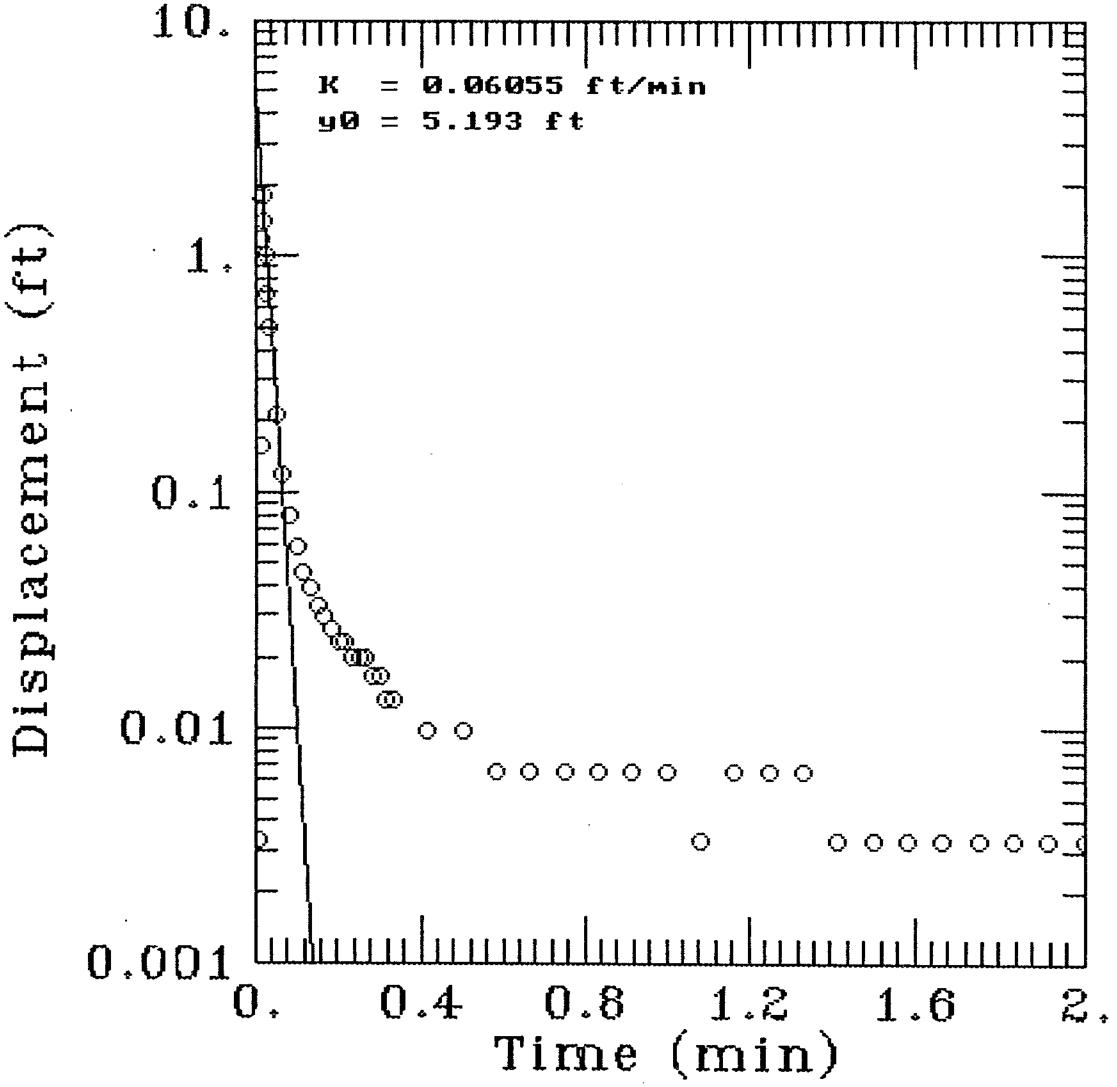


12-21-93

MW-3 Slug Test Results (Test 2)

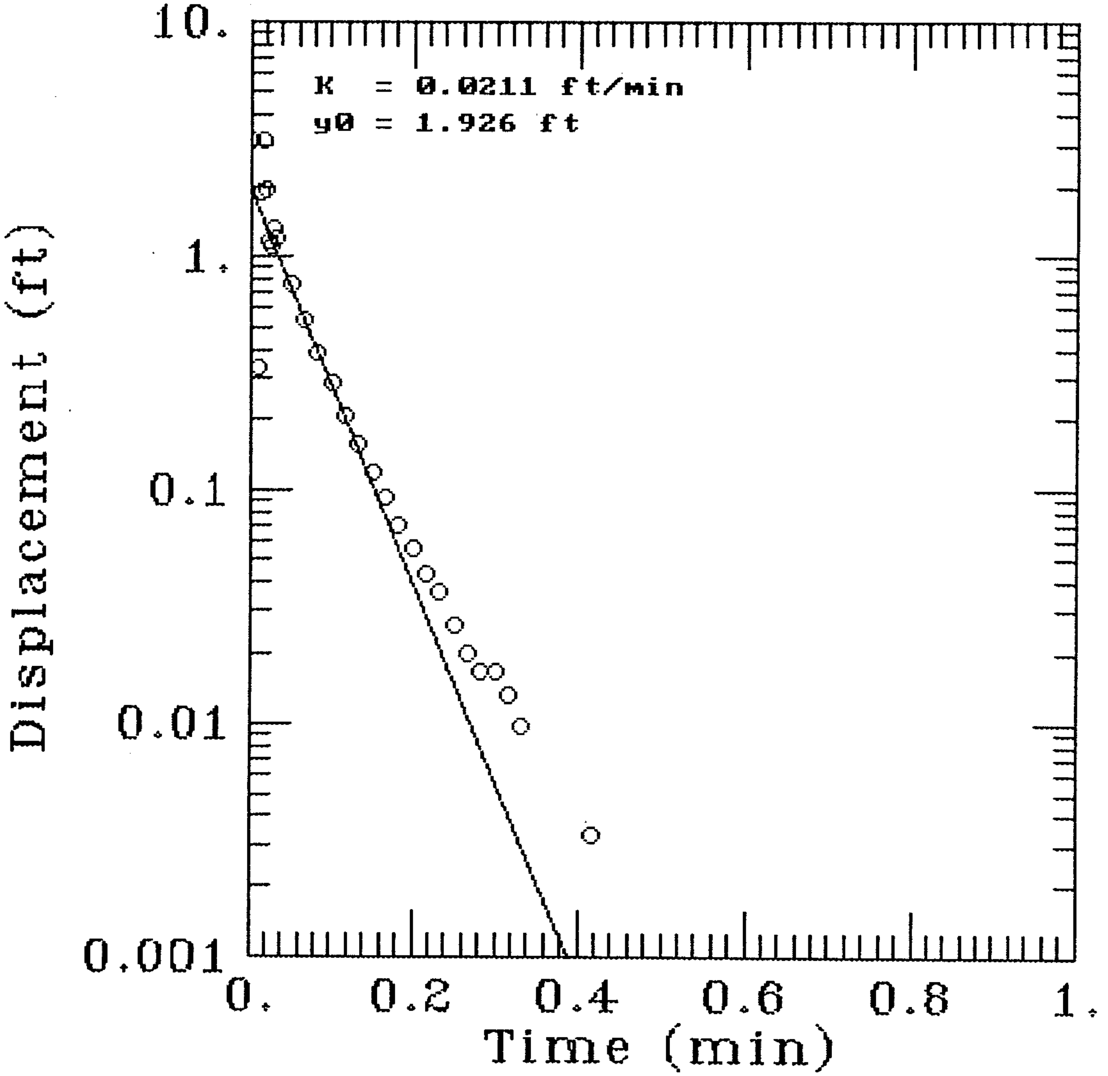


MW-4A Slug Test Results – Test #1

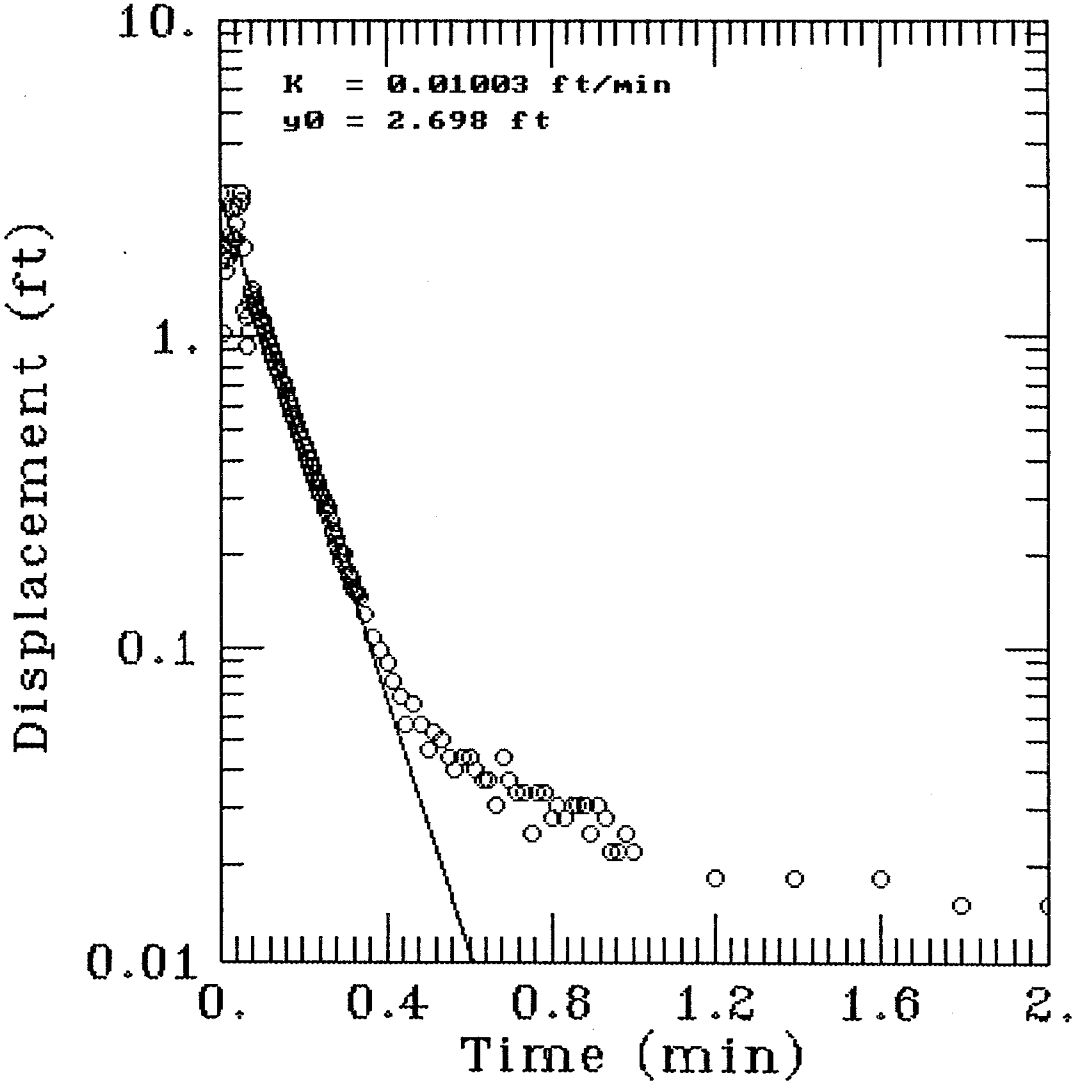


4-21-93

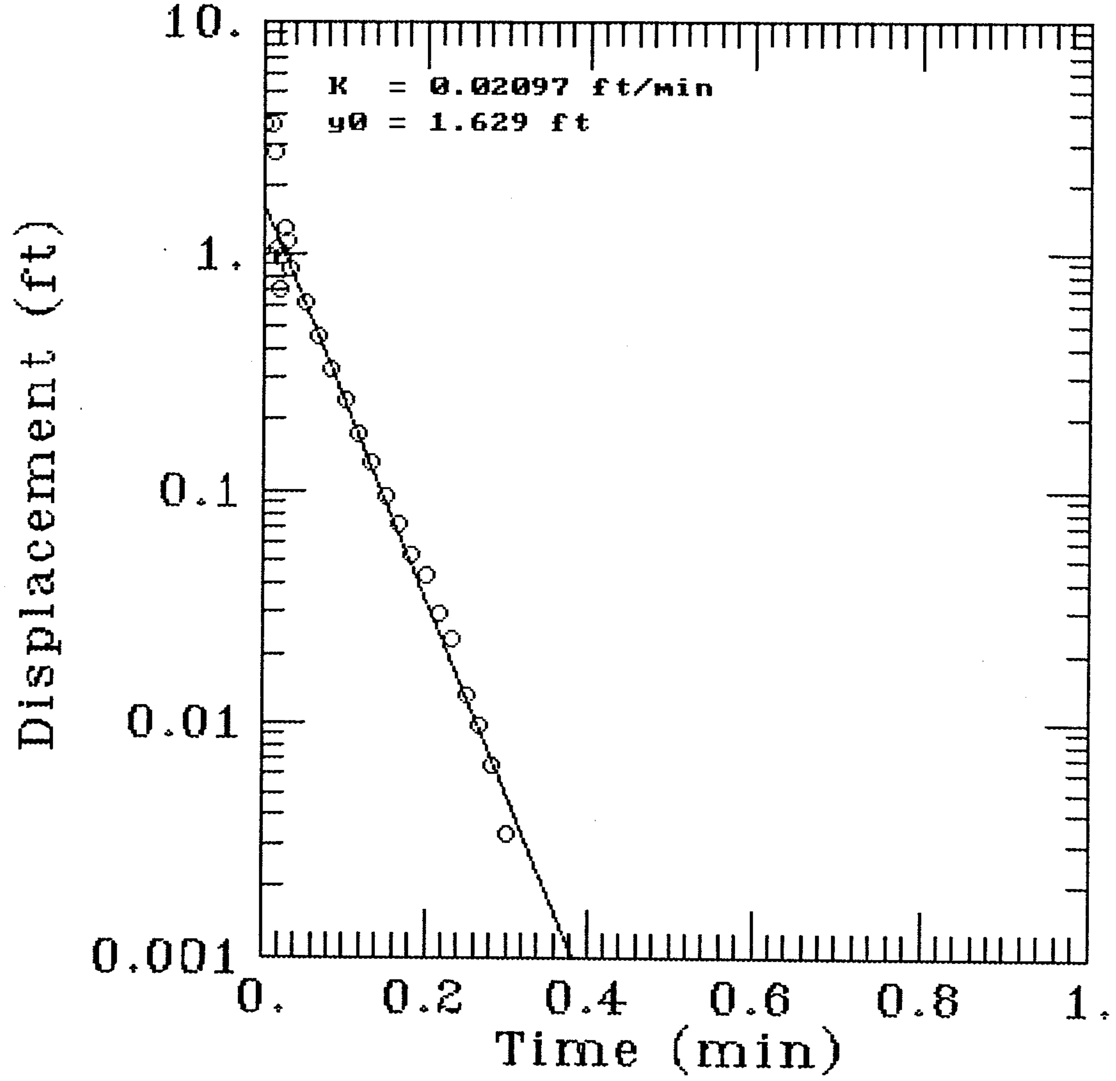
MW-5 Slug Test Results - Test #1



WP-1 Slug Test Results – Test #1



MW-5 Slug Test Results - Test #2



GRAIN SIZE ANALYSES

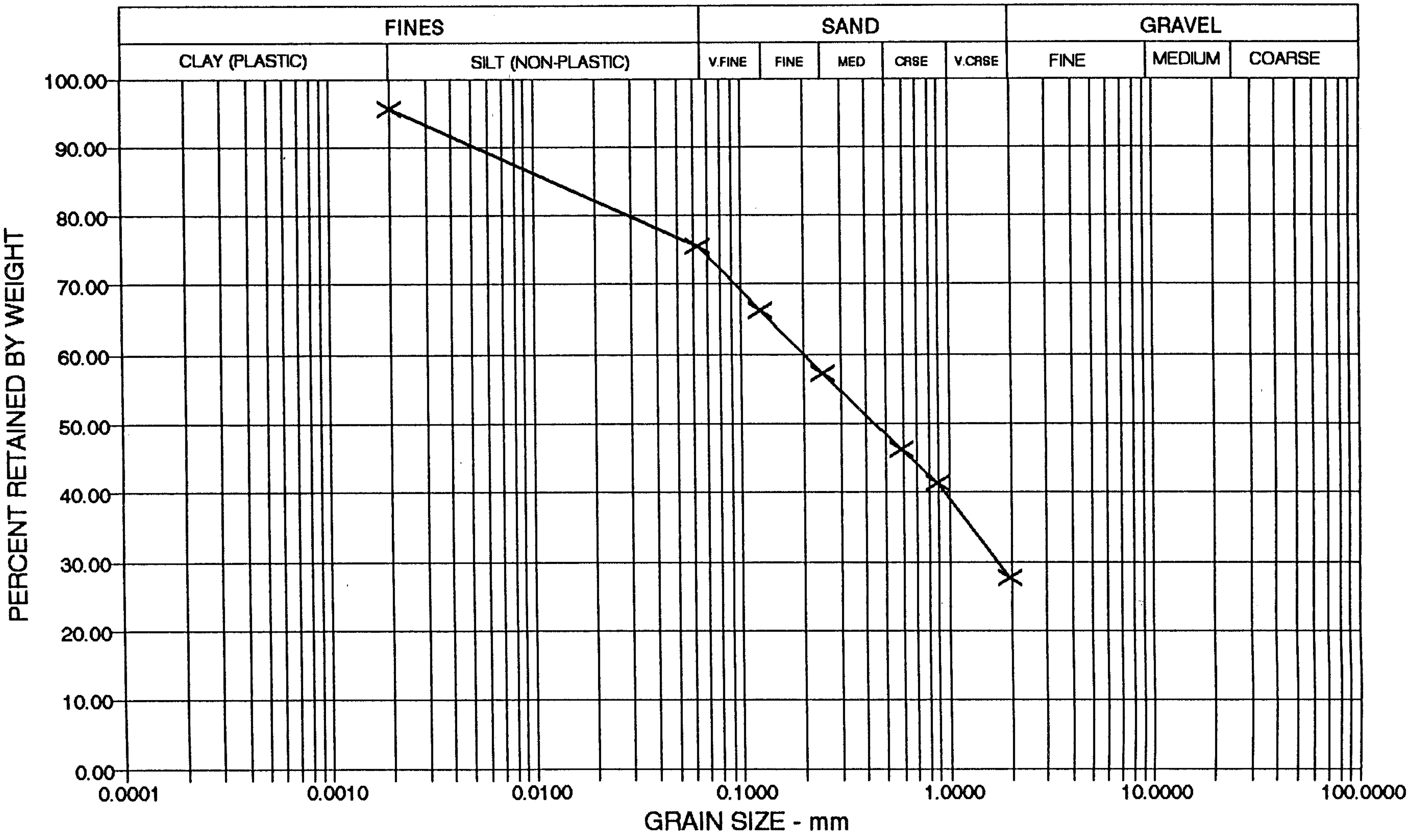
LOCATION: Everett, WA
PROJECT: Everett RI/FS - ASEV01
PROJECT ENGINEER: Bill Thompson
RESULTS RELEASED TO: Bill Thompson
DATE SAMPLES DELIVERED: 5/10/93
TEST(S) CONDUCTED: Sieve Analysis (ASTM D-421), Textural Analysis (ASTM D-422)
ANALYST(S): Erin Sexaurer, Deanna Hersey

======================================

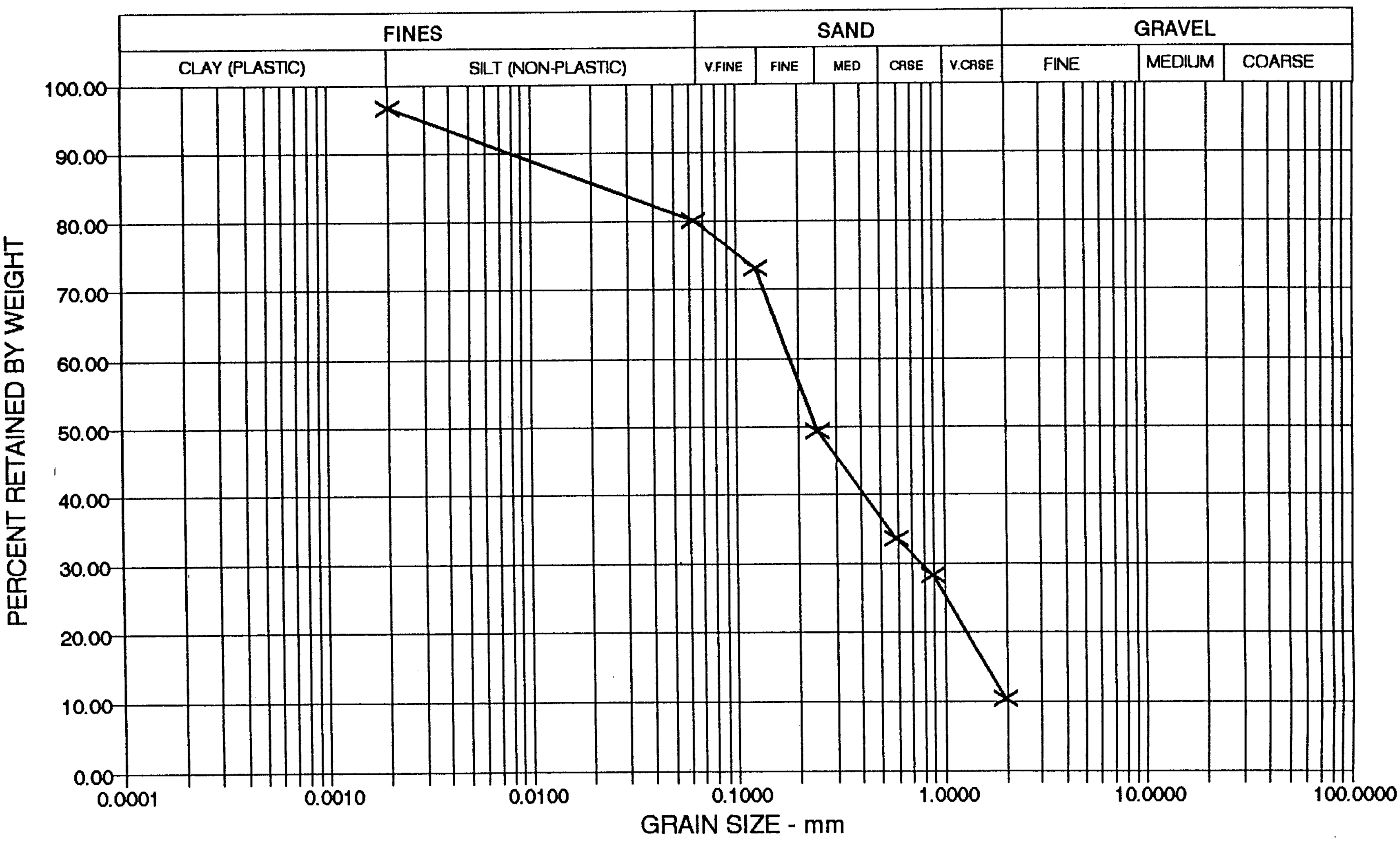
WELL NO.	SAMPLE NO.	DEPTH (ft)	UNIT	SIEVE ANALYSES - PERCENT RETAINED						HYDROMETER ANALYSES			*Textural Type
				#10	#20	#30	#60	#120	<#120	%Sand	%Silt	%Clay	
EV-1	S-7	11.5 - 13.0	TILL	27.7	13.9	4.6	11	9.2	32.1	29	62	9	SiL
EV-3	S-4	5.5 - 7.0	FILL	35	16	7.2	17.4	10.5	13.4	31	58	11	SiL
EV-3	S-8	11.5 - 13.0	TILL	27.6	15.5	6	22.8	16.6	11.2	22	65	13	SiL
EV-3	S-13	29.0 - 30.5	OUTWASH	0.8	3.4	7.2	51.7	28.7	8.5	64	35	2	SiL
EV-4B	S-5	6.0 - 7.5	FILL	14.4	20	8.4	20.2	12.6	23.7	24	61	15	SiL
EV-4B	S-10	17.0 - 19.0	MARSH	8.1	6.3	5.7	39.5	25.7	14.1	43	46	11	L
EV-4B	S-14	29.0 - 30.5	TILL	52.8	9.8	5.1	19	7	6.2	36	49	15	L
EV-4B	S-16	44.0 - 46.5	OUTWASH	0	0.8	0.8	72	19.8	6.3	52	48	0	SL
EV-5	S-3	3.0 - 4.5	FILL	28.3	11.2	10.8	28.4	10.6	10.3	32	57	12	SiL
EV-5	S-11	15.0 - 16.5	MARSH	0	3.7	10.9	14.5	13.6	56.5	19	70	11	SiL
MW-1	S-3	3.5 - 4.0	FILL	10.4	17.8	5.4	15.8	23.8	25.8	27	64	9	SiL
MW-1	S-9	12.0 - 13.5	TILL	36.7	16.8	4.7	13.5	12.1	15.7	31	60	9	SiL
MW-1	S-13	18.0 - 19.5	OUTWASH	3.5	8	3	72.7	9.1	3.4	50	31	19	L

*L = Loam
SL = Sandy Loam
SiL = Silt Loam

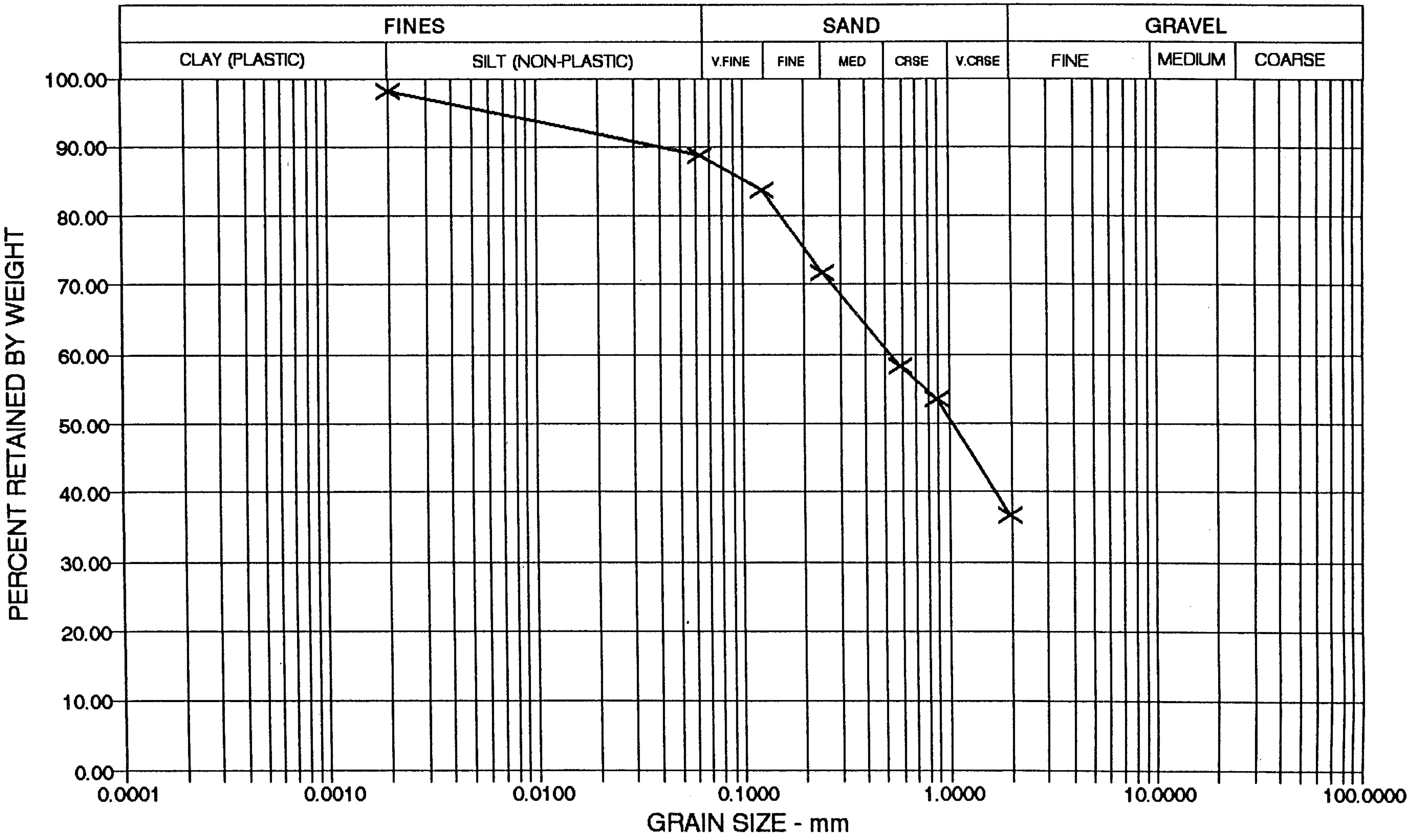
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-1 (11.5-13.0 ft)



PROJECT: ASARCO EVERETT
SAMPLE: WELL MW-1 (3-4.5 ft)



PROJECT: ASARCO EVERETT
SAMPLE: WELL MW-1 (12-13.5 ft)



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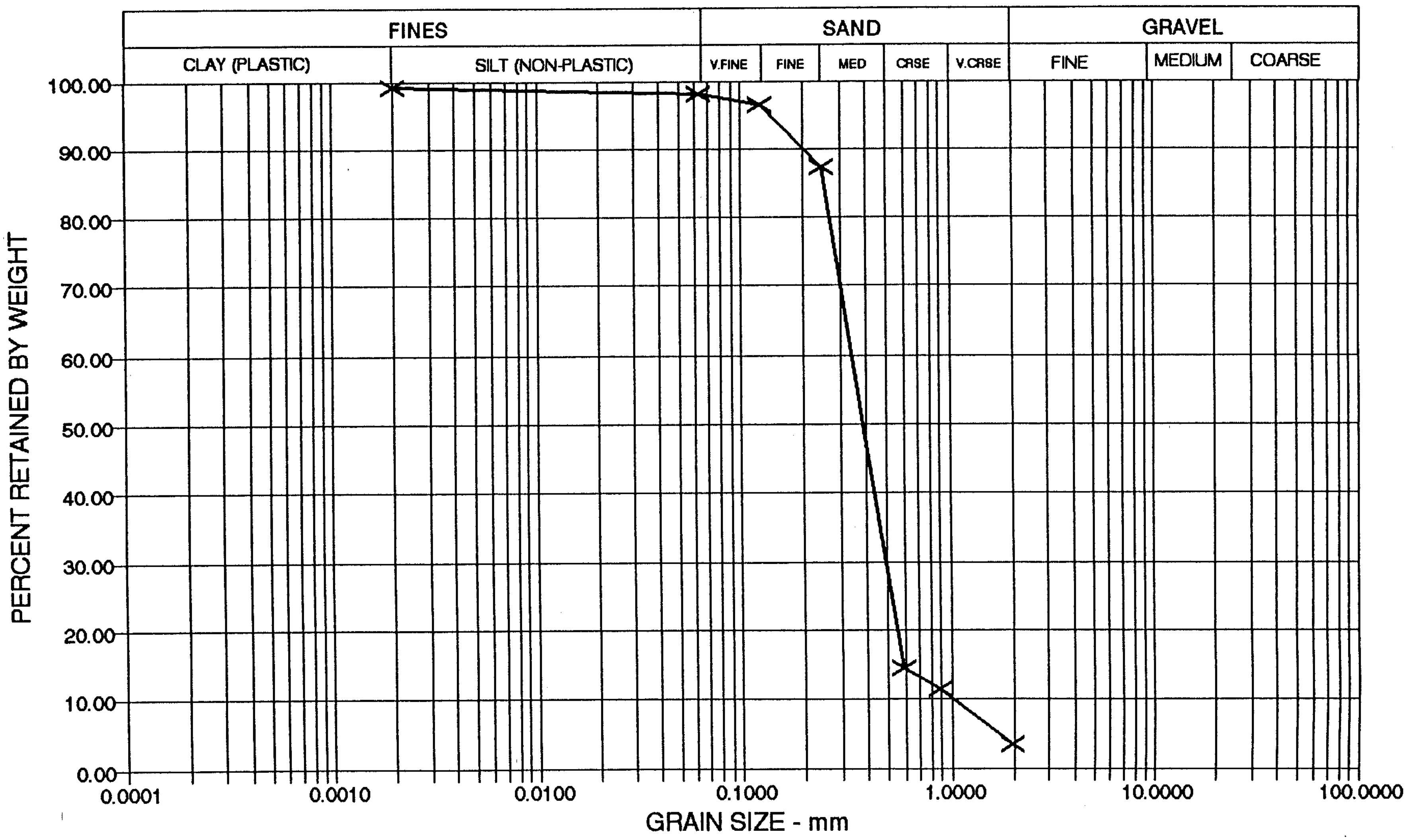
SAMPLE: WELL MW-1 (18-19.5 ft)



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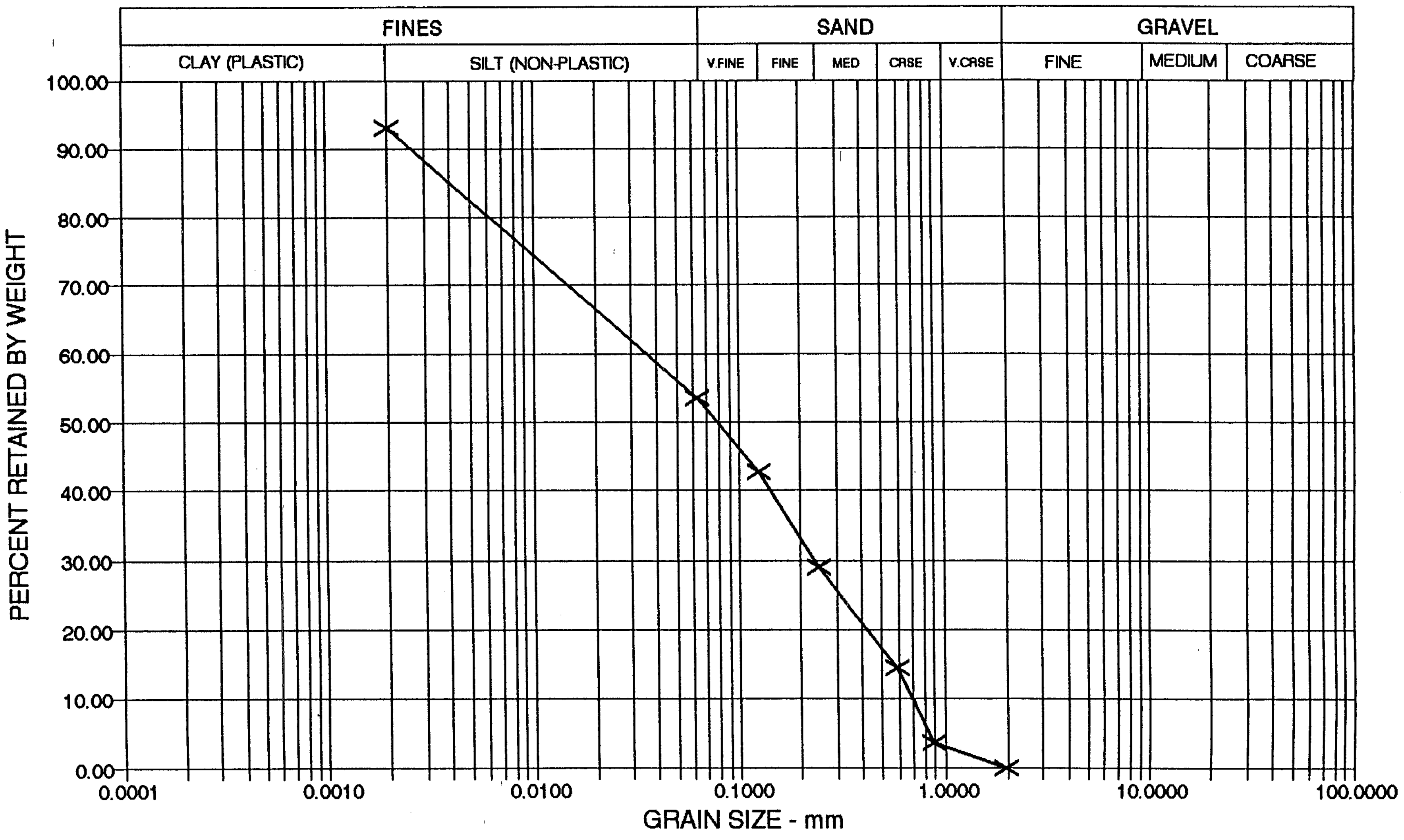
SAMPLE: WELL EV-5 (15-16.5 ft)



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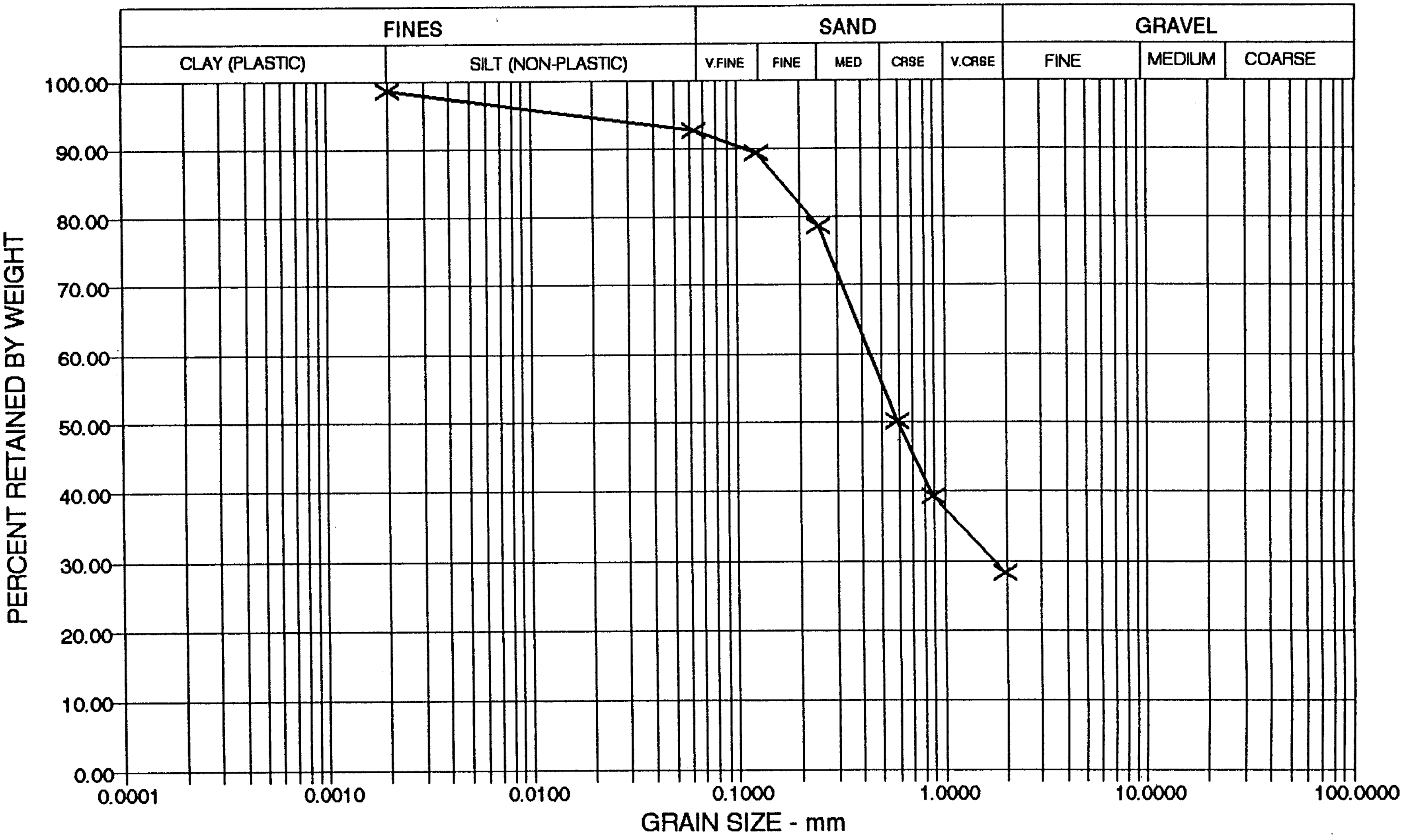
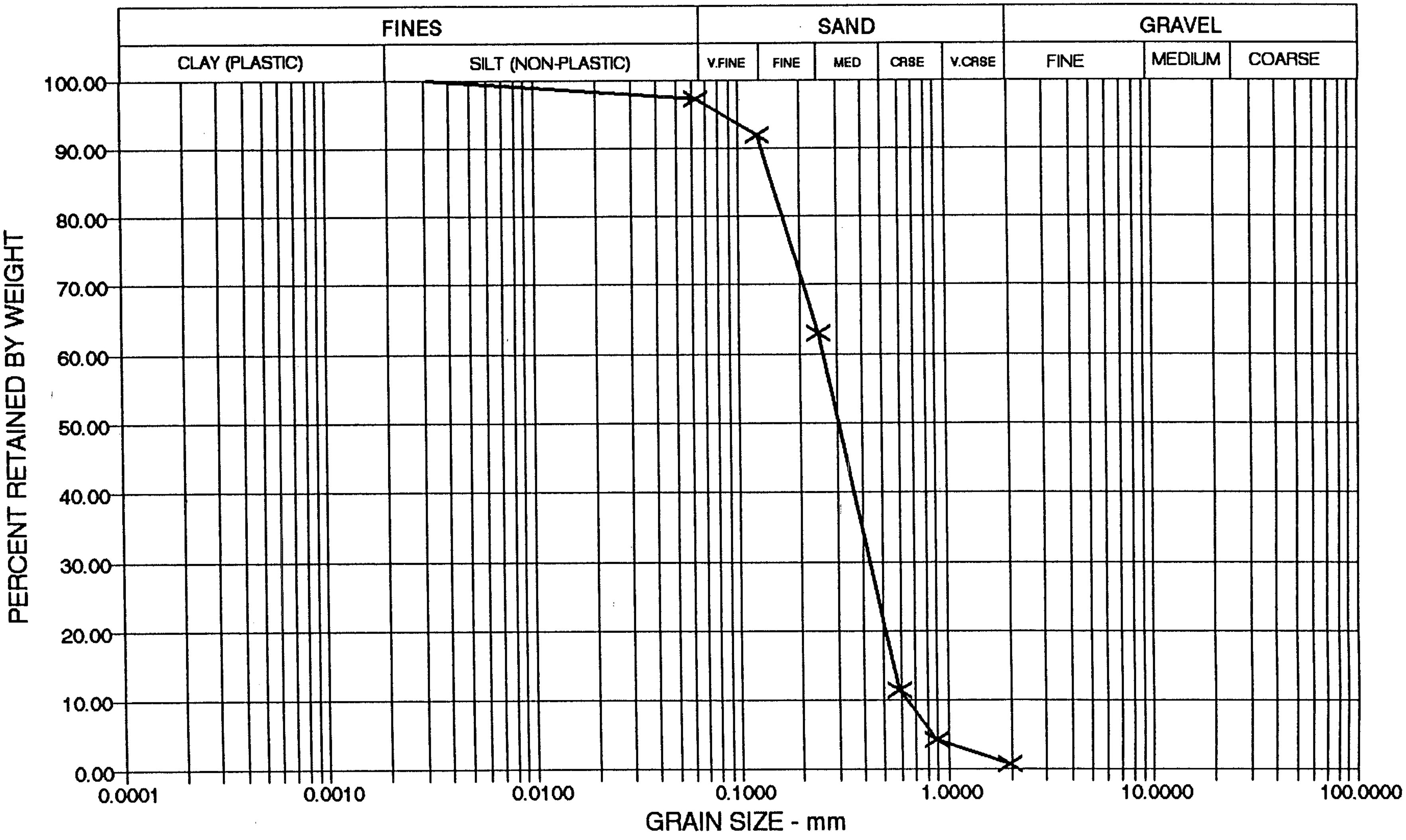
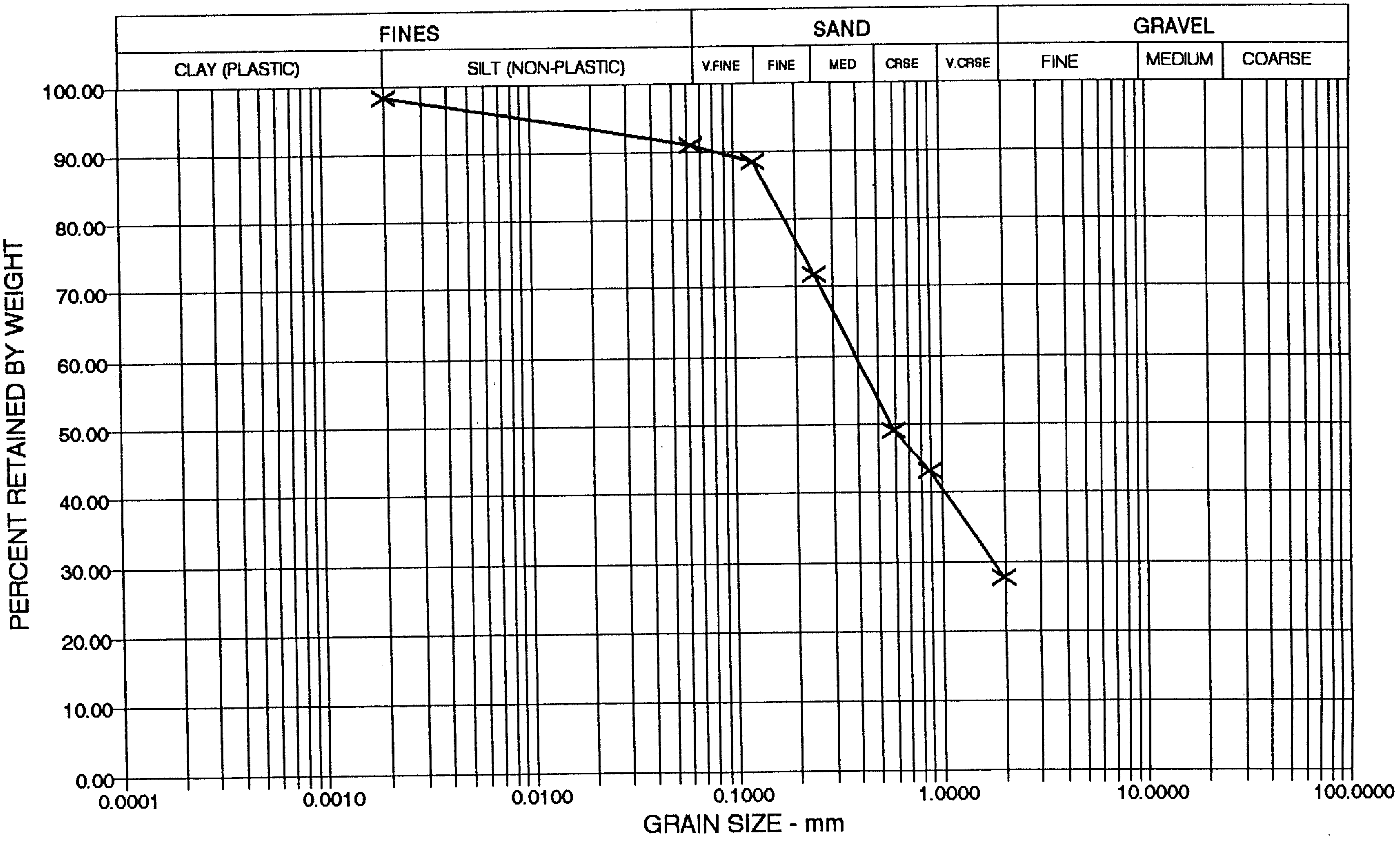
SAMPLE: WELL EV-5 (3-4.5 ft)



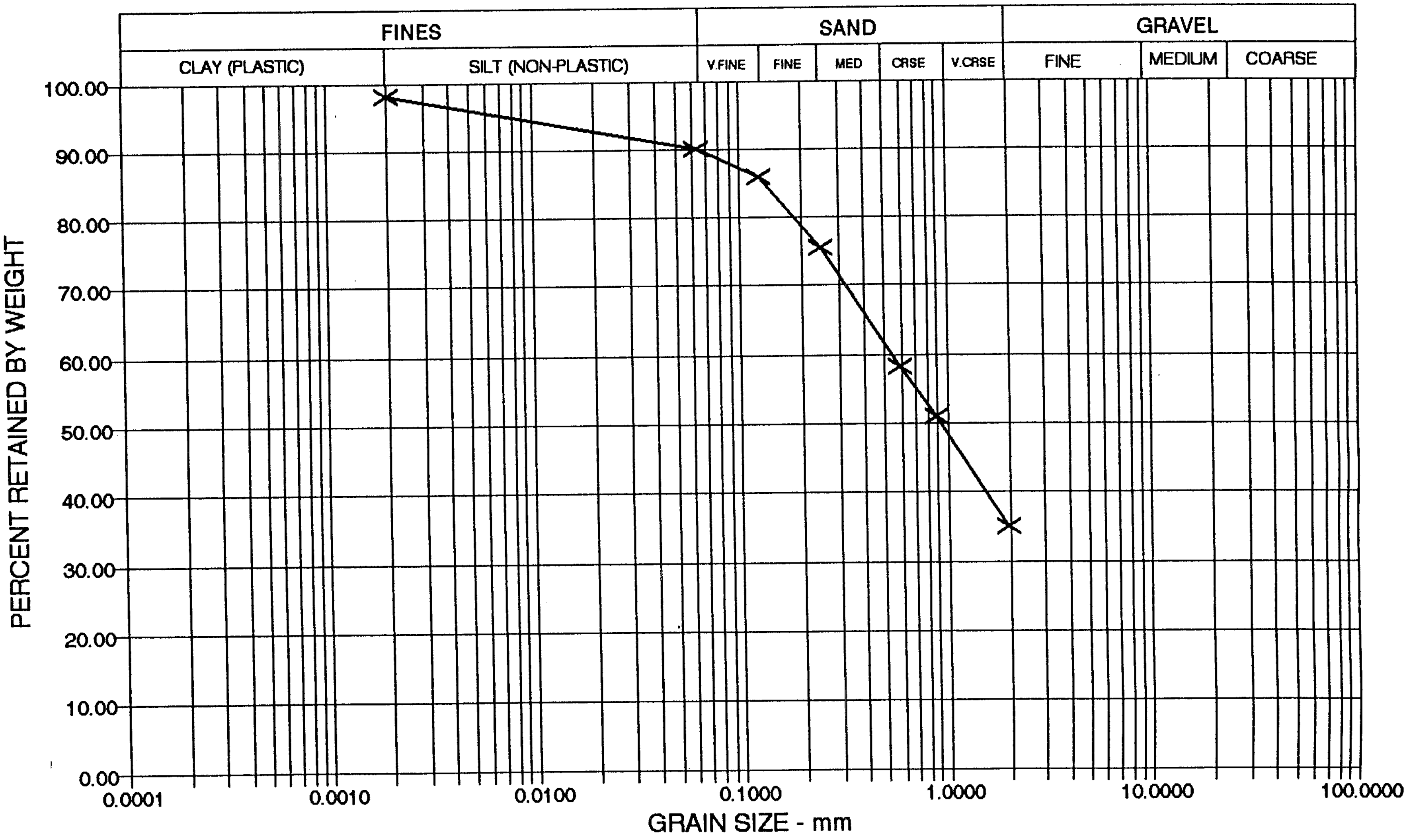
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-3 (29-30.5 ft)



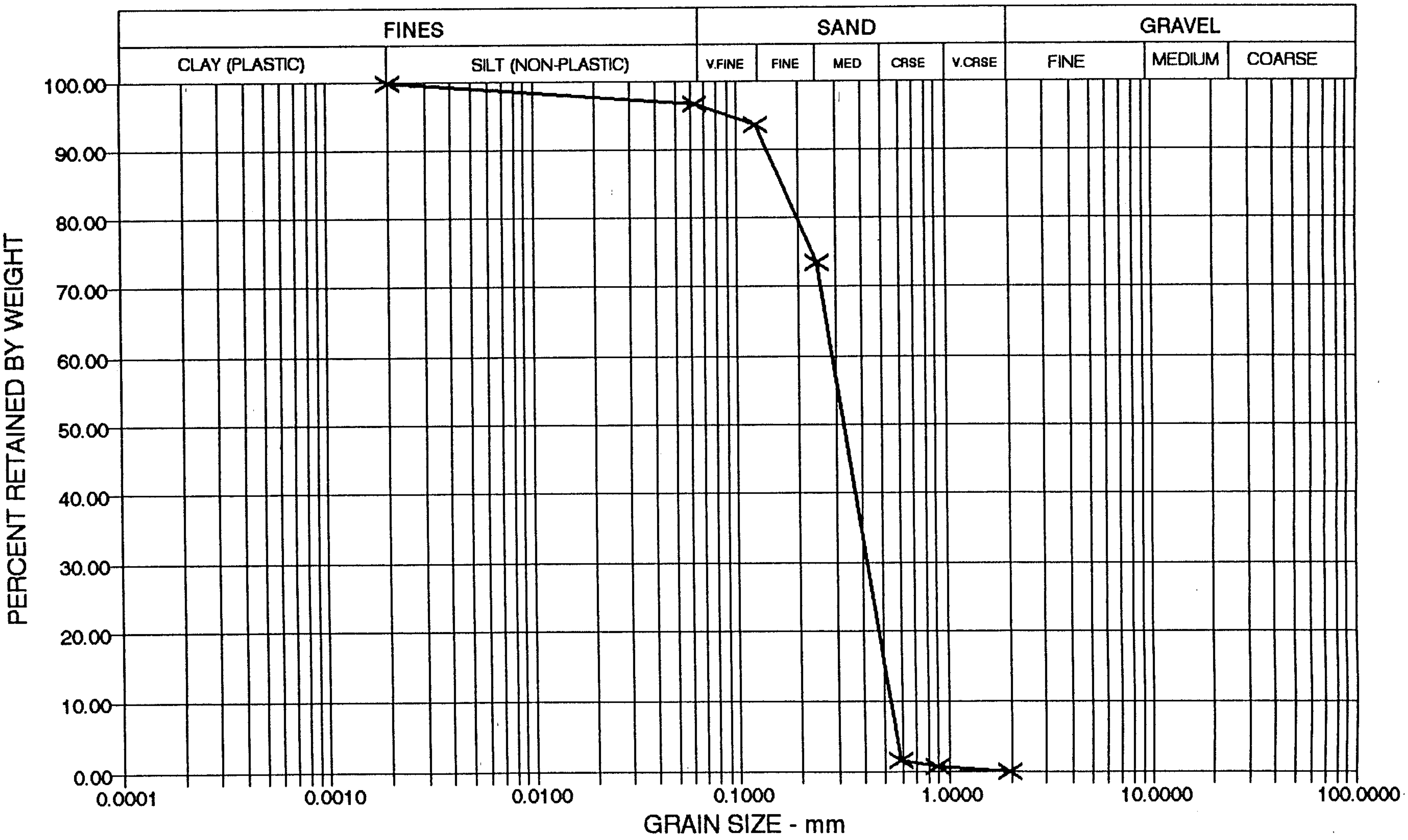
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-3 (11.5-13 ft)



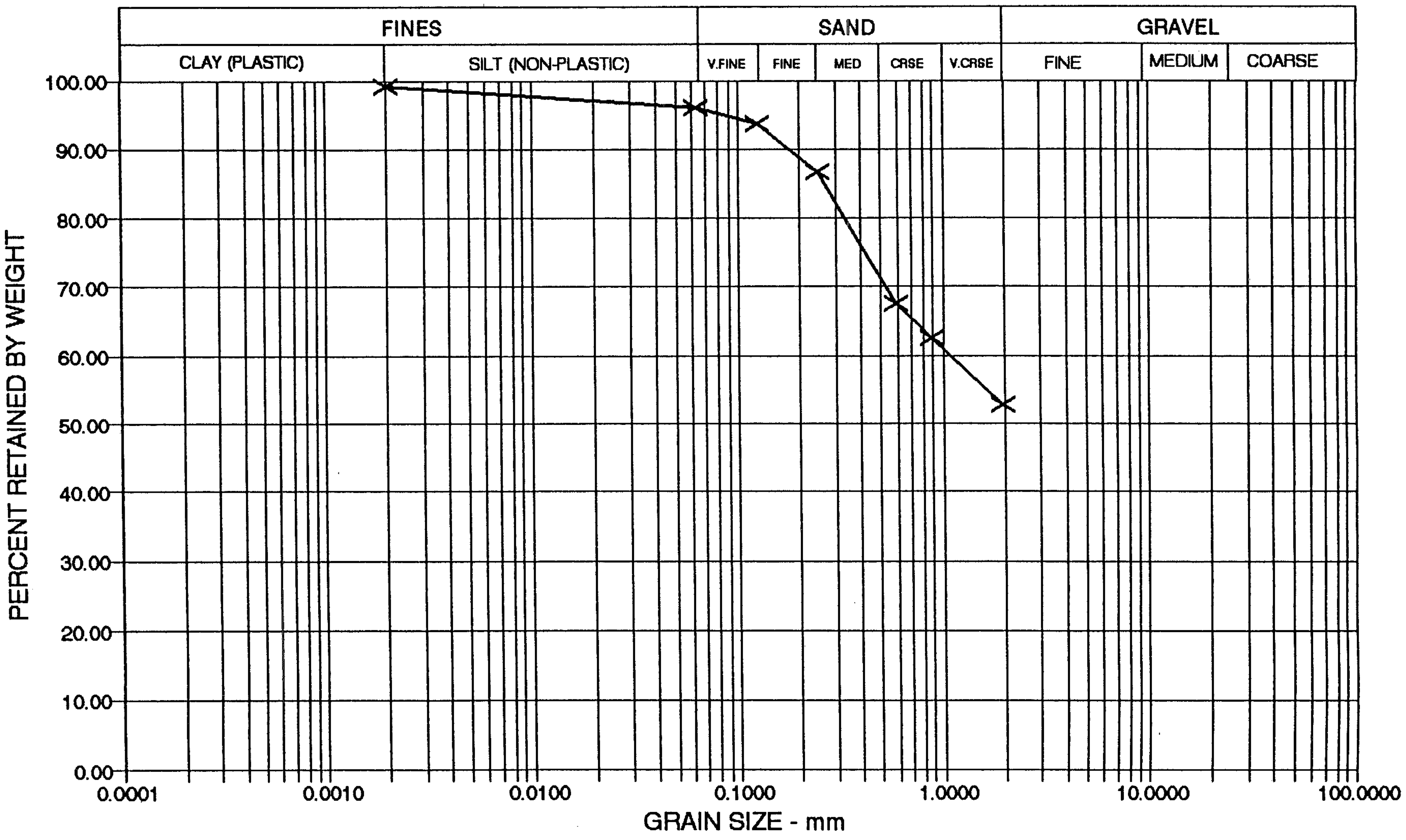
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-3 (5.5-7 ft)



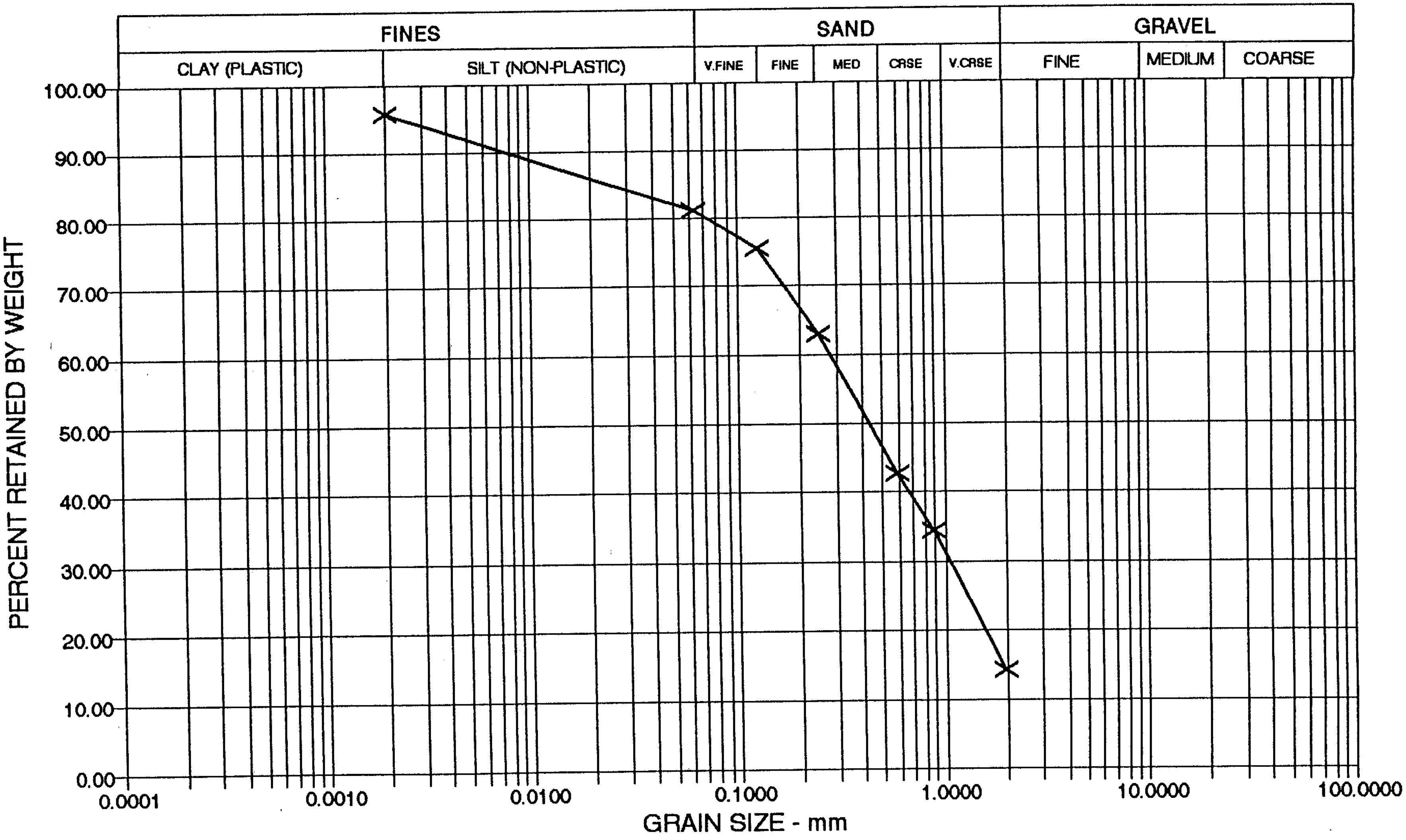
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-4B (44-45 ft)



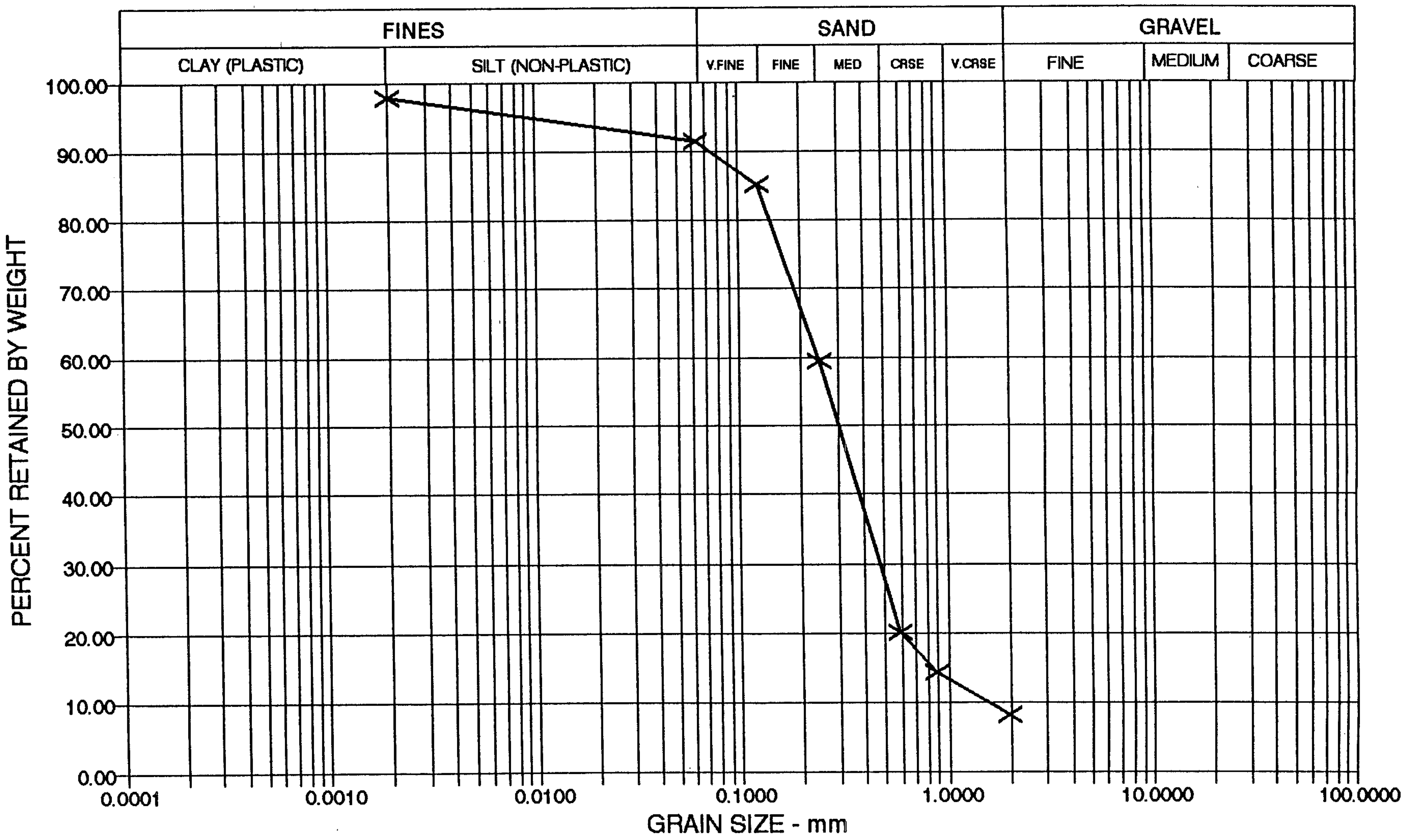
PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-4B (29-30.5 ft)



PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-4B (6-7.5 ft)



PROJECT: ASARCO EVERETT
SAMPLE: WELL EV-4B (17-19 ft)

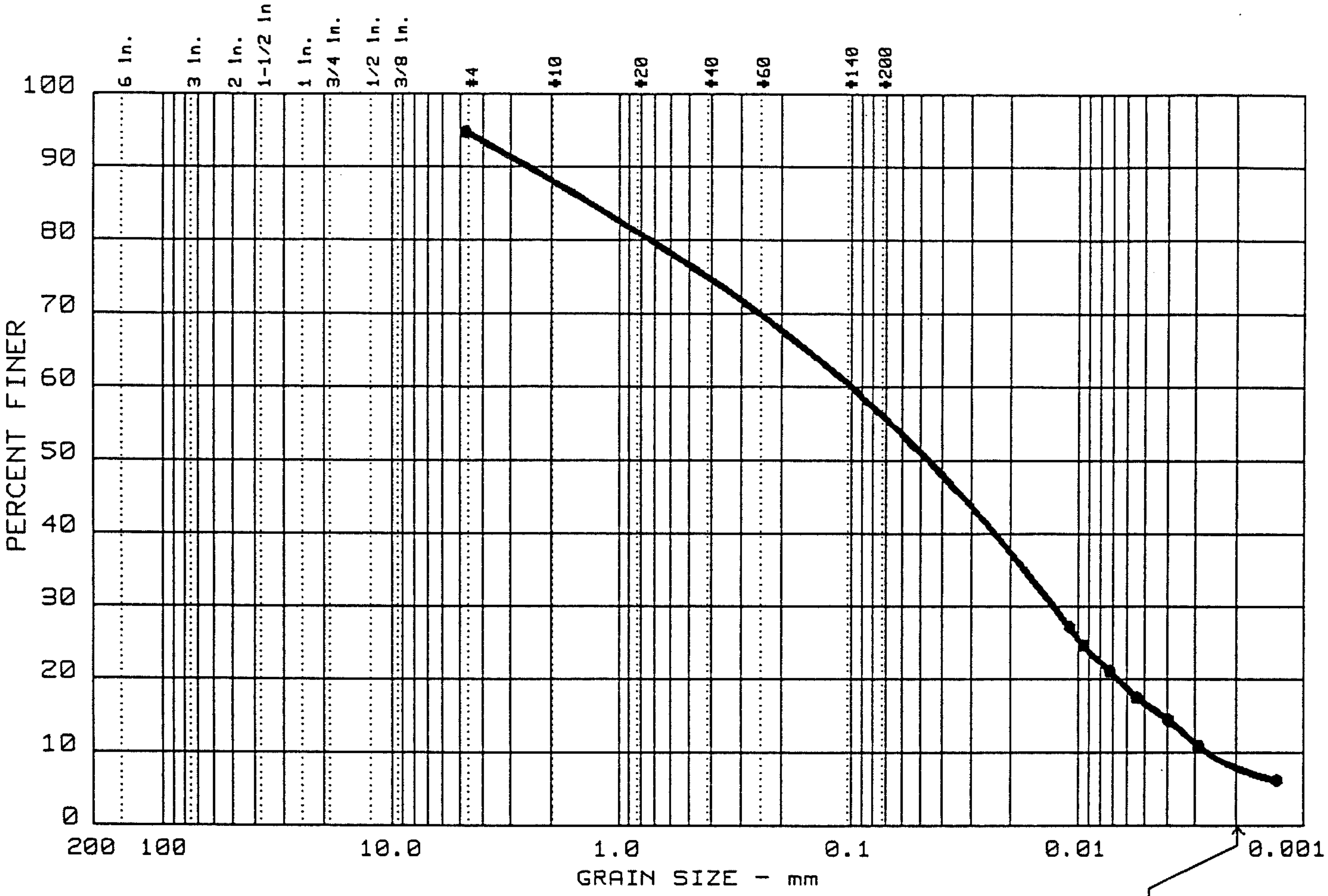


GRAINSIZE ANALYSES AND PERMEABILITY TEST RESULTS FOR TILL FROM EV-1 (SAMPLE ID .0001) AND EV-2A (SAMPLE ID .0002)

Table 1. Test Results

Sample ID	**.0001.01**	**.0002.01**
Sample Description	Grey Sandy Silt Trace Clay & Gravel	Grey Silt With Sand Some Clay
% Gravel	5.3	1.9
% Sand	38.3	32.0
% Silt	48.5	55.1
% Clay	7.9	11.0

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	19	0.0	5.3	38.3	48.5	7.9

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NA	NA	1.349	0.100	0.046	0.013	0.0042	0.0027	0.61	37.6

MATERIAL DESCRIPTION	USCS	AASHTO
● GREY SANDY SILT TRC CLAY & GRVL	ML	A-4

Certificate No.: 9503.6855 LR No.: 91042

Client: HYDROMETRICS

● Location: ASARCO / EVT01-9312-100 / 17.5-19.5'

Date: 4-20-95

Remarks:ID#.0001

ASTM D422/D854

Tested by: ML

Date: 4-20-95

Checked by: MM

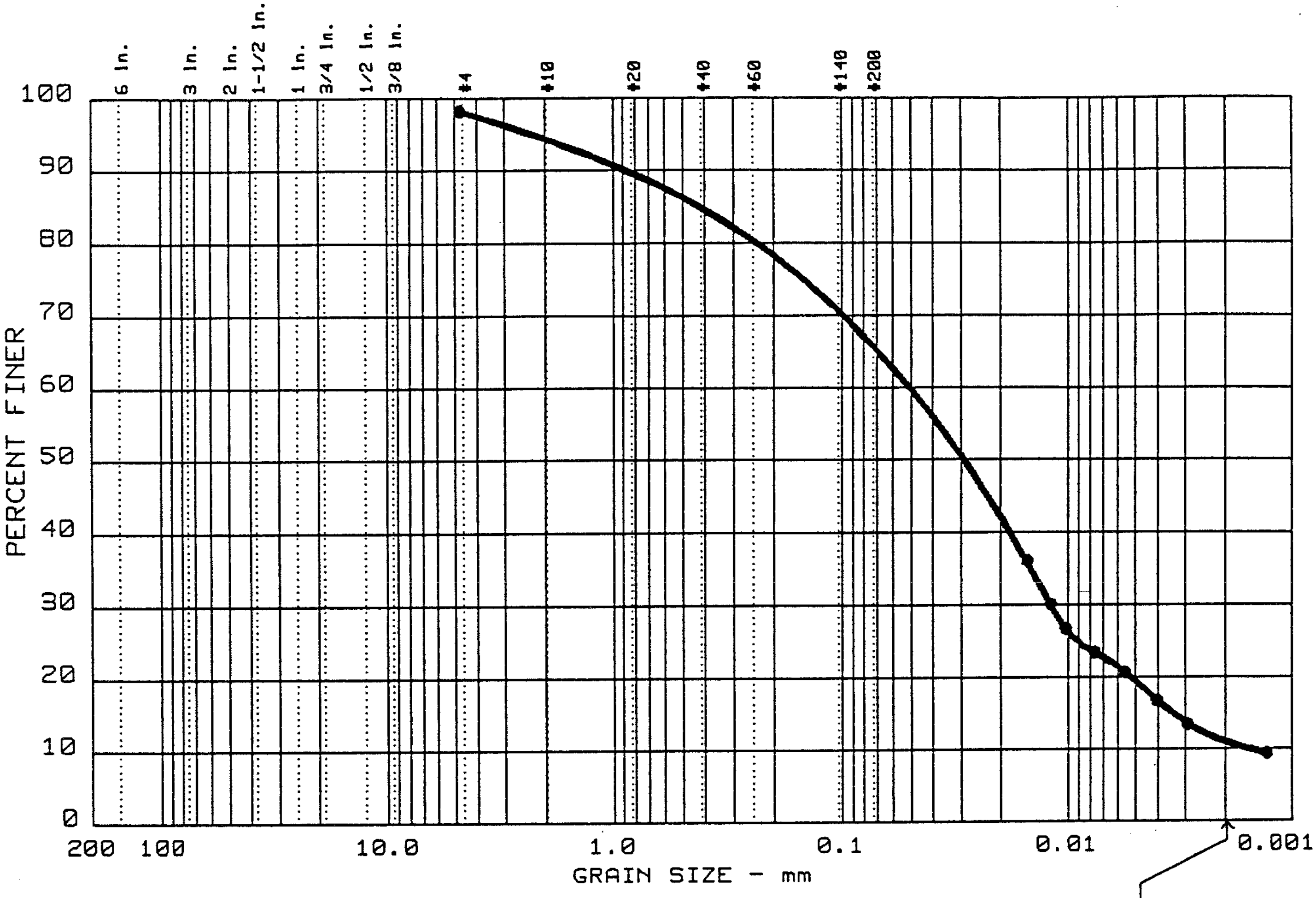
Date: 4-20-95

Fig. No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT

PACIFIC TESTING LABORATORIES

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	20	0.0	1.9	32.0	55.1	11.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NA	NA	0.427		0.029	0.012	0.0034	0.0016	1.79	32.1

MATERIAL DESCRIPTION	USCS	AASHTO
● GREY SILT W/SAND SM CLAY	ML	A-4

Certificate No.: 9503.6855 LR No.: 91042

Client: HYDROMETRICS

● Location: ASARCO / CVT 9302 - 208

Date: 4-20-95

Remarks: ID#.0002

ASTM D422/D854

Tested by: ML

Date: 4-20-95

Checked by: MM

Date: 4-20-95

Fig. No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT

PACIFIC TESTING LABORATORIES

FLEXIBLE WALL PERMEABILITY
ASTM D 5084-90

CLIENT: Hydrometrics	DATE:April 12, 1995
CERT. NO. 9503-6855	TESTED BY: M.Miller
SAMPLE I.D. No. .0001	LOCATION:Asarco 17.5' - 19.5'

SPECIMEN DATA		
	INITIAL	FINAL
HEIGHT (cm)	4.20	4.19
DIAMETER (cm)	7.25	7.23
AREA (cm^2)	41.28	41.05
MOISTURE %	8.2	9.9
DRY UNIT WT.(#/ft^3)	135.9	137.04
DEGREE OF SATURATION	98.1	124.2
SPECIFIC GRAVITY	2.66	2.66

TESTING PARAMETERS	
CONFINING PRESSURE(psi)	80
MAX. EFFECTIVE STRESS(psi)	5.5
MIN. EFFECTIVE STRESS(psi)	5
AVE. EFFECTIVE STRESS(psi)	5.25
HYDRAULIC GRADIENT RANGE	8.38
PERMEANT LIQUID	DE-AIRED WATER

Permeability (X 10^{-7} cm/sec)	Elapsed Time (sec)
1.18	10440
2.07	17580
2.07	21240
1.96	81900
2.04	AVERAGE

FLEXIBLE WALL PERMEABILITY
ASTM D 5084-90

CLIENT: Hydrometrics
CERT. NO. 9503-6855
SAMPLE I.D. No. .0002

DATE: April 12, 1995
TESTED BY: M.Miller
LOCATION: CVT 9302-208

SPECIMEN DATA

	INITIAL	FINAL
HEIGHT (cm)	3.53	3.34
DIAMETER (cm)	7.25	7.23
AREA (cm^2)	41.28	41.05
MOISTURE %	10.6	11.4
DRY UNIT WT.(#/ft^3)	125.5	133.4
DEGREE OF SATURATION	87.3	124.2
SPECIFIC GRAVITY	2.66	2.66

TESTING PARAMETERS

CONFINING PRESSURE(psi)	80
MAX. EFFECTIVE STRESS(psi)	5.5
MIN. EFFECTIVE STRESS(psi)	4.5
AVE. EFFECTIVE STRESS(psi)	5
HYDRAULIC GRADIENT RANGE	19.93
PERMEANT LIQUID	DE-AIRED WATER

Permeability (X 10^{-8} cm/sec)	Elapsed Time (sec)
9.05	78780
4.17	90780
3.17	98760
6.39	176940
5.70	AVERAGE

APPENDIX H

RISK ASSESSMENT CALCULATIONS

APPENDIX H
CALCULATION OF DOSES USED IN TABLE 5-6 AND 5-7

Table 5-6 and Table 5-7 in the text compare arsenic doses children would receive from soil assuming MTCA exposure factors with arsenic doses correlated with health effects seen in human epidemiological studies. Doses received by persons in the epidemiological study were derived using the method and exposure parameters that best fit the study population. If an average dose for the study population was estimated in the literature, that dose was used in the tables except for some adjusted values to modify adult doses to child doses (See Section 2.0). Doses for populations in Taiwan were calculated by the EPA using exposure factors that reflected the greater water ingestion rate and smaller body weight of the Taiwanese people in the study population compared with average Americans. The dose that would correspond to the EPA's Maximum Contaminant Level (the MCL) for municipal drinking water was calculated with MTCA standard exposure parameters for drinking water.

Due to the difficulty in conducting epidemiological studies, the dose calculated may correspond either to the population as a whole or the affected sub-population and may be the average over the exposure period (e.g., lifetime) or an average taken at the time the study was conducted. The subpopulation who suffered adverse health effects may have been exposed to a greater dose for the whole exposure period or for shorter periods. In general, the exposed populations for reported chronic and carcinogenic effects were exposed considerably longer than the 0 to 6 years exposure assumed by MTCA.

The methods for estimating each dose are described below. Each method is labeled with the reference number used in Table 5-6 or 5-7 and the table number.

1.0 Carcinogenic Doses

Table 5-6, 1: Drinking Water MCL:

A dose of 0.57 ug/kg/day corresponding to the drinking water MCL was calculated using MTCA exposure factors. These factors are similar to those developed by the EPA which are estimated for the upper 95th percentile of exposure for the U.S. population. If EPA standard default exposure parameters were used, the dose becomes 0.58 ug/kg/day.

$$\text{Dose} = \frac{\text{Arsenic Concentration} * \text{IR} * \text{ED}}{\text{BW} * \text{AT}}$$

Where:

Arsenic concentration in water (MCL) of 50 ug/L (Federal Drinking Water Standard)
IR: Water intake rate of 2 L/day (MTCA)
ED: Exposure Duration of 30 years (MTCA)
BW: Adult body weight of 70 kg (MTCA)
AT: Averaging time of 75 years (MTCA)

Table 5-6, 1 and 6: Taiwan Skin Cancer Study:

An arsenic dose for the three water concentration groups in the Taiwanese skin cancer study was calculated using exposure factors for the study population estimated by the U.S. EPA (1988, 1995) and Abernathy et al. (1989) for water and food.

$$\text{Dose} = [(\text{Arsenic Concentration}_{\text{Water}} * \text{Water Ingestion}) + \text{Arsenic}_{\text{Rice}}] \,/\, \text{BW}$$

Where:

Water ingestion of 3.75 L/day: Average of 4.5 L/day for males and 3.0 L/day females. These values assume direct water ingestion of 3.5 L/day and 2.0 L/day for males and females (Abernathy et al., 1989), respectively, and indirect water ingestion of 1 L/day for both males and females (i.e., food preparation).

Body weight of 52.5 kg: Average of 55 kg and 50 kg for Taiwanese males and females, respectively (U.S. EPA, 1988, Abernathy et al., 1989).

Average arsenic concentration in well water for dose groups used to calculate U.S. EPA slope factor (U.S. EPA, 1988):
Low = 170 ug/L
Medium = 470 ug/L
High = 800 ug/L

Arsenic in rice of 2 ug/day (U.S. EPA, 1995).

Table 5-6, 2 through 5: No Skin Cancers in Fairbanks, AK; Fallon, NV; and Millard County, UT.

A dose for arsenic intake in three epidemiological studies (Harrington et al., 1987; Vig et al., 1984; Southwick et al., 1983) was estimated by Valberg et al. based on a 2 L/day water consumption rate and 70 kg body weight.

Table 5-6, 7. Bladder Cancer Threshold In Taiwan:

The arsenic dose for the bladder cancer threshold study (Guo et al, 1995) among Taiwanese people was calculated from the highest water concentration group using average exposure factors for the study population estimated by the U.S. EPA (1989, 1995) for water and food.

$$\text{Dose} = [(\text{Arsenic Concentration}_{\text{Water}} * \text{Water Ingestion}) + \text{Arsenic}_{\text{Rice}}] \,/\, \text{BW}$$

Where:
Water ingestion: 3.75 L/day
Body weight: 52.5 kg

- Arsenic concentration in water: 640 ug/L (Guo et al., 1995)
- Daily ingestion of arsenic in rice: 2 ug/day (U.S. EPA, 1995)

2.0 Noncarcinogenic Doses

Table 5-7, 1 and 2: NOAEL

The U.S. EPA derived a no-observable-adverse-effects-level (NOAEL) and a lowest-observable-adverse-effects-level (LOAEL) of 0.8 and 14 ug/kg/day, respectively, from Tseng's (1968) Taiwan study (U.S. EPA, 1995; ATSDR, 1993). Both doses were derived using a concentration of arsenic in water and exposure parameters estimated for the exposed adult Taiwanese population of 4.5 L water per day, 55 kg body weight (Abernathy et al., 1989), and an estimation of amount of arsenic in food (2 ug/day). The concentration of arsenic used for the LOAEL was the average concentration for the lowest dose group for which dermal effects were observed (170 ug/L) and the arithmetic mean (9 ug/L) of the range of arsenic concentrations (1 to 17 ug/L) observed in the control group (Tseng, 1977).

The NOAEL and LOAEL were then adjusted to more accurately represent a dose in a child to make it more comparable to the MTCA child doses in Table 5-7. This was done by assuming that the same relationship between the U.S. between adult and children's body weight and water consumption rates exists in Taiwan. In the U.S., a child is assumed to weight 16 kg and drink 1 L/day of water (MTCA), whereas an adult weighs 70 kg and drinks 2 L/day (MTCA, U.S. EPA, 1991). Therefore, the NOAEL and LOAEL calculated by U.S. EPA were adjusted by a factor of (70 kg/16 kg * 1 L per day/2L per day) = 2.19.

Table 5-7, 3 through 7: Doses Derived by ASTDR

4. ATSDR (1993) derived the lowest doses received that led to hypo- and hyperpigmentation, hyperkeratosis, but did not explain the method used. The doses of 100 ug/kg/day were based on epidemiological studies of children of Antofagasta, Chile, by Borgono (1980).

5. ATSDR (1993) calculated the lowest doses received that led to Raynaud's disease, and thrombosis, but did not describe the method used. The doses of 170 ug/kg/day were based on epidemiological studies of children and adults of Antofagasta, Chile, by Zaldivar (1974).

6,7. ATSDR (1993) reports a dose of 60 ug/kg/day for a Chilean population, which led to an increase in nausea, vomiting, hyperkeratosis, and Raynaud's disease. ATSDR did not explain the methods used to derive this dose from the arsenic concentration in water. This dose was based on a study of adults and children by Zaldivar and Guillier (1977; Zaldivar, 1977).

Because the Chilean populations studied contained all or a large percentage of children, the doses were not adjusted to include a difference between adult doses and child doses as was done for the Taiwanese data and the New York study reported below.

Table 5-7, 8: Granite Falls, Washington

Two average drinking water concentrations from Granite Falls (7,000 ug/L and 25,000 ug/L) were used in the MTCA drinking water equation to calculate child dose for two exposed groups. The drinking water concentration was multiplied by 1 L/day water intake rate and divided by 16 kg body weight.

Table 5-7, 9: New York

ATSDR (1993) calculated a dose of 290 ug/kg/day received by an adult couple over a one to two month period from their drinking water concentration. The method of dose calculation is not explained. The dose derived by ATSDR was adjusted to a child's dose by multiplying the dose by 2.19 (see Table 5-7, 1 through 2, above).

APPENDIX I

DATA VALIDATION REPORTS

See
hard copy
retained in
Ecology Files

APPENDIX J

RISK ASSESSMENT ADDENDUM

RISK ASSESSMENT ADDENDUM

The purpose of this addendum to the risk assessment (Chapter 5) is to evaluate the degree of health-protectiveness of various soil concentrations associated with possible remedial (engineering) actions (WAC 173-340-360(5)(d)(vi)). As specified by the MTCA regulation, the evaluation incorporates recent scientific information on chemical toxicity (WAC 173-340-702(6)), along with consideration of site-specific conditions (WAC 173-340-350(6)(e)). This information supplements the feasibility study which assesses remedial action alternatives after consideration of all factors including health risks (WDOE, 1993a; WAC 173-340-360). Depending on the cleanup actions selected, soil concentrations after remediation may differ from MTCA cleanup levels. Ecology (WDOE, 1993b) defines these alternative (to cleanup levels) soil concentrations as:

> *...the range of concentrations for which a particular remedial technology will take place. For example, e.g., "excavation action level(s)" would delineate those areas where excavation of soil would take place, "capping level(s)" would describe those soils which would be capped, etc. Sites could have multiple "action levels"; e.g., one for excavation and landfilling, one for excavation and treatment, and one for groundwater. These concentrations must be established IN ADDITION to cleanup levels.*

Because cleanup levels may be exceeded depending on the remediation technologies used, additional health-protective remedies such as educational programs and institutional controls can be implemented after remediation is complete. Activities associated with both the cleanup levels and other soil levels for various remedial actions comprise a site-specific cleanup program that is protective of health and will allow "closure" of a site. Decisions on appropriate remedial actions and associated soil concentrations for this site are a separate process from this addendum.

This assessment of health-protectiveness supplements Chapter 5 of the Remedial Investigation (RI) report using recent scientific data and the latest federal guidelines for assessing health risk. Health risks were quantified in Chapter 5 according to the MTCA Method B cleanup level soil ingestion equation. The equation for soil ingestion is a conservative, simplified, adaptation from the U.S. EPA guidance. Method B equations are part of a regulatory policy for developing cleanup levels at which "a particular hazardous substance does not threaten human health or the environment" (WDOE, 1993b). These equations are not intended to provide estimates of health risks. This addendum also addresses other relevant pathways for the site (not covered by MTCA) and uses the more detailed equations from U.S. EPA guidance (e.g., including child and adult exposure) to estimate health risks over a range of potential soil concentrations. The focus is on assessing risks associated with chronic (continuous) exposure through ingesting soil, eating home-grown vegetables, and inhaling airborne dust; as well as short-term exposures for children encountering surface water runoff.

Accordingly, the following sections (1) discuss relevant exposure pathways, (2) present toxicological information on the chemicals of concern including a review of available health studies, (3) explain the risk calculations, (4) calculate potential health risks by pathway, (5) review site-specific conditions affecting exposure and risk, and (6) analyze the degree of health-protectiveness obtained at different soil concentrations. The final section of this addendum discusses the uncertainties involved in the calculation of health risks presented in Chapter 5 and in the calculations and analysis presented here.

1.0 EXPOSURE ASSESSMENT

This section identifies the populations potentially exposed to chemicals in community soil or surface water and evaluates the means by which exposure occurs. The exposed populations and pathways evaluated in this addendum are those related to residential land use as identified in the MTCA risk assessment (see Section 5.2.2 of RI). Nevertheless, the MTCA regulation does not address all pathways which might be possible at this site. The MTCA regulation specifies equations for calculating soil cleanup levels based on soil ingestion, groundwater cleanup levels based on drinking water, and surface water cleanup levels based on eating fish/shellfish. Of these three potential exposure sources, soil ingestion is the primary pathway in the residential area and thus the MTCA risk assessment addressed soil cleanup levels based on children ingesting soil. At this time no conclusions can be drawn as to chemical concentrations in groundwater. Further monitoring is being conducted at this time. According to the RI, surface water runoff in the residential area will not support fish or shellfish and does not flow to water bodies with fish. In addition to soil ingestion, other potential exposure pathways (see Section 5.2.2 of the RI) that are not included in the MTCA regulation are presented below and are evaluated quantitatively in Section 3.0 of this addendum.

Ingestion of Soil and House Dust: Ingestion of soil (which may include slag or similar debris) or house dust is a primary route of exposure to chemicals in soil. Soil ingestion is evaluated in the MTCA risk assessment according to MTCA formulas. Health risk estimates are calculated in this addendum using the less simplified U.S. EPA equations which include long-term exposure to both children and adults.

Ingestion of Garden Produce: Although not included in MTCA, ingestion of home-grown vegetables that take up chemicals in soil may present an additional exposure source for residents. Exposure via this pathway is of particular relevance for some chemicals such as cadmium which have been reported to be taken up in crops to a greater extent than other metals (U.S. EPA, 1981).

Airborne Dust Inhalation: Exposure to chemicals in soil may also occur by inhalation of dust resuspended by wind, traffic, or other activity which may push dust into the breathing zone. Although the MTCA regulation specifies an equation for calculating cleanup levels for chemicals in air, no measured air concentrations exist to relate to soil concentrations in the residential area. Airborne dust inhalation is therefore addressed using U.S. EPA models to estimate soil concentrations that would be protective of inhalation exposure to resuspended dust.

Ingestion of Onsite Surface Water: The surface water sources currently associated with the site are runoff and puddles from precipitation. Chemical data on surface water runoff are available from three separate rain events. The adjacent Snohomish River is not part of the area evaluated in this risk assessment (see discussion in beginning of Chapter 5 of the RI). Possible surface water exposures may occur after a heavy rainfall when puddles of water may form on the site, thereby serving as a source of exposure for young children playing in puddles. Such exposures would be short-term (acute) and therefore inappropriate to evaluate with the available MTCA equations for drinking water. Potential health risks from short-term surface water ingestion by children playing in puddles (the most sensitive subpopulation) were therefore assessed semi-quantitatively using the available toxicological data for acute exposures to metals.

Dermal Contact with Soil: Dermal contact with soil can be a complete pathway for children playing in dirt or mud, adults working in the garden or digging holes, or construction workers who excavate soil. Dermal absorption can contribute to systemic levels of some chemicals; however, this exposure route is generally not a concern for most metals. Ionic compounds such as metals generally do not cross the skin as readily as fat-soluble compounds which dissolve into the layers of skin (U.S. EPA, 1992a). For most metals, the amount of dermal exposure is therefore small compared to the amount ingested.

MTCA does not have cleanup calculations for dermal contact. Currently, the available scientific data are sufficient to derive skin absorption coefficients for only cadmium chloride. This form of cadmium differs from the less soluble (i.e., less easily absorbed through the skin) form of cadmium chloride present at the site. Therefore, a quantitative evaluation of cadmium by the dermal route has not been included in this addendum.

The lack of specific inclusion of the dermal pathway for the other metals and arsenic is not expected to underestimate risk appreciably. Absorption by the dermal pathway is likely accounted for by the conservative assumptions used in the soil ingestion pathway. Other studies have shown that the dermal absorption of arsenic and lead do not add significantly to site risks. The arsenic risk by the dermal pathway was found to be minor compared to the risk by the soil ingestion pathway for the residential area near the Tacoma Smelter site (Glass and SAIC, 1992). A recent study found dermal absorption of arsenic to be low and absorption could be prevented by hand washing (Wester et al., 1993). Similarly, EPA risk assessments of lead have not found actual exposure to be underestimated relative to blood lead measurements in children when dermal exposure is not included (e.g., U.S. EPA, 1994).

2.0 TOXICITY ASSESSMENT

Definitions of the two basic types of toxicity criteria (slope factors for assessing carcinogenic effects and reference doses, i.e., RfDs, for noncarcinogenic effects) were presented in Section 5.3 of the RI. These values for the chemicals of concern are summarized in Tables J-1 and J-2. The last portion of this section presents a review of the relevant health studies for this site.

2.1 Chemicals of Concern

The primary toxic effects reported in humans are summarized below followed by the toxicity criteria for assessing noncarcinogenic and carcinogenic effects.

TABLE J-1
CARCINOGENIC TOXICITY CRITERIA
SLOPE FACTORS

Chemical	Exposure Route	Criteria Value[a]	Weight of Evidence[b]	Toxic Endpoint	Source
Arsenic	Oral	1.5	A	skin cancer	IRIS
	Inhalation	15[c]	A	lung cancer	IRIS
Cadmium	Inhalation	6.3	B1	lung tumors	IRIS

NOTE
IRIS = Integrated Risk Information System, U.S. EPA (1995).

[a] Units $(mg/kg/day)^{-1}$

[b] Classification definitions: A – Human Carcinogen, sufficient evidence in humans.
B1 – Probable Human Carcinogen, limited human data available.
B2 – Probable Human Carcinogen, sufficient evidence in animals, inadequate or no evidence in humans.

[c] The IRIS inhalation slope factor for arsenic is based on an administered dose from occupational exposure, see text.

TABLE J-2
NONCARCINOGENIC TOXICITY CRITERIA
REFERENCE DOSES

Chemical	Exposure Route	RfD mg/kg/day	Uncertainty Factor	RfD Confidence	Toxic Endpoint	Source
Arsenic	Oral	0.0003-0.0008	3	Medium	hyperpigmentation, hyperkeratosis of skin	Glass & SAIC (1992) IRIS
Cadmium	Oral	0.0005 (water)	10	High	kidney proteinuria	IRIS
		0.001 (food)	10	High		
Lead	Oral	none			neurological and behavioral effects	U.S. EPA (1990)

NOTE
RfD = Reference Dose.
IRIS = Integrated Risk Information System, U.S. EPA (1995).

2.1.1 Arsenic

On the site, arsenic is most likely present as a mixed trivalent/pentavalent oxide. The toxicity of arsenic varies with its chemical form with trivalent (arsenite) compounds being more acutely toxic than pentavalent (arsenate) compounds. Arsenite is converted to arsenate In the environment (Goyer, 1991).

In humans, arsenic does not appear to accumulate in physiologically active compartments of the body (U.S. EPA, 1981). Arsenite reacts with sulfhydryl groups of proteins, which leads to higher amounts of arsenic in hair, skin, and stomach (U.S. EPA, 1988; Goyer, 1991). Absorbed arsenic is also readily converted by the liver into compounds that are rapidly excreted in the urine. About 75 percent of absorbed arsenic is eliminated by urinary excretion over time (Marcus and Rispin, 1988a), and the majority of excretion occurs within one to three days (ATSDR, 1993). Consequently, urinary arsenic levels are a reliable indicator of the amount of recent arsenic exposure. Other elimination routes from the body include feces, hair, sweat, and desquamation of the skin. Arsenic may also be an essential nutrient based on studies in several types of animals (rodents, chickens, goats, mini-pigs) which show that diets that are low in arsenic result in various growth and developmental abnormalities (U.S. EPA, 1988, 1992c). A mechanism for essentiality in humans has yet to be determined.

Carcinogenic Effects: Risk assessments for arsenic are generally based on the potential for lung cancer by inhalation and skin cancers by ingestion. These are the primary effects for assessing chronic exposure and cleanup objectives.

The oral slope factor for skin cancer was derived from a study involving arsenic exposures to over 40,000 people in Taiwan. These people consumed arsenic in groundwater for a significant portion of their lifetime. Despite the many uncertainties (see Addendum Section 5.0), this data base on arsenic represents one of the best available sources of dose-response information in humans. Unfortunately, the study design limited its usefulness to derive precise risk estimates. Specifically, the subjects were classified into three exposure groups (high, medium, low) because of lack of information on the amount of exposure. Skin cancer has been noted in arsenic-exposed populations in Chile, Argentina, and Mexico, although no association has been found between oral arsenic exposure and cancer incidence for environmentally-exposed populations in the U.S. Sample sizes of exposed populations in the U.S. may have been too small to statistically detect a relationship (U.S. EPA, 1995).

The oral slope factor of 1.5 (mg/kg/day)$^{-1}$ derived by U.S. EPA (1988; 1995) is an order of magnitude lower than the previous 15 (mg/kg/day)$^{-1}$ estimate (U.S. EPA, 1984). The difference is due to a revised evaluation of the incidence of skin cancer in the Taiwan study using a modified cancer risk model and incorporating assumptions that are more realistic for extrapolating the epidemiological data to the U.S. population (U.S. EPA, 1988; 1995).

Because of the current controversy surrounding the carcinogenicity and toxicity of ingested arsenic (see Addendum Section 5.0), further revisions to the slope factor are likely in the future. Some of the outstanding issues include (1) a possible sub-linear or threshold (i.e., risks are less than predicted based on the linear model) relationship between dose and cancer risk at low doses (Marcus & Rispin, 1988b); (2) differences in health and dietary conditions between Taiwan and the U.S. which might increase cancer risk in Taiwan (U.S. EPA, 1988; Hsueh et al., 1995); (3) the possibility of internal cancers such as the lung, liver, kidney, bladder, and colon (Chen and Chen, 1991; Chiou et al., 1995); and (4) contribution of arsenic from the diet and dietary uses of drinking water (e.g., cooking rice and rehydration of yams, the dietary staple) which were not counted (Abernathy, 1989), thereby overestimating the slope factor.

"Detoxification" by methylation and elimination of arsenic in the urine has been proposed as a mechanism which may result in lower risks than expected at low doses (Marcus and Rispin, 1988a,b). This mechanism is thought to be overwhelmed at higher doses, thereby increasing the amount of arsenic remaining in the body to cause toxic effects, such as the cancers observed in Taiwan. Review of this information by the EPA and their Science Advisory Board prompted the EPA administrator to state that the arsenic slope factor may result in risks that are actually overestimated by ten times (U.S. EPA, 1988). Since the slope factor and RfD (see noncarcinogenic effects, below) for arsenic are extrapolated from the high-dose studies from Taiwan, use of these toxicity criteria assumes that one is unable to transform and eliminate arsenic at lower doses, and thereby is more sensitive to the toxic effects.

An inhalation potency factor of 50 $(mg/kg/day)^{-1}$ was developed from studies of human males occupationally exposed to arsenic via inhalation (U.S. EPA, 1988; 1995). This estimate is an absorbed dose which was calculated from the administered dose assuming 30 percent absorption. The unit risk factor for air (4.3×10^{-3} m^3/ug) is based on the administered dose. Overall, the confidence in this estimate is relatively good since a large study population was observed and air and urinary arsenic measurements were available. Uncertainties include the lack of controls for other carcinogenic substances these smelter workers were exposed to, such as other toxic metals, chemicals in smoke, dust, and the higher incidence of smoking in this population as compared to the general population today.

Noncarcinogenic Effects: Exposure and health effects associated with chronic exposure to elevated levels of arsenic have been documented in the U.S. and throughout the world, most commonly through natural occurrence of high levels in drinking water and also through agricultural and medicinal uses of arsenic. Noncarcinogenic effects noted in populations that have been exposed to high levels of arsenic include gastrointestinal irritation, skin disorders, anemia, injury to peripheral and central nervous systems, and a cardiovascular disorder in Taiwan known as blackfoot disease (U.S. EPA, 1988; ATSDR, 1993). Skin effects are generally observed at the lowest levels of exposure to cause health effects. Such effects include hyperpigmentation (excess pigment) and hyperkeratosis (excess keratin leading to wart-like skin thickening).

The chronic RfD for arsenic is based on the NOAEL for skin effects from the same study as described above for the slope factor. The RfD listed in the IRIS data base is 0.0003 mg/kg/day, which incorporates an uncertainty factor of three. Because U.S. EPA scientists are not in agreement on the interpretation of the data and the appropriate oral RfD for arsenic, the agency allows flexibility in the RfD as high as 0.0008 mg/kg/day. The chronic oral RfD was calculated from arsenic concentrations in well water using adult drinking water intake rates and body weight. Because children have higher water intake per body weight than adults, the dose per body weight would have actually been higher for this population during childhood. The chronic reference dose is thus lower than necessary (too stringent) for assessing childhood exposures as assumed in the MTCA cleanup level equation.

Because more conservative cleanup and action level calculations for arsenic are generated using the slope factor, cleanup levels and action levels will be based on the carcinogenic rather than the noncarcinogenic effects of arsenic.

2.1.2 Cadmium

Long-term exposure to cadmium by both inhalation and ingestion is associated with proteinuria (protein in the urine indicative of kidney effects) in both worker and general populations (ATSDR, 1993; Kjellstrom et al., 1977; Nogawa et al., 1989; U.S. EPA, 1995). In both occupational and non-occupational populations, kidney effects were found only after long term (greater than 30 years) chronic exposure to fairly high levels of cadmium. In addition, a threshold amount of cadmium apparently must be inhaled or ingested before kidney effects are seen. This total amount has been estimated to be in excess of approximately 2,000 mg over 50 years from a study of a residential population in Japan that ate rice grown in cadmium-polluted waters (Nogawa et al., 1989).

A concentration of 200 ug cadmium/wet weight kidney cortex is the highest renal level not associated with proteinuria in humans based on chronic exposure (U.S. EPA, 1995). The EPA extrapolated this level to a NOAEL of 0.005 mg/kg/day in water and 0.01 mg/kg/day in food using a toxicokinetic model and assuming 5 percent and 2.5 percent absorption, respectively. EPA's oral RfD was thus calculated as 0.0005 mg/kg/day cadmium ingested in water and 0.001 mg/kg/day for cadmium ingested in food. These calculations used an uncertainty factor of 10 to account for variation in individual sensitivity. Confidence in the data and in the RfD values is rated as high.

The RfC for inhalation of cadmium is currently under review.

Cadmium is classified by the U.S. EPA as a B1 or probable human carcinogen by inhalation. There is limited evidence in humans that occupational exposures to cadmium may cause an increased risk for lung cancer, although smoking and exposure to other carcinogenic chemicals may represent confounding variables in the studies. The inhalation unit risk for cadmium is 0.0018 per ug/m^3. This unit risk may not be appropriate if the air concentration of cadmium exceeds 6 ug/m^3.

Cadmium has not been shown to be carcinogenic in laboratory animals via oral exposure at doses of 2.5 mg/kg/day and below (ATSDR, 1993). Studies in humans likewise have not shown evidence of cadmium causing carcinogenic effects following oral exposure, although these studies may have limited sensitivity to detect increases in cancer incidence (ATSDR, 1993).

2.1.3 Lead

As summarized by ATSDR (1993) and U.S. EPA (1986a), lead is ubiquitous in the environment due to its widespread historical uses as a fuel additive, in paints, solders, and other consumer products. At high doses, lead can cause a wide range of toxic effects. The primary effects of concern for chronic exposures to lead, however, are subtle neurobehavioral effects in young children. Subclinical effects on the blood-forming system are a secondary issue at low levels of exposure. Controversy continues to surround the question of low-level health effects from lead, which are often indistinguishable from other factors, particularly socioeconomic influences.

<u>Blood Lead as an Indicator of Exposure and Toxicity</u>: The concentration of lead in the blood (usually expressed as micrograms of lead per deciliter of whole blood, ug/dl) is generally considered the screening test of choice today (CDC, 1991a). Other biological measures, such as the level of erythrocyte protoporphyrin (EP) in the blood or lead in the bone, are not as effective a measure as blood lead. EP is not sensitive enough to register blood lead concentrations at the relatively low levels now prevalent in the United States and lead in the bone is too cumbersome and invasive to achieve widespread acceptance.

The Centers for Disease Control of the U.S. Department of Health and Human Services have established a multi-tier approach for interpreting blood lead levels in children (CDC, 1991a). The 1991 CDC Statement on Preventing Lead Poisoning in Young Children identifies five classes of blood lead concentrations ranging from lower than 10 ug/dl to higher than 70 ug/dl, and describes corresponding responses depending on the results of blood lead tests (Table J-3). At levels below 10 ug/dl, for example, no action is considered necessary; as blood lead levels increase (at 15-19 ug/dl), nutritional and educational counseling are recommended, but medical evaluation is not advised until levels of 20 ug/dl or higher are observed. Thus, although the CDC Statement (1991b) sets a goal of reducing all children's blood lead concentrations below 10 ug/dl, recommended intervention for the individual child is very modest until blood lead levels of at least 20 ug/dl. Table J-3 summarizes CDC recommended responses at various blood leads.

Blood lead levels have declined dramatically--78 percent for the overall population--in the last fifteen years, from an average 12.8 ug/dl in 1976-80 to 2.8 ug/dl for the period 1988-1991 (Pirkle, 1994, reporting on the NHANES III results). For children aged 1 to 5 years, considered the most sensitive group, the corresponding numbers show a drop during the same time period from an average of 15 ug/dl to 3.6 ug/dl (76% reduction).

The 10 ug/dl level from CDC (1991a) has come to be used as a health-protective guideline, even though as noted above remedial action is not recommended until higher blood levels occur or a widespread problem is found. Considerable controversy remains, however, regarding the significance of health effects associated with low levels of lead exposure, and even whether such effects have been adequately established in the scientific literature. For example, although there is evidence of neurobehavioral deficits at higher blood lead levels, the significance of such a relationship at levels in the 10 to 15 ug/dl range and below is uncertain, due to conflicting results among well-conducted, large-scale population studies, the subtleness of effects even where studies show an association, and a host of confounding factors such as nutrition, socioeconomic status, parental IQ, and other major influences on outcome (Schroeder et al., 1985; Ernhart et al., 1988; Bellinger et al., 1990; Davis, 1992; Pocock, 1994).

Besides young children, pregnant women are often identified as a sensitive subgroup for lead exposure, although the fetus rather than the mother is at greatest risk. Lead is able to cross the placenta as evidenced by umbilical cord levels which are slightly lower but correlated with maternal blood lead levels (Goyer, 1991). Prenatal exposure is likely to be less than exposure for young children, since exposure for the unborn child is mediated by the mother who has a lower lead absorption rate and is less likely to eat soil or paint chips. A recent statistical evaluation of a number of studies failed to show an effect of lead exposure prior to birth on later mental development in the absence of separate exposure during early childhood (Pocock, 1994).

TABLE J-3. CDC SLIDING SCALE OF RECOMMENDED ACTIONS FOR CHILDREN AT VARIOUS BLOOD LEVELS

Class	Blood Lead Concentration (ug/dl)	Comments
All children, ages 6-36 mo.		Pediatric health-care providers should assess the child's risk for high-dose exposure at every regular office visit. Children considered low risk should have blood lead testing at ages 12 and 24 months. Children at high risk should have tests every six months.
I	≤9	No special follow-up required.
IIA	10-14	Community education and community-wide lead poisoning prevention activities should occur if many children in the community have these blood levels. Blood lead should be screened more frequently.
IIB	15-19	Nutritional and education interventions and more frequent blood lead screening should occur. If blood level persists, environmental investigation and intervention should be performed.
III	20-44	Environmental evaluation and medical evaluation within 10 working days. If needed, medical treatment and environmental remediation.
IV	45-69	Medical intervention within 48 hours. Environmental investigation and remediation should begin within five working days.
V	≥70	Child has a medical emergency, hospitalize and start medical investigation immediately. Environmental investigation and intervention should begin within 24 to 48 hours.

Source: CDC, 1991a.

Some epidemiological evidence has indicated that middle-aged white males (e.g., age 40-59) might also be a lead-sensitive subgroup for elevation of blood pressure. The overall data base, however, is controversial (summarized by Micciola, 1994). In some studies, a significant association between blood pressure and blood lead may be attributed to lack of controls for important confounders such as other work place exposures, body mass index, alcohol consumption, and age. Other studies which have attempted to control for some of these variables have conflicting conclusions on whether a significant association exists. Even where an association has been found, the increase in blood pressure is very slight.

Evaluation of Health Impacts: The forms of lead at the Everett site (e.g., lead oxide or possibly sulfide from non-smelted ore) are unlikely to be carcinogenic. The U.S. EPA has classified lead salts (primarily acetates and phosphates) as a probable human carcinogen (Class B2) based on evidence from oral administration of these soluble forms to animals (U.S. EPA, 1991a; 1995). Although administration of relatively high doses of lead phosphates and acetates to rodents resulted in primarily renal (kidney) tumors, a clear relationship was lacking, between the magnitude of the dose and the carcinogenic potency (U.S. EPA, 1995).

The salt form of lead has also been implicated as the cause of the carcinogenic effect (Williams and Weisburger, 1991) as indicated by a recent study by the National Toxicology Program which found that lead acetate was associated with renal tumors in rats, but environmental lead compounds such as lead oxide, lead sulfide, and lead ore were not carcinogenic (Dieter et al., 1993). Accordingly, the EPA has concluded that lead does not appear to be a potent carcinogen and that for regulatory purposes noncarcinogenic effects of lead are of greatest concern at low levels (U.S. EPA, 1991a; 1995).

2.2 Review of Available Health Studies

Biomonitoring is a way of measuring levels of chemicals in the body (e.g., in blood, urine, etc.) which are indicative of exposure. Limited studies of levels of arsenic in urine and hair and of lead in the blood have been conducted in the Everett community surrounding the former smelter. In addition, results are presented for urinary arsenic and epidemiological studies near the former Ruston/Tacoma smelter and other smelter sites in the Western U.S. The Ruston/Tacoma site has similar soil arsenic concentrations to the "peripheral" area. These epidemiological studies have examined the association between arsenic and lung and skin cancer in former smelting and mining communities in the United States. Information is also presented on two local blood lead studies of children, one on the Puget Sound Region, and one specifically for the City of Everett.

2.2.1 Arsenic Biomonitoring Studies

The concentration of arsenic in the urine is generally accepted as the most sensitive and reliable method for measuring recent exposure to arsenic (Valentine et al., 1979; U.S. EPA, 1984; Polissar et al., 1990; ATSDR, 1993). Urinary arsenic is a good reflection of exposure because approximately 75 percent of a total arsenic dose is excreted in the urine (Marcus & Rispin, 1988a), and excretion is relatively rapid, occurring within one to three days of exposure (ATSDR, 1993). Although urinary arsenic levels reflect recent exposure, this limitation does not negate the usefulness of this method for evaluating chronic exposure situations such as for the Everett community. Chronic exposure for populations may be inferred from these measurements with appropriate consideration for factors that cause short-term variation such as ingestion of seafood or trips out of the area. Factors potentially affecting the representativeness of urinary arsenic data for assessment of chronic exposure are the season, sample size, age of subjects, and ingestion of seafood or organ meat. For example, if a number of young children are measured in late summer or fall when soil contact would likely be higher, the overall results are representative of the sensitive population at the worst-case time of year. The likelihood is also slim that all children would have abnormally low exposure in the last three days.

ATSDR (1993) reports that a urinary arsenic level of 100 ppb must be exceeded before "above average" ingestion exposures can be considered to have occurred. The 100 ppb value is based on research from seven different groups of investigators. Therefore, urinary arsenic levels above 100 ppb appear to be a reliable indicator of populations exposed to arsenic concentrations above background levels, provided seafood has not been eaten. Levels of 40 ppb and 80 ppb were used by the Tacoma Pierce County Health Department to screen for possible arsenic exposure (see below; TPCHD, 1988); and 50 micrograms of arsenic per gram of creatinine (ug/gC; creatinine is a compound present in urine) was used in a joint ATSDR/Washington State Department of Health investigation for the Everett site (Sanderson, et al., 1995). Because arsenic in urine may be increased by eating seafood or some meats, a high urinary arsenic is not necessarily indicative of inorganic arsenic exposure from soil. The form of arsenic in seafood and some meats is a relatively "non-toxic" organic form of arsenic which is not considered a health concern. More sensitive tests of urinary arsenic check for specific arsenic compounds in the urine to separate inorganic arsenic exposure from organic "seafood" arsenic exposure. Due to a certain amount of overlap in arsenic forms excreted, however, these tests are not 100 percent reliable.

Another arsenic biomonitoring technique is measuring the amount of arsenic in hair; however, unlike urinary arsenic, little guidance is available regarding what arsenic hair concentration constitutes excess-exposure (ATSDR, 1993). The development of guidelines regarding exposure may be difficult because of the great variablility present in individual arsenic hair levels (Olgiun et al., 1983; Cross et al., 1979; Iyengar and Woittiez, 1988). Valentine et al. (1979) did note a clear increase in hair arsenic concentrations after ingestion of approximately 400 ppb of arsenic in drinking water, whereas water concentrations of 50 to 120 ppb produced little effect. In addition, the arsenic content of the hair may be inflated by external contamination. Arsenic in soil or dust can chemically bind to the hair making external arsenic difficult to remove by washing (Yamauchi et al., 1989). Arsenic levels in hair are also difficult to relate to exposures especially at low doses because arsenic levels in hair may be due to brief high doses or low chronic doses (Valentine et al., 1979; ATSDR, 1993). As a developmental and metabolic end product, hair is not in a dynamic equilibrium like other tissues in the body (Srivastava and Gupta, 1994); consequently, hair is less likely to accurately reflect the arsenic exposure history.

<u>Everett Urinary Arsenic Studies</u>: In the spring of 1991, the *Snohomish County Health District* tested the urine of six children ages one to 12 who lived in the vicinity of the former smelter. Four of these children, plus two additional children were retested in September of the same year. Participants were asked not to eat seafood, but the specific arsenic compounds were not measured. The highest urinary arsenic levels were 20 ppb (in three of the children). The number of samples was limited by the small number of children living within the smelter area.

In 1994, the *Agency for Toxic Substances and Disease Registry (ATSDR) and the Washington State Department of Health* conducted a study of arsenic levels in urine and hair for residents in the vicinity of the former Everett smelter area (Sanderson et al., 1995). This investigation selected 95 residents (approximately half children and half adults) on the basis of location in the target area (smelter and peripheral areas) and whether residents regularly engaged in activities involving soil in their yards. Approximately 92 percent of the individuals tested did not have detectable amounts of inorganic arsenic in their urine, 5 percent had less than 50 ug/gC and 1 percent (one adult) had a urinary arsenic level of over 50 ug/gC (107 ug/gC). The authors used 1 ppm as a guideline for assessing whether hair arsenic results indicated potential exposure. Results for total arsenic in hair showed a similar pattern to the urinary results with 87 percent of the people at less than one ppm and 6 percent over one ppm (6 people; 2 were children; maximum value was 7.6 ppm). The authors concluded that the majority of residents did not have recent exposure to arsenic; however, a few participants likely had been exposed over background levels. Nevertheless, this conclusion is uncertain. Only one urinary arsenic measurement could possibly be considered elevated and it was measured in one adult rather than in a child. Children are more likely to show exposure according to more extensive studies of communities (e.g, Polissar et al., 1990). The majority of hair arsenic levels above 1 ppm were in adults as well. Hair results are also difficult to evaluate because of lack of reliable data on what levels would be considered indicative of excess oral exposure. As a result, because of the possible confounding effects of diet and external contamination of hair, other sources for arsenic cannot be ruled out.

Tacoma Urinary Arsenic Studies: Larger studies have been conducted of urinary arsenic in the residential community of Ruston, Washington, near the former Tacoma smelter. One study was performed in 1985, while the smelter was still operating (closed in 1986; Polissar et al., 1990), and another was performed approximately two years after plant closure in late 1987 (TPCHD, 1988). Voluntary testing of residents in the area occurred in 1992.

University of Washington Pathways Study: The UW Pathways study (Polissar et al., 1990) measured arsenic levels in urine, dust, and other environmental samples for 121 households located at varying distances from the smelter (zero to eight miles). Measurements were collected during four quarterly visits from January 1985 to February 1986 which overlapped with operations at the plant site. Copper smelting at the plant ended in March of 1985, and arsenic processing ended in

January of 1986. The analysis focused on urinary arsenic compounds that could possibly be due to inorganic arsenic in an attempt to control for seafood arsenic. Residents of Bellingham, Washington, were used as a control group.

Results from this study showed no correlation between environmental arsenic concentrations and urinary arsenic levels except for one subpopulation: children up to the age of six living within one-half mile of the active smelter site. The rest of the population did not show elevated urinary arsenic levels (median urine concentrations were 4.5 to 17 ppb, the same as the control group in Bellingham) even though environmental levels were higher than for the control group.

Younger children in the community near the Tacoma Plant site had median urinary arsenic concentrations of 43.6 ppb for males, and 24.5 ppb for females (means were 63.3 ppb and 30.3 ppb, respectively). The study concluded, after analysis of the amount of soil and dust on the children's hands, that these elevated concentrations were primarily due to ingestion of outdoor soil and indoor dust, a result of young children's hand-to-mouth behavior. No differences in urinary arsenic levels were noted with season.

Tacoma-Pierce County Health Department 1988 Survey: The Tacoma-Pierce County Health Department (TPCHD, 1988) conducted a follow-up to the Pathways study, and focused on 61 households with children under age eight and living within a half mile of the smelter (89 children participated in the study). Two consecutive morning urine samples were collected from each child from September to November of 1987. Parents were requested not to feed the children seafood for three days prior to urine collection, and a detailed diet history of the three preceding days was also collected. Total arsenic and speciated arsenic were analyzed in the urine in the same manner as in the Pathways study.

The TPCHD study mentions an "Interagency Air Work Group" that established a guideline to be used in interpreting urine data, specifically from the Pathways study. The guideline stated that a mean urinary arsenic level greater than 40 ppb or a single value greater than 80 ppb should be considered as "elevated." The criteria used in establishing the guideline was not discussed in the study. Twelve percent of the TPCHD study population had a single urinary arsenic value greater than 40 ppb; only two children had a single value greater than 80 ppb.

Results showed no difference in urinary arsenic levels between the Ruston study population and the Bellingham population used as a control group in the UW Pathways study. The TPCHD concluded that urinary arsenic levels had declined since the Pathways study, and did not differ from the general population. The median arsenic level of the children in the study was 10.9 ppb for males (mean of 17.2 ppb) and 6.4 ppb for females (mean of 16.0 ppb), a considerable reduction from the Pathways findings. Unlike the Pathways study, where 94 percent of the high urine values were from males, the TPCHD found no differences between males and females. The study did identify a slight geographical trend: children with a urinary arsenic level over 40 ppb lived in a southwest direction from the smelter (the direction of prevailing winds).

TPCHD Voluntary Testing Program: Since March of 1992, the TPCHD has offered urinary arsenic monitoring available to residents (Snyder, 1992). Individuals living within the study area designated by the EPA for elevated arsenic exposure may come into the health department offices to have their urine analyzed for arsenic. At the time of urine collection, a dietary history focusing on seafood ingestion in the immediate past is taken from each individual along with other information such as age, sex, and distance the home is from the former smelter stack. The urine is then analyzed for total arsenic (not speciated as in the previous two studies).

From March through the end of July 1992, 44 urine samples were collected from individuals ranging in age from <1 to 59 years. Thirteen of the samples are from children of age six or less, seventeen are from children aged 7 - 14, and fourteen samples are from adults. All but two of the samples were below the detection limit of the analytical method of 10 ppb. Two samples had total arsenic levels of 13 ppb (4-year-old male) and 27 ppb (44-year-old female); both of these individuals lived within 0.5 to 0.625 miles from the former smelter stack. The 4 year old had reportedly eaten seafood within three days prior to urine sample collection (Payton, 1993; TPCHD, 1993). The 44-year-old female retested as undetectable for arsenic in urine. Eight children under the age of eight in this biomonitoring program lived within one-half mile of the smelter, the area noted in the previous studies as containing the elevated urinary arsenic levels seen in young children (TPCHD, 1988; Polissar, et al., 1990). None of these children had detectable amounts of arsenic in their urine, although the sample size is small.

The preliminary results from this program indicate that urinary arsenic concentrations have continued to decline in the community. Season is unlikely to have lowered these values because the monitoring took place during warmer seasons when children would be outdoors more often and at home from school. The drier soil conditions during this period would also result in more airborne transport of dust indoors. 1992 was also an exceptionally dry year. Because several individuals have been measured (cross-sectional study), possible short-term variation in the amount of exposure is in part controlled for by the low variation among individuals. Additional samples from this on-going program will increase the confidence in the data as representative of the community.

The available urinary arsenic data collected in the vicinity of the Tacoma plant site in 1987, 1988, and 1992 indicate that exposure levels have declined in the community near the former smelter since the closure of this plant. These data reflect the decrease in fine, bioavailable particles in the environment with the passage of time since the closure of this facility. The Pathways study also noted that indoor dust levels in homes was more influenced by outdoor air levels (influenced by the smelter site emissions) than soil levels in the yard. Consequently, exposure to arsenic seems to be greatly influenced by the presence of fine particulate dust from airborne emissions from the facility.

2.2.2 Epidemiological Studies on Arsenic Health Effects

A number of health monitoring and epidemiological studies have been conducted in the Ruston/North Tacoma area by local and state health departments and the University of Washington (summarized in Black and Veatch, 1988; Polissar et al., 1990; Glass and SAIC, 1992; see also Frost et al., 1987; Harter et al., 1994). Both carcinogenic effects (lung cancer), and noncarcinogenic effects (birth problems such as low birth weights, stillbirths, perinatal deaths, premature delivery, and certain birth defects; children's growth rates, school attendance, and hearing problems; blood-related problems in older age groups) have been examined. These studies have not shown increases in disease or death as a result of arsenic exposure despite the higher exposure levels in the past when the plant was operating. Problems related to the skin (e.g., arsenical warts, skin cancer) were not specifically examined in any of these studies, but nor have any such problems been noted in the community during these studies (Milham, 1990) or by local health authorities. It should also be noted that cancer risks in the low range considered a concern by Washington State and U.S. EPA risk management guidelines may be far lower than can actually be measured in the local population (see Glass and SAIC, 1992).

A number of lung cancer studies of populations living near smelters in the United States have found no increased cancer incidence over control populations with arsenic exposure (Frost et al., 1987; Greaves et al., 1981; Harter et al., 1994; Lyon et al., 1977; Rom et al., 1982). Two of the best studies (based on study design, sample size, and sensitivity; Frost et al., 1987 and Harter et al., 1994) were conducted specifically on the residents living around the former Tacoma/Ruston smelter. The more recent study performed a follow up of Ruston/Tacoma school children (Harter et al., 1994). This study is the first to evaluate lung cancer mortality for childhood exposure to elevated levels of arsenic in air and soil during the early years of smelter operation (i.e., 1907 to 1932). No evidence of increased risk of lung cancer mortality was found to be associated with exposure to arsenic based on length of exposure and distance to the smelter. In fact, a non-significant trend showed reduced risk for higher levels of exposure.

The few studies which have shown a possible association of arsenic with lung cancer in smelter communities are generally of weaker study design (e.g., evaluate exposed or non-exposed communities rather than individuals) and do not rule out the possible influence of other causes such as smoking, occupation (e.g., smelter workers), and socioeconomic conditions (e.g., ADHS, 1990). The exposures at many of these sites were also likely increased by historical exposures to operating smelter emissions before the increased regulation in recent time. In contrast, residents in the vicinity of the former Everett Smelter are not exposed to the more bioavailable emissions in airborne dust and fine particulates from an active smelter, operating prior to regulatory controls.

In addition, increased skin cancer rates have not been observed in U.S. populations exposed to arsenic. In fact, populations exposed to a smelter and an open pit mine in two separate counties in Montana had lower skin cancer rates than in the two control counties (Wong et al., 1992). The skin cancers noted in the exposed counties were clinically different from those caused by arsenic.

Children living near a smelter in Arizona who were also drinking water containing 0.09 mg/l of arsenic (approximately twice the federal maximum containment level, MCL, for municipal water) were found to have elevated urinary arsenic levels but no signs of adverse health effects that could be attributed to arsenic (Morse et al., 1979).

Drinking water appears to be a much more direct source of exposure for arsenic than soil. Other studies involving drinking water exposure due to naturally occurring arsenic levels have shown elevated urinary levels, and in some cases, even arsenic poisoning (e.g., Granite Falls, Snohomish County; SHD and WDOH, 1991). Population studies have not reported increases in skin cancer or other health effects as reported in other countries such as Taiwan. Whether this difference is due to smaller sample sizes in the United States or because of better nutrition and socioeconomic conditions has not been resolved.

Valentine et al. (1992) conducted a survey on four U.S. communities with various concentrations of arsenic in their drinking water ranging from 0.1 mg/L to 0.39 mg/L. The results indicated that the health of these arsenic-exposed populations had not been adversely affected. The values in these cities exceed the MCL for arsenic in drinking water of 0.05 mg/L.

An epidemiological study in Utah examined 145 people exposed to arsenic (predominantly arsenic pentoxide) levels in drinking water that were approximately 0.2 mg/L (Southwick et al., 1983). Skin effects that might be associated with arsenic were rare, and were scattered singly among exposed and control subjects. Typical signs and symptoms of chronic arsenic poisoning were not found in any of the subjects. Exposed and control subjects did not significantly differ in the incidence of anemia, and nerve conduction slowing was uncorrelated with arsenic exposure.

2.2.3 Blood Lead Studies

In general, blood lead levels have been found to be greater in children from older cities which have a longer history of urban lead accumulation, and in minority children and low income families. For example, blood lead levels of children living in older homes in Seattle are relatively low compared to similar populations living in older cities in the United States (Johnson and McDade, 1994; Chisolm, 1995). The population near the former Everett smelter is typical of western cities which do not have as long of a history of high population density and urban lead use. This population would be expected to have a relatively low background blood lead level and consequently less chance of exceeding the 10 ug/dl target blood lead level.

According to the data made available by the Snohomish Health District, blood lead levels of 13 children living in the "smelter" area were reported from a study in 1991. Ten of the children were six-years old or less. Eight of the 13 children were tested in the spring. Five of these children were retested and five additional children were tested in the fall. None of the reported blood lead levels exceeded the EPA's level of concern of 10 ug/dl; most were below the detection limit (5 ug/dl). If half of the detection limit is used for samples below the detection limit, the average blood lead level was 3.8 ug/dl for the spring of 1991 and 3.3 ug/dl for the fall of 1991.

A larger study of house dust and blood lead levels was conducted by the University of Washington in cooperation with the King County Department of Public Health as a part of a larger study to evaluate blood lead levels of children in Seattle, Everett, and Grays Harbor (Batik, 1992; Jones, 1992). All children between nine months and six years in the "smelter" area were invited for blood lead testing (Batik, 1992). In addition, a random sample of children living in pre-1950s Everett housing were asked to participate. The goal was to test 150 children in Everett. One hundred fifty-one children were tested and included in the statistical analysis. In addition, questionnaires were distributed to the families of each child tested. The questions were aimed at determining if a potential for high lead exposure existed in the house. House dust samples were collected; however, none were taken from the "smelter" area (Jones, 1993).

The larger blood lead study showed no statistical difference between blood lead levels in Everett, Seattle, or Gray's Harbor (Batik, 1992). Blood lead levels in Everett ranged from below the detection limit (5 ug/dl) to 18 ug/dl, with six percent exceeding 10 ug/dl (nine children). A large proportion of children tested (71%)

had blood lead levels below the detection limit. Jones (1992) calculated blood lead averages for Everett children in two ways to account for all the "non-detects." First, all "non-detects" were assumed to have a blood lead level of 4 ug/dl which resulted in a mean blood lead level for Everett of 4.9 ug/dl. For comparison purposes, a lower blood lead of 1 ug/dl was substituted for all samples below the detection limit, which resulted in a mean blood lead level of 2.1 ug/dl (Jones, 1992).

In Everett, significant amounts of lead were measured from carpets; however, house dust concentrations and blood lead levels were not correlated (Jones, 1992). The large number of blood lead samples below the detection limit may have obscured detection of an association even if a slight trend did exist.

3.0 CALCULATION OF HEALTH RISKS BY EXPOSURE PATHWAY

In this section, health risks are calculated using U.S. EPA equations (e.g., including child and adult exposure) for the pathways of concern presented earlier in this addendum (Section 1.0). Health risks are quantified over a range of arsenic and cadmium soil concentrations assuming that residents are exposed for 30 years to each concentration. Nine arsenic concentrations are evaluated from 7 ppm to 1,000 ppm, and two concentrations (1 ppm and 14 ppm) are evaluated for cadmium. These ranges represent background to approximate maximum concentrations for arsenic and cadmium in the peripheral area. The area comprising the former smelter is assumed to be remediated to at least 1,000 ppm. Because lead lacks an established EPA toxicity criteria (RfD or slope factor), lead health risks cannot be calculated using MTCA or U.S. EPA equations. Lead concentrations at the site are discussed in Section 4.0.

Section 5.4.1 of the RI described the calculation of health risks. In summary, potential health effects are calculated differently depending on whether a chemical's primary effect is noncarcinogenic or carcinogenic. Health hazards for noncarcinogenic chemicals are estimated quantitatively by calculating a hazard quotient. A hazard quotient is the ratio of the estimated intake or dose of a chemical to the chemical-specific reference dose. At a hazard quotient of 1.0, the estimated dose equals the upper dose associated with no adverse health effects (i.e., the RfD). In contrast, potential health effects for carcinogenic chemicals are quantified by calculating a risk which represents the upper-bound chance of developing cancer in a lifetime in addition to a background U.S. cancer risk of one chance in three (30 percent risk, or 3×10^{-1}).

The general equations used to estimate the hazard quotient for noncarcinogenic effects of chemicals and carcinogenic risks are as follows.

$$\text{Hazard Quotient} = \frac{\text{Soil Concentration x Intake Factors}}{\text{RfD}}$$

$$\text{Risk} = \text{Soil Concentration x SF x Intake Factors}$$

where,

$$\text{Intake Factors} = \frac{(\text{CR x EF x ED x AB})}{\text{BW x AT}}$$

RfD = Reference Dose
SF = Slope Factor
CR = Contact Rate
EF = Exposure Frequency
ED = Exposure Duration
AB = Absorption
BW = Body Weight
AT = Averaging Time

According to EPA risk assessment guidelines, health risks (carcinogenic and noncarcinogenic) are calculated for reasonable maximum exposure (RME) conditions defined as the highest exposure that can reasonably be expected to occur at the site. The intent of the guidance is for the combination of exposure and toxicity variables to result in an estimate of RME even though some intake variables may not be at their individual maximum value (U.S. EPA, 1989b). As stated by U.S. EPA (1991c), "the goal of RME is to combine upper-bound and mid-range exposure factors ... so that the result represents an exposure scenario that is both protective and reasonable; not the worst possible case." RME assumptions have been established by the Risk Assessment Guidelines for Superfund (U.S. EPA, 1989b, 1991c), and by region-specific guidance of EPA Region 10 for residential land use conditions (U.S. EPA, 1991b).

As a comparison, risks associated with "typical" or average exposure conditions are also presented. EPA's risk assessment council recommends that risk assessments show a range of risks reflecting the range in uncertainty for possible exposures rather than one upper-bound estimate (Habicht, 1992). "Typical" exposure conditions represent risks closer to central tendency or average estimates. Potential soil action levels for "typical" exposure are provided for soil ingestion and dermal exposure pathways which have sufficient information and guidance to assess average exposures. EPA RME and "typical" exposure assumptions are summarized in Table J-4.

Exposure assumptions common to all pathways are presented below followed by calculation of pathway-specific risk based on these assumptions and others specific to each pathway.

3.1 General Exposure Assumptions

Under RME assumptions (U.S. EPA, 1991b,c), residents are born at the site and reside there until age 30. A 30-year residency is the national 90th-percentile time for individuals living in one house (U.S. EPA, 1989a). During this time, they rarely leave their residence, spending 350 days per year on average at home. A longer exposure duration than 30 years does not greatly increase one's overall exposure because exposure is highest during childhood (see Section 5.0 below).

By contrast, "typical" exposure assumes that residents would reside at the site for nine years (average residence time in the U.S.) with a frequency of 275 days per year at home (U.S. EPA, 1991c, 1993b).

The amount of exposure is "averaged" over the period of exposure for noncarcinogenic calculations and over one's lifetime for carcinogenic calculations. Accordingly, the averaging time for assessing noncarcinogenic effects is the same as the exposure period (30 years for RME exposure and nine years for "typical" exposure), whereas for carcinogenic effects, the averaging time is equivalent to the lifetime (70 years, U.S. EPA, 1991c,d).

RME exposure is evaluated separately for younger and older age groups for pathways such as soil ingestion or dermal exposure in which a child would have a much higher dose per body weight because of their greater contact rate with soil. Age-specific intake rates (e.g., for soil or vegetable ingestion) are combined with the representative

TABLE J-4
SUMMARY OF EPA RME, EPA TYPICAL, AND MTCA EXPOSURE PATHWAY VALUES FOR RESIDENTS

Exposure Group	Exposure Route	Age Group (years)	Body Weight (kg)	Contact Rate	Frequency (days/years)	Duration (years)
EPA RME	inhalation	0–30	70	20 m³/day	350	30
	soil ingestion	0–6	15	200 mg/day	350	6
		6–30	70	100 mg/day	350	24
	leafy vegs.	0–6	15	0.3 g/day	40 [a]	6
		6–30	70	1.4 g/day	40 [a]	24
	root vegs.	0–6	15	1.5 g/day	69 [a]	6
		6–30	70	2.5 g/day	69 [a]	24
EPA Typical	soil ingestion			100 mg/day	275	9

NOTE

EPA RME and Typical values from U.S. EPA (1991b,c).

[a] Vegetable ingestion frequencies are expressed as days/year for ease of calculation in the standard equation. In reality, frequencies are 11% of leafy vegetables and 19% of root vegetables in the diet as home grown.

body weights and evaluated over the exposure time period. Therefore, the chemical dose is calculated based on young children from birth to age six weighing 15 kg, and on ages six to 30 weighing 70 kg (U.S. EPA, 1991b,c). "Typical" exposure considers older children or adults, assuming the average weight is 70 kg.

3.2 Pathway-Specific Potential Health Risks

In this section, health risks and hazards are calculated for each exposure situation at the site: soil ingestion, vegetable ingestion, airborne dust inhalation and ingestion of surface water runoff. The calculations use the general exposure assumptions presented above along with pathway-specific exposure assumptions for each of the pathways of concern.

3.2.1 Soil Ingestion

In addition to the general exposure assumptions, the soil ingestion pathway involves assumptions on soil ingestion rates and on digestive tract (gastrointestinal) absorption of chemicals in soil. Health risks using these assumptions were calculated for a range of arsenic and cadmium concentrations that may potentially be present in the peripheral area

Pathway Assumptions: The U.S. EPA (1991b,c) has recommended RME **soil ingestion rates** of 200 mg/day for young children (ages zero to six) and 100 mg/day for older age groups (> age six; Table J-4). The "typical" or average soil ingestion rate recommended by U.S. EPA Region 10 (U.S. EPA, 1991c) is 100 mg/day (Table J-4). No correction is made for decreases in exposure to soil or airborne dust due to seasonal effects.

A 100 percent **gastrointestinal absorption rate** (i.e., the same absorption as assumed by the toxicity criteria; see addendum Section 2.1) is conservatively assumed for cadmium. However, this assumption is overly conservative for absorption of arsenic in soil relative to absorption of arsenic in drinking water (the basis of the oral slope factor), consequently Ecology recommends a 40 percent absorption rate (Kissinger, 1991).

Ecology's absorption rate is within the range (20 to 50 percent) reported for arsenic trioxide in soil or in suspension rather than dissolved (U.S. EPA, 1984; Tetra Tech, 1987; Freeman et al., 1993; Freeman et al., 1994). Even lower absorption rates

TABLE J-5
RISKS AND HAZARDS BY PATHWAY
RME ASSUMPTIONS

Soil Concentrations mg/kg	Soil Ingestion	Vegetable Ingestion	Dust Inhalation
Arsenic	Carcinogenic Risks	Carcinogenic Risks	Carcinogenic Risks
7	4×10^{-6}	2×10^{-7}	9×10^{-9}
20	1×10^{-5}	6×10^{-7}	2×10^{-8}
50	3×10^{-5}	1×10^{-6}	6×10^{-8}
76	4×10^{-5}	2×10^{-6}	1×10^{-7}
100	6×10^{-5}	3×10^{-6}	1×10^{-7}
152	9×10^{-5}	4×10^{-6}	2×10^{-7}
230	1×10^{-4}	7×10^{-6}	3×10^{-7}
500	3×10^{-4}	1×10^{-5}	6×10^{-7}
1,000	6×10^{-4}	3×10^{-5}	1×10^{-6}
Cadmium	Noncar. Hazards	Noncar. Hazards	Carcinogenic Risks
1	0.004	0.01	2×10^{-10}
14	0.05	0.2	2×10^{-9}

NOTES

Soil ingestion risks from arsenic are calculated using a 25% gastrointestinal absorption rate.

Noncar. = Noncarcinogenic

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(10 to 11 percent) have been reported for soil containing sulfide ore forms of arsenic (Davis et al., 1992; Yanez et al., 1993). The most recent of these studies (Freeman et al., 1994) measured arsenic absorption rates of 20 percent and 29 percent in monkeys fed Anaconda smelter site soil and dust, respectively. Based on the latest scientific data, an absorption factor of 25 percent was selected as a more accurate assumption in comparison to the MTCA assumption of 40 percent or the EPA RME assumption of 80 percent. Uncertainties concerning the amount of arsenic absorbed through the gastrointestinal tract are reviewed in Section 5.0.

Risks From Soil Ingestion: Risks of skin cancer from arsenic exposure were calculated at nine different soil concentrations under RME versus typical exposure assumptions (7 ppm, 20 ppm, 50 ppm, 76 ppm, 100 ppm, 152 ppm, 230 ppm, 500 ppm, and 1,000 ppm). Noncarcinogenic hazards from exposure to cadmium were calculated for soil concentrations of 1 ppm and the maximum concentration in the peripheral area of 14 ppm. Risks for RME conditions range from 4×10^{-6} at 7 ppm to 6×10^{-4} at 1,000 ppm. If a gastrointestinal absorption factor of 80 percent is used rather than 25 percent, arsenic risks range from 1×10^{-5} to 2×10^{-3}, approximately three times greater than the estimates using 25 percent. Risks calculated under the "typical" exposure scenarios (4×10^{-7} to 5×10^{-5}) are approximately an order of magnitude smaller than risks calculated using RME exposure assumptions. These "typical" risks are presented for comparison purposes to the RME level to show the potential range in estimated health risks based on more average exposure assumptions. Risks using RME assumptions are presented in Table J-5, the detailed calculations are shown in Appendix J-1, Tables J1-A and J1-B.

Hazards from exposure to cadmium in soil did not exceed one using RME or typical exposure assumptions at the maximum cadmium concentration in the peripheral area.

3.2.2 Home Garden Produce

In the absence of actual site measurements, chemical concentrations in home-grown produce can be estimated from soil concentrations through literature values for vegetable "uptake factors." An uptake factor is the measured relationship of chemical concentration in plant parts to the concentration in the soil. The amount of chemical in home-grown produce is thus:

Vegetable concentration = Uptake Factor x Soil Concentration

Calculations of exposure and health risks for this pathway thus involve estimated uptake factors, vegetable ingestion rates, and the percentage of home-grown vegetables in the diet.

Pathway Assumptions: **Uptake of chemicals by plants** has been measured as a part of research on the environmental and health effects of metals in sewage sludge (U.S. EPA, 1981; U.S. EPA, 1985b,c,d) and mining and smelter emissions (Alloway and Morgan, 1986; Thornton, 1986), as well as studies of radionuclides released in the environment (Baes et al., 1984). Perhaps the most complete data set is from the Tacoma Smelter site in Washington (Heilman and Ekuan, 1977), which provided uptake data for several metals including arsenic, cadmium, mercury, and lead.

Uptake rates are greatly affected by vegetable types. Specifically, vegetative parts (e.g., leaves, roots, and stems) generally contain higher levels of metals than do grain, fruit, or tubers (e.g., potatoes) (U.S. EPA, 1991c; Sikora et al., 1980; U.S. EPA, 1981; U.S. EPA, 1985b,c,d). Of the vegetables evaluated by Heilman and Ekuan, using uptake factors for beet greens and lettuce (leafy vegetables) and beets (root vegetables) in almost all cases result in the highest uptake factors. Therefore, uptake factors for those vegetable types were used in our calculations. Uptake factors and spreadsheet calculations are presented in Appendix J-1, Table J1-C.

Ingestion rates for young children and adults are based on U.S. population averages for leafy and root vegetables in the diet and the fraction of these types of vegetables that are home grown (U.S. EPA, 1990a). For each type of produce, the dietary consumption rates at the 70th to 75th percentile level (0.3 g/day leafy and 1.5 g/day root for children and 1.4 g/day leafy and 2.5 g/day root for adults; Glass and SAIC, 1992) were multiplied by an estimate of the fraction of leafy (11%) or root (19%) vegetables that is home-grown in "suburban" areas based on data from the U.S. Department of Agriculture (U.S. EPA 1990a). "Suburban" was defined as those areas within a Standard Metropolitan Statistical Area but not within city limits.

of airborne dust[1] from wind erosion of soil given conservative assumptions of wind speed and erodibility of soil. For example, the formula assumes the soil has "unlimited erosion potential," such as for barren, sandy, agricultural land. Because the surface of the site area contains little bare soil and the climate is wet for much of the year, this formula should overestimate the amount of chemicals from soil that could be inhaled in the study area.

The chronic **inhalation rate** for EPA RME exposure for residents is 20 m^3/day (U.S. EPA, 1991b,c). According to U.S. EPA (1989a), the basis for this value is a report of the task group on "reference man" by the International Commission on Radiological Protection (ICRP), assuming 16 hours of light activity and 8 hours of resting. Although ICRP considered 20 m^3/day to be an average value, using hourly inhalation rates presented by EPA (1989a) and the same activity assumptions as ICRP, an average daily inhalation rate would be approximately 14 m^3/day. Therefore, the 20 m^3/day value is likely to be a conservative estimate of inhalation exposure.

Risks From Dust Inhalation: The primary health effects of concern from this pathway are all carcinogenic because both arsenic and cadmium are considered carcinogenic by the inhalation pathway. Risks from arsenic exposure ranged from 9×10^{-9} at 7 ppm to 1×10^{-6} at 1,000 ppm (Table J-5). Risks from cadmium are 2×10^{-9} at the maximum soil concentration. Thus, health risks from this pathway appear to be negligible in comparison to the soil ingestion pathway.

3.2.4 Potential Acute Hazards From Ingestion of Surface Water Runoff

As discussed in Section 5.1.4.3 of the RI, surface water in the "smelter" and "peripheral" areas is present during and after rainfall. The greatest potential for exposure is for children possibly ingesting water while playing in puddles; however, no exposure is assumed for the smelter area because no children have access to smelter-area puddles (area has been fenced). Thus the evaluation of exposure is focused on surface water in areas with arsenic concentrations of less than 1,000 ppm. Concentrations of arsenic, cadmium, and lead were found to be a potential concern based on measurements that were taken in storm drains during and after several rain events (see Section 5.1.4.3). Exposures to these temporary

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[1] Particles less than 10 um in diameter, which are small enough to enter the deep portion of the lungs and cannot be easily cleared by body mechanisms.

puddles would be short-term (acute) and sporadic rather than chronic (i.e., occurring daily over a long time period), such as for soil exposure. Little quantitative information is available on concentrations that would be protective against acute, toxic health effects for children. Consequently, our approach is more of a qualitative discussion of the potential for an acute dose at the site in comparison to acute toxicity levels based on the available information.

Exposure Assessment: Potential acute doses were estimated using the minimum and the maximum *measured* site surface water concentrations (some samples were less than the detection limit and therefore less than the measured minimum concentrations used here). Minimum and maximum concentrations provide an approximate range of potential exposures for a child. To calculate a dose for children playing in puddles, minimum or maximum values were multiplied by the anticipated amount of water ingested during play (50 ml), and divided by the EPA default value for the body weight of a child under six years old (U.S. EPA, 1991b,c):

$$\text{Acute Dose (mg/kg)} = \frac{\text{concentration (mg/L)} \times 50 \text{ ml}}{15 \text{ kg}}$$

The basis of the water ingestion value is an estimated intake for incidental ingestion of water per hour by adults while swimming (U.S. EPA, 1989b).

Estimation Of Hazards: This evaluation reviewed the available literature for acute information on lowest-observable-adverse-effect levels (LOAELs) and no-observable-adverse-effect levels (NOAELs). Preference was given for using NOAELs over LOAELs, LOAELs with less serious effects (if LOAELs were used), and human over animal data. Information was obtained primarily from the Agency for Toxic Substances Disease Registry (ATSDR) profiles for each chemical, although other general review sources were also consulted.

The calculated toxicity values should be viewed more as estimated acute NOAELs than as "safe" levels on par with reference doses. Levels of uncertainty in these estimates differ considerably among chemicals as noted qualitatively below.

Potential acute site doses were compared to acute toxicity values to estimate the amount of hazard. Specifically, the acute dose was divided by the appropriate toxicity value to calculate a hazard ratio indicating the magnitude of a dose above or below the toxicity value:

$$\text{Hazard Ratio} = \frac{\text{Acute Dose}}{\text{Acute Toxicity Value}}$$

Hazard ratios above one indicate that the estimated dose for children in puddles may approach levels associated with acute toxic effects reported in the literature. A summary of doses, acute toxicity values, and hazard ratios are presented in Appendix J-1, Table J1-E.

Arsenic: ATSDR (1993) reports one acute exposure study for human subjects that might be applicable to the Everett site. A family of eight drank water containing an estimated 110 mg/L of arsenic for one week (exposure frequency unknown). A LOAEL of 1 mg/kg/day was established based on gastrointestinal irritation (7/8), proteinuria (5/8), anemia (7/8), and hepatitis (4/8). From this same study, ATSDR (1991) derived a LOAEL of 2 mg/kg/day for death (2/8).

An acute toxicity value of 0.01 mg/kg was estimated from this study by dividing by an uncertainty factor of 100 (10 for use of a LOAEL rather than a NOAEL, 10 for the serious effects of the LOAEL). Limitations of the study noted were small sample size and the unknown form of arsenic. In addition, when compared to the potential situation of children playing in puddles, the repeated drinking water situation represents a greater exposure.

The maximum acute dose at the site was estimated at 0.02 mg/kg, which is well below the LOAEL of 1 mg/kg derived from the drinking water study, but exceeds the derived acute toxicity value by two times. Acute arsenic exposure to the maximum sample concentration is therefore potentially a hazard. The minimum dose level had a hazard ratio of 0.002 (i.e., is 500 times lower than the acute toxicity value), which is unlikely to pose an acute hazard.

Cadmium: Acute oral exposure to cadmium in beverages due to leaching from containers causes nausea, vomiting, muscular cramps, and salivation in humans

(U.S. EPA, 1985a). As summarized by U.S. EPA (1985a), a single dose of 3 mg is estimated to be the no-effect threshold dose for emetic (i.e., vomiting) effects in humans. Various reports on poisoning incidents in adults and children concur with this level as a lower threshold. Using a body weight of 15 kg results in an estimated toxicity value of 0.2 mg/kg. Hazard ratios are thus 0.0004 and 0.7 for minimum to maximum water concentrations. At the maximum level, the estimated dose approaches the threshold value, indicating that emetic effects are not likely to occur except possibly in sensitive individuals at the maximum concentrations.

Lead: Little quantitative information on acute lead exposure in humans is available (ATSDR, 1993). However, much information has been collected on the effects of chronic lead exposure, particularly in children (U.S. EPA, 1991a). The U.S. EPA has developed an uptake/biokinetic model which estimates blood lead levels in children that might be expected given a variety of environmental sources of lead (U.S. EPA, 1991e). Because of the lack of generally accepted methods for assessing acute lead exposure, we used the model to estimate an environmental concentration of lead (i.e., in water) which results in a given blood concentration (see Section 2.1.4). The uptake/biokinetic model, however, is based on chronic drinking water exposure rather than incidental acute exposure, and therefore may not be appropriate to extrapolate to acute situations. Nevertheless, use of this model is unlikely to underestimate acute hazards.

Frank or acute effects (i.e., clinically evident), such as lead colic (considered an early sign of lead poisoning involving damage to other organ systems), have a LOAEL in children at blood concentrations of 60 to 100 ug/dl (ATSDR, 1993). Thus a target blood lead level of 30 ug/dl (half the low range of the LOAEL for colic) was used as a conservative estimate for acute effects in children based on reviews by ATSDR (1993) and CDC (1991a). Exposure assumptions for water intake and body weight were those presented above. In accordance with EPA policy on use of this model, a target goal of a child having less than a 5 percent risk of exceeding the target blood lead level was used. The drinking water concentration which met this goal was 0.17 mg/l.

Using 0.17 mg/L as the target water concentration for comparison to lead concentrations in surface water in the "smelter" area, hazard ratios are 0.05 (minimum) and 0.7 (maximum). Based on these hazard ratios below one, lead is unlikely to be an acute hazard, except for a sensitive individual at the maximum concentrations in site surface water.

Summary of Results: Arsenic may pose an acute hazard at the higher surface water concentrations, as indicated by the maximum dose exceeding a potential toxicity value by two times. Cadmium and lead have estimated maximum doses that are close to a potential level of concern for acute effects, although these effects for cadmium (e.g., gastrointestinal upset) are milder than those of concern for arsenic or lead. Results of the calculations are presented in Appendix J-1, Table J1-E.

3.3 Summary of Risks

Comparison among the four pathways indicates that soil ingestion of arsenic is the pathway of highest potential risk, and that cadmium does not appear to be a health concern at the maximum concentration found in the peripheral area. Estimated health risks from arsenic exposure can vary widely depending on the exposure assumptions used (e.g., gastrointestinal absorption, amount of soil ingested, etc.). The degree of health-protectiveness at various soil concentrations is therefore assessed for soil ingestion exposure to arsenic. Reduction of arsenic to health protective levels is protective of other metals and pathways as well.

4.0 ANALYSIS OF INCREMENTAL DEGREE OF PROTECTIVENESS

This section presents health risks at various soil concentrations of arsenic to provide information on the degree of health protectiveness associated with potential soil levels for remedial actions (i.e., engineering controls) and institutional controls. The evaluation focuses on soil exposures and risks in the community after remedial actions. The analysis incorporates site-specific information and the latest scientific data on toxicity and exposure. The calculated health risks are not actual risks but hypothetical risks for the purposes of evaluating health protectiveness. Actual risks would likely be considerably lower because of the conservative assumptions in the calculations (e.g., reasonable maximum exposure) and associated health-protective actions (i.e., institutional controls) which would be required for any soil concentrations in excess of MTCA cleanup levels. Lead which was not evaluated in previous sections because of lack of standard risk assessment methods, is assessed qualitatively using the available public health guidelines for lead in soil.

4.1 Risks Associated with Soil Concentrations after Remediation

To provide a better understanding of health risks in the community, risks are evaluated for the maximum soil concentration after remediation as well as for the resulting average soil concentration in the community. The maximum concentration, which will be the remedial action level, would occur on few properties. Risks associated with this concentration overestimate those for the rest of the community as well as for most individual that might live on such a property. Specifically, to be at this risk level, a resident would have to meet all of the conservative exposure and toxicity assumptions in the risk calculations. Risk assessments therefore assess exposure to a conservative estimate of the average rather than a maximum concentration (U.S. EPA, 1989 RAGS; 1992d).

The average concentration in the community is calculated by replacing all soil concentrations above a remedial action level with a background fill concentration (7 ppm) and averaging these concentrations with the remaining concentrations below the remedial action level. Concentrations on individual properties may be above or below this average; however, for simplicity, the average and maximum concentrations were used for evaluation purposes. Only soil concentrations in accessible areas (i.e., not under structures or roads) were considered in calculating exposure.

The analysis of health protectiveness examined potential risks associated with maximum and average soil concentrations for nine hypothetical arsenic remedial action levels, ranging from natural background of 7 ppm to the maximum concentration in the peripheral area of 1,000 ppm (actually 994 ppm). Within the former smelter area where arsenic concentrations are higher than 1,000 ppm, we assume that some type of remediation will occur. Health risks associated with the maximum concentration for RME exposure assumptions ranged from 4 x 10^{-6} to 6 x 10^{-4} (Table J-6). With the exception of 1,000 ppm, the maximum soil concentrations at 500 ppm and below are associated with risks within the EPA target goal of 10^{-6} to 10^{-4} (U.S. EPA, 1990b). The EPA has interpreted risks as high as 5 x 10^{-4} to be on the order of 10^{-4} and therefore considered protective of health under federal guidelines (U.S. EPA, 1993a). This evaluation considers the recent scientific data on arsenic absorption in using 25% oral bioavailability. By comparison, adjustment of this factor to the MTCA default absorption of 40% for arsenic would result in risks ranging from 7 x 10^{-6} to 9 x 10^{-4}, whereas use of the EPA default factor of 80% would result in risks of 1 x 10^{-5} to 2 x 10^{-3}.

TABLE J-6
SKIN CANCER RISKS FROM ARSENIC IN SOIL
RME EXPOSURE ASSUMPTIONS

Potential Maximum Arsenic Concentration After Remediation mg/kg	Carcinogenic Risks at Maximum Concentration	Estimated Average Accessible Concentration of Arsenic Remaining After Remediation mg/kg	Carcinogenic Risks at Average Accessible Concentration
7	4E-06	7	4E-06
20	1E-05	15	9E-06
50	3E-05	19	1E-05
76	4E-05	22	1E-05
100	6E-05	24	1E-05
152	9E-05	28	2E-05
230	1E-04	32	2E-05
500	3E-04	44	3E-05
1,000	6E-04	58	3E-05

NOTES

Average accessible arsenic concentratations calculated assuming a clean fill concentration of 7 ppm.

Risk notation, e.g., 4E-6, means a risk of 4×10^{-6}, or 4 chances-in-a-million of developing skin cancer. Risks are in addition to the U.S. population average background cancer risk of 3×10^{-1}, or three chances-in-ten of developing any type of cancer.

Typical exposure assumptions would result in considerably lower risks at all soil levels which would be within U.S. EPA guidelines for protection of health (Table J-7). Risks are also within MTCA guidelines for all concentrations except the two maximum levels (500 ppm and 1,000 ppm).

Unlike the maximum soil concentration, the average soil concentration remaining after remediation changes relatively little from 7 ppm to 58 ppm over the range of remedial action levels considered. Consequently, changes in risk are also slight over the range of average soil concentrations (RME risks of 4×10^{-6} to 3×10^{-5}; typical risks of 4×10^{-7} to 3×10^{-6}; Table J-6, J-7). These risks are well below the EPA target risk goals and approach the MTCA risk goals for setting cleanup levels of 1×10^{-6} for a single chemical and pathway and 1×10^{-5} for multiple pathways or chemicals. The change in RME risk over this range is 0.009 percent of the U.S. population average background cancer risk of 3×10^{-1} or 30 percent. The increase in skin cancer risk is therefore relatively negligible compared to the amount of uncertainty in risk estimates (at least ten times or more) and the background cancer incidence.

Changes in health protectiveness over a large range in soil concentrations considered for remedial action are slight. Decreases in soil concentrations from 500 ppm to 100 ppm to 7 ppm therefore provide little additional health benefit for the community as a whole particularly given that other institutional control measures will be required at levels in excess of the cleanup level. Such health information should be considered in selecting among different cleanup actions (WAC 173-340-360 (5)(d)(vi)). Several site-specific conditions and other scientific considerations further mitigate actual risks in the community, for example:

- An active source of chemicals at the site has not been present for over 80 years. Studies indicate that sites with no active source of air emissions are of lesser health concern because fine, highly absorbable particulates are no longer present in air and dust (see discussion in addendum Section 2.1.2).

- Chemicals at the site are likely less bioavailable because of the formation of mineral complexes in the soil. These complexes are expected to be less toxic than the compounds on which the toxicity criteria are based (e.g., soluble compounds in drinking water or fine particulates in dust).

TABLE J-7
SKIN CANCER RISKS FROM ARSENIC IN SOIL
"TYPICAL" EXPOSURE ASSUMPTIONS

Potential Maximum Arsenic Concentration After Remediation mg/kg	Carcinogenic Risks at Maximum Concentration	Estimated Average Accessible Concentration of Arsenic Remaining After Remediation mg/kg	Carcinogenic Risks at Average Accessible Concentration
7	4E-07	7	4E-07
20	1E-06	15	8E-07
50	3E-06	19	1E-06
76	4E-06	22	1E-06
100	5E-06	24	1E-06
152	8E-06	28	1E-06
230	1E-05	32	2E-06
500	3E-05	44	2E-06
1,000	5E-05	58	3E-06

NOTES

Average accessible arsenic concentratations calculated assuming a clean fill concentration of 7 ppm.

Risk notation, e.g., 4E-6, means a risk of 4 x 10^{-6}, or 4 chances-in-a-million of developing skin cancer. Risks are in addition to the U.S. population average background cancer risk of 3 x 10^{-1}, or three chances-in-ten of developing any type of cancer.

- Standard U.S. EPA and MTCA default assumptions assume greater exposure than will likely occur for the majority of residents, especially considering the wet northern climate which would decrease soil exposure (Section 5.0).

- In the former smelter area, actions have been taken to reduce risks to the local community. Interim actions include replacing yard soil with clean soil, and the purchase of many of the homes within the former smelter area by Asarco. From a health risk perspective, these actions reduce exposure where soil has been removed and homes purchased, thereby lowering overall risks for the area.

- Arsenic may be less toxic at lower doses associated with environmental exposure than assumed in risk assessment (see Section 5 below).

4.2 Lead Exposure After Remediation

The most recent national guidelines for lead in residential soil are (1) an OSWER directive for CERCLA and RCRA sites (Laws, 1994), and (2) interim guidance prior to the promulgation of the section 403 rule of the Toxic Substances Control Act (TSCA; Goldman, 1994). Both guidelines specify a screening level of 400 ppm below which no further action is required. The documents clearly state that this screening level is intended as a trigger for deciding whether further study is warranted and is not a cleanup goal. Above 400 ppm, further investigation is warranted such that the type and extent of measures to address health risks should be proportional to the degree of risk. Both sets of guidance mention interim controls or intervention measures that change the use patterns and create barriers to reduce exposure. Such measures may include, for example, institutional controls, education/public outreach, monitoring and health consultation, gardening restrictions, or additional cover. Abatement action (e.g., soil removal or lead paint abatement) are reserved for higher risk situations.

If lead concentrations are over the screening level, the OSWER directive specifies that the EPA Lead Model and site-specific information are to be used to evaluate soil levels for health-protective actions. The EPA lead model in its most conservative mode with default assumptions results in a soil concentration of approximately 400 ppm. Site specific assumptions may yield higher soil concentrations. The OSWER directive also states that soil levels defined using the EPA lead model do not necessarily require excavation of soil.

The TSCA section 403 guidance differs from the OSWER directive in that actions are recommended at specific soil concentrations above 400 ppm. Above 5,000 ppm, soil removal or capping is recommended. Below this level, less permanent or aggressive measures are specified for areas where children would regularly be exposed. For areas where children rarely frequent, such actions are generally not recommended until soil lead levels exceed 2,000 ppm.

Without any remedial actions in the peripheral area of the Everett site, only a few surface soil samples exceed 400 ppm and area-wide average concentrations are below this level Any soil removal activities to lower arsenic concentrations would further lower lead concentrations. For example, if the site was remediated to an arsenic cleanup level of 230 ppm, the maximum surface concentration of lead would be 434 ppm at the surface (only sample above 400 ppm), and the highest concentration at depth is 495 ppm at one foot. The average concentration of lead would be 27 ppm. The remedial action level for arsenic along with institutional controls above cleanup levels should thus be protective of lead exposure in the community.

5.0 UNCERTAINTIES

The results of a risk assessment are associated with uncertainties reflecting the limitations in knowledge on site concentrations, exposure parameters, and toxicity of chemicals. Where information is incomplete, conservative (erring on being overprotective) assumptions must be made. The greater the uncertainty, the more conservative the assumptions in an attempt to be protective of public health. In other words, risk assessments often must simplify calculations of exposure to a few pathways or subgroups within a population; however, conservative assumptions are made to account for public health in case of other unknown conditions. Even when actual characteristics of a population are known, assumptions on exposure are often biased toward producing over-protective rather than under-protective cleanup levels (and higher estimated health risks than are actually present) for the majority of the population. This section discusses the uncertainties both in Chapter 5 of the RI and in the addendum.

5.1 Factors Leading to a Possible Overestimation of Risk

The number of assumptions in the risk assessment that result in overestimated risks and lower, more stringent cleanup levels are evaluated below by section of the risk assessment. These conservative assumptions compensate for uncertainties in the calculations or simplifications that might potentially underestimate risk (presented in Section 5.2).

5.1.1 Data Collection and Evaluation

- During the **site characterization**, over 725 soil samples were collected from the residential properties in Everett. Areas where concentrations were expected to be high (e.g., in and near the "smelter" area) were sampled more intensively than other areas, thus biasing chemical concentrations upwards. In addition, only samples with the highest arsenic levels were tested for all priority pollutant metals, including antimony and thallium, thereby biasing the concentration of these metals for the site--particularly if they are more highly retained in flue dust or other parts of the "smelter" area than dispersed in stack emissions.

- Maximum chemical concentrations were used in **screening chemicals** and reporting of risk isopleths regardless of depth or surface cover material, such as grass or pavement. In reality, long-term exposure to a single sample point is highly remote. Exposure to chemicals in soil at depth would also be less frequent, if at all, depending on the depth.

- The amount of time that has passed since the original deposition of metals in soil at the Everett site would decrease the **migration** (e.g., resuspension of dust) of the inorganic chemicals from soil relative to a site with recently emitted chemicals. The available site data also indicate that arsenic and lead concentrations in indoor dust appear to be low even for houses with the highest soil concentrations. This information was accounted for in estimating a lead action level. Arsenic in indoor dust, however, was conservatively assumed to be the same concentration as the yard soil. By contrast, the University of Washington Pathways study at the Tacoma smelter area (Polissar et al., 1987) showed that indoor dust was more related to airborne dust from smelter emissions than to soil in the yard. The lack of an active airborne source in Everett would decrease house dust concentrations of arsenic and metals.

- In the residential area slag has been encountered in a few samples but slag and soil were treated equally in this addendum. However, exposure to slag differs from exposure to soil in that the coarse nature of slag would decrease oral absorption and the chance of adding to indoor dust concentrations or to air exposure. Exposure may therefore be overestimated using soil cleanup or action calculations. Because slag, if present, is most likely to be found at depth, exposures to this material would be infrequent and possible overestimation consequently slight.

5.1.2 Exposure

- Under reasonable maximum exposure (RME), upper 90th percentile values or upper-bound estimates of national averages are generally used for exposure assumptions. The intent of RME, as discussed by the EPA Deputy Administrator and the Risk Assessment Council (Habicht, 1992), is that risks should be presented as a range from central tendency to high-end risk ("above about the 90th percentile of the population distribution"). Bounding estimates or worst-case scenarios are not intended to be high-end risk estimates because "although it is possible that such an exposure (e.g., maximum chemical concentration, upper-bound intake rates), dose, or sensitivity (e.g., inability to detoxify arsenic) combination might occur in a given population of interest, the probability of an individual receiving this combination of events and conditions is usually small, and often so small that such a combination will not occur in a particular, actual population." "This descriptor is intended to estimate the risks that are expected to occur in small but definable 'high end' segments of the subject population" (Habicht, 1992). RME calculations thus overestimate risk for the majority of a hypothetical population even though all assumptions may not be at their maximum.

- **MTCA cleanup level equations** for soil ingestion (also used to calculate health risks for arsenic and cadmium in the RI) are more conservative than the equivalent U.S. EPA equations. The source of this difference is that MTCA equations compare a high daily dose per body weight for a child to the chronic (e.g., lifetime or near lifetime) reference dose based on lifetime intake rates and body weight. This surmise is equivalent to assuming that one consumed a high amount of soil and weighed 15 kg (33 lbs) for a lifetime. For carcinogenic substances, the MTCA equations also use a much more stringent risk goal (i.e., 10^{-6}). Finally, MTCA cleanup levels for arsenic and cadmium were based not on human health considerations but on MTCA policy regarding background concentrations and protection of vegetation, respectively.

- Standard default rates for residential **ingestion of soil and dust** are 200 mg/day for young children and 100 mg/day for older ages in the PRG equations. When first recommended by U.S. EPA guidelines for the Reasonable Maximum Exposure (RME) scenario (U.S. EPA, 1989a), the 200 mg/day rate for children was believed to be an average based on soil ingestion studies prior to 1988 (U.S. EPA, 1989a). U.S. EPA (1989a) presented estimates of 1 mg/day to 100 mg/day for soil ingestion rates of children older than five and adults.

  The current default soil ingestion rates now appear to be upper-bound values based on more recent soil ingestion studies (Calabrese et al., 1989; Calabrese et al., 1990; Davis et al., 1990), which report lower soil ingestion rates on average than those determined by earlier studies (primarily Binder et al., 1986). Soil ingestion rates estimated by these studies are similar (median estimates all within approximately 9 to 96 mg/day), although the estimates from these studies differ widely in reliability (Calabrese and Stanek, 1991). The most reliable data (Calabrese et al., 1990) generally report lower soil ingestion rates; however, these data have been reanalyzed several times (Calabrese and Stanek, 1991; Calabrese and Stanek, 1995, Stanek and Calabrese, 1995). The reanalyses have reported both increases and decreases in previous estimates and further reanalysis is ongoing. Some evidence indicates that outdoor soil concentrations of tracer elements may have been underestimated by including a large range in particle size relative to the fines expected to be ingested by children. Such underestimation of tracers would overestimate soil ingestion rates. Thus, the 200 mg/day default value will likely be found to be a conservative estimate for most children when averaged over time.

  Further analysis by Calabrese and Stanek (1992a,b) indicates that not all of the indoor dust ingested originates from yard soil and that the ingestion rate of soil and dust coming from outdoor soil is 35 percent less than the median soil ingestion rate predicted by Calabrese et al. (1989). As a result, median soil ingestion rates for the most reliable tracers (Calabrese and Stanek, 1991) would decrease to 10 to 36 mg/day. These ingestion rates are currently under review by the authors.

- Data on **soil ingestion rates in adults** are scarce. In the only study to attempt such measurements, Calabrese et al. (1990) concluded that soil ingestion rates for the most reliable tracers were less than the 100 mg/day recommended by U.S. EPA. For these reliable tracers, the average was 39 mg/day and the maximum was 77 mg/day. These data have less accuracy than those for children since they are based on a smaller pilot study. In addition, the ability of the mass-balance tracer method to estimate significant soil ingestion rates is greatly weakened at lower soil ingestion rates, such as in adults.

- Soil ingestion rates are also conservative estimates because **seasonality** and long-term averaging are not considered. Soil ingestion studies are short-term studies conducted in summer or early fall. The amount of high-end variability especially in warmer seasons (when children have more access to soil and ingest more soil) is expected to be greater than for chronic exposures throughout the year (see U.S. EPA, 1992b). In addition, dust concentrations indoors have been found to vary with season and dust levels in winter are lower (Bornschein, 1995). Consequently, evaluations of soil ingestion should consider that: (1) several of the studies with the highest estimates are of questionable reliability for accurate estimates of soil ingestion, and (2) variation among subjects measured over a short time period during warmer seasons is likely to be far greater than measured over a long time period which is more relevant for estimating chronic exposure in a risk assessment. Thus, the 200 mg/day and 100 mg/day EPA default values, while certainly conservative estimates, may overestimate chronic soil ingestion rates for most people over several years of exposure.

- The MTCA and EPA default **exposure frequencies** for soil assume that one would ingest soil, breathe air, etc., year round at home regardless of season. The EPA default frequency allows only two weeks out of the year without exposure on average, whereas MTCA assumes exposure every day all year round. This assumption overestimates exposures for Everett where inclement weather may prevent children and adults from regularly contacting soil outdoors for much of the year. The wetter climate would also reduce the transport of fine airborne dust indoors. Van Wijnen et al. (1990) determined that soil ingestion rates were reduced by half during weeks with four or more days of precipitation versus those with less than two days of precipitation. This study also reported that the amount of time that children spend outdoors increases the amount of soil ingested.

According to Calabrese and Stanek (1992a,b), 50 percent of the total soil/dust ingestion rate may be made up of indoor dust; however, only 31.3 percent of dust ingested indoors is of yard soil origin. These findings suggest that of the total soil or dust ingested, not all comes from soil in the yard as assumed by the risk equations. Thus, instead of 200 mg/day, the intake of soil and dust originating from yard soil would be 131 mg/day. The results of this study are being reanalyzed by the authors.

Trips away from home would reduce the amount of home exposure especially for older children and adults who go to school or work. Home exposures are greatest for younger children who ingest the most soil and dust and who are more likely to remain at home. Nevertheless, the total reduction in exposure to account for seasonal effects and trips can have a significant effect on the risk when combined with other corrections for more realistic exposures.

- The assumption of a 70-year **averaging time** used in EPA RME assumptions tends to overestimate carcinogenic risks for residents in the Everett community. Data from a similar community near the Tacoma smelter site (Frost et al., 1987) indicate that the life span of local residents is longer than 70 years. A 76.2-year lifetime was assumed by the Endangerment Assessment for the community near the Tacoma site (Black and Veatch, 1988) which was conducted for Ecology. A 76.2-year averaging time is more consistent with the way the arsenic slope factor was developed and thus technically should be used in the risk assessment rather than the default 70 year value. Therefore, the MTCA lifetime default of 75 years may more closely match actual site conditions than the EPA value of 70 years.

- Factors that could result in an overestimation of the amount of **chemicals in vegetables** include potential differences in chemical concentration and chemical availability between site soils and garden soil, which is usually modified by gardeners through the addition of fertilizer or compost. Even at the site of an active lead smelter in East Helena, Montana, lead concentrations in garden soils were found to be lower than the rest of the yard in studies conducted in 1983 and 1993 (CDC, 1986; Hydrometrics, 1993b). Soil concentrations are also based on the total amount of chemical in soil, although some of that amount is likely to be unavailable to plants because of normal soil chemistry and fate processes.

- Dietary **consumption rates for leafy and root vegetables** represent 70 to 75th percentile values from a nationwide study (U.S. EPA, 1990a). These consumption rates were modified to account for the fraction of these vegetables in the diet that would be home grown, 11 percent and 19 percent, respectively, based on home-grown percentages of "suburban" residents who live outside city limits. By comparison, the percentages of home-grown leafy and root vegetables in the diet are reported to be approximately 4 percent and 5 percent, respectively, for those living within city limits (U.S. EPA, 1990a). Therefore, rates of home-grown vegetable consumption for suburban residents could overestimate the amount of home-grown produce eaten by most residents living within city limits such as in Everett (an exception may be residents in Everett Housing Authority homes many of whom have large vegetable gardens). In addition, national averages of home-grown produce consumption may not be representative of consumption in the Everett area, a northern city with a shorter harvesting season.

- **Uptake rates** of a given metal by plants may also be altered by the types of other metals present in the soil (U.S. EPA, 1981). Metals can compete for sorption sites in the soil, and for uptake by plants or translocation within plants. The presence of other metals may also cause toxic effects in plants, thereby affecting growth and accumulation. These factors all tend to decrease exposure.

- Oral **absorption of arsenic from soil** was assumed in the calculations to be 25 percent relative to absorption of arsenic in drinking water, the exposure pathway on which the RfD and slope factor are based. The default values of percent absorption used to estimate risks in Section 4.0 under MTCA and EPA guidelines are 40 percent and 80 percent, respectively, and likely overestimate absorption. Although preliminary results of arsenic trioxide in soil fed to swine indicate that the 80 percent estimate may not be overly conservative (U.S. EPA, 1993a; Lorenzano, 1995), the possible range in values is high based on the uncertainty in this study. In addition, other studies have found much lower absorption percentages of arsenic from soil (10 percent to 50 percent, see Section 3.2.1).

An oral absorption of 40 percent was assumed by the U.S. EPA for slag at the Tacoma site (U.S. EPA, 1993a; Lorenzano, 1995). Some of the arsenic present in Everett soil may be more similar to slag (i.e., in the form of more insoluble particles of larger grain size from ore or slag) than arsenic trioxide emitted by combustion and used in the Tacoma swine study on which the 80 percent value is based. The common ore forms of arsenic (sulfides) likely found in Everett have a lower solubility in hydrochloric acid (HCl; stomach acid) and water than arsenic trioxide emitted by combustion (Smith, 1946; Sinkankas, 1972; Lide, 1992; Tsuji, 1993). In addition, oxidation reactions on the surface of mineral particles from ore or smelter emissions over time can cause armoring which may result in a decrease in bioavailability. Encapsulation of the mineral in an insoluble matrix by, e.g., silica, is also common and also results in decreased bioavailability (Davis et al., 1992).

Because the 80 percent factor is at the upper end of the range suggested by the available data for arsenic trioxide, it likely overestimates absorption for the Everett site particularly for slag (relative to other ore forms). The 40 percent recommended by the Washington Department of Ecology, although also an overestimate according to recent evidence in monkeys, is probably a more reasonable estimate of arsenic absorption.

5.1.3 Toxicity Assessment and Risk Calculations

Toxicity values have been developed by the EPA from the available toxicological data. These values frequently involve high-to-low-dose extrapolations and are often derived from animal rather than human data. In addition, there may be few studies available for a particular chemical, and/or a value for the oral exposure route may be the only toxicity value available requiring further extrapolations for use with dermal or inhalation pathways. As the unknowns increase, the uncertainty of the value increases. Uncertainty is addressed by reducing reference doses using uncertainty factors and by deriving slope factors by using a conservative model. The greater the uncertainty, the greater the uncertainty factors and tendency to overestimate the toxicity.

The health risk calculations combine uncertainties in the data evaluation, exposure assessment, and toxicity assessment sections.

- For **carcinogenic effects**, the conservative assumption is made that some finite risk is associated with exposure to even one molecule of a chemical. U.S. EPA slope factors are generally based on linear high-to-low-dose extrapolations. In reality, detoxification reactions in the body may significantly reduce the risk of cancer at low doses (Williams and Weisburger, 1991). This may be especially true for arsenic because the human body has the ability to detoxify inorganic arsenic into less toxic organic forms which are more readily excreted in urine. Some inorganic arsenic is also directly excreted in the urine. Between these two methods it is estimated that more than 75 percent of the absorbed arsenic dose is excreted (Marcus and Rispin, 1988a). Long-term accommodation to arsenic is also possible in which methylation and excretion becomes more efficient with several months of exposure.

  The assumption of no reduction in exposure by detoxification at low doses is a worst-case scenario because even those who are slow methylators still have some arsenic detoxification which would reduce the amount of exposure at low doses versus at high doses. Even if methylation is not 100 percent complete, the amount of exposure to arsenic, and therefore risk, may be greatly reduced at the lower doses (U.S. EPA, 1988; Marcus and Rispin, 1988a,b; U.S. EPA SAB, 1989) that are relevant for estimation of action levels. By contrast, at high levels, such as those experienced in the Taiwan study on which the arsenic slope factor is based (U.S. EPA, 1984; U.S. EPA, 1988), the detoxification system is overloaded and more arsenic is available to interact with the tissues. The reduction in the amount of exposure for most individuals who are able to methylate arsenic could reduce risk predictions for the community. For example, if exposure is reduced to 20 percent of full exposure because of methylation, the soil concentration associated with an upper risk of 5 x 10^{-4} increases from 852 ppm to 4,260 ppm (the maximum "peripheral" concentration is 994 ppm).

  The role of methylation in arsenic toxicology continues to be a focus of much scientific interest, and the impact of methylation was emphasized as an uncertainty in the current risk assessment methods by the EPA Arsenic Task

Force (Thomas, 1995). Current evidence in support of methylation as a saturable detoxification mechanism includes: an increase in skin lesions associated with decreased methylating capacity at high doses (Del Razao et al., 1995), and decreases in methylating ability and increases in arsenic tissue levels associated with diets that are deficient in essential proteins and amino acids required for methylation (Vahter, 1995).

Because of the potential impact of detoxification of arsenic, the past EPA administrator has stated that:

> *In reaching risk management decisions in a specific situation, risk managers must recognize and consider the qualities and uncertainties of risk estimates. Based on the Risk Assessment Council's review of the Forum's Report on inorganic arsenic, I am recommending that:...The uncertainties associated with ingested inorganic arsenic are such that estimates could be modified downwards as much as an order of magnitude, relative to risk estimates associated with most other carcinogens. (U.S. EPA, 1988)*

Nevertheless, because of uncertainties in the impact of methylation for reduction of arsenic risk (e.g., see Smith et al., 1992), the EPA continues to use the linear, no-threshold approach for arsenic in assessing risk.

Recent studies of populations drinking high-arsenic well water in Taiwan indicate that both skin cancer and bladder cancer demonstrate possible thresholds for negligible risk at doses which exceed those associated with the upper action level for soil (1,000 ppm) considered here (Guo et al., 1994a,b; 1995). For example, Guo et al. (1995) report a possible threshold for bladder cancer risk at an arsenic concentration in drinking water of 0.17 mg/L. This drinking water concentration under U.S. EPA RME assumptions would be associated with a risk of 4 x 10^{-3} and an equivalent soil concentration of 7,000 ppm, assuming no lower threshold for risk. The predicted risk in Taiwan and equivalent U.S. RME soil concentration would be even greater because of the higher dose associated with greater water consumption in this hotter latitude, more physical labor, and smaller body weight on average. Thus, the implication of a possible threshold or sublinearity in risk is that the 5 x 10^{-4} risk associated with a 852 ppm soil concentration could be overestimated, perhaps considerably, for the majority of the population.

- Other potential sources of overestimation in the **arsenic slope factor** are due to differences inherent in the Taiwanese population as compared to the population in the United States. These differences include diet, hygiene, and exposure by the Taiwanese population to other carcinogenic chemicals in their water as well as sources of arsenic other than drinking water (arsenic contaminated water was used for agriculture and aquaculture). The arsenic slope factor may also be overestimated because those exposed to higher arsenic levels in well water were also of lower socioeconomic status which would increase their disease incidence (U.S. EPA, 1984). In addition, this population relies on a diet of primarily dehydrated sweet potato chips (Chen et al., 1988). These chips would have been grown with arsenic-containing water and would have been rehydrated with arsenic-containing water prior to eating. Thus, the cancer slope factor may have been increased by higher disease incidence in the more exposed group because of poor nutrition and socioeconomic conditions, as well as by underestimation of the arsenic dose. A recent study on 1,571 arsenic-exposed individuals in Taiwan reports an increased prevalence of arsenic-induced skin cancer which was significantly associated with undernourishment (quantified by high consumption of yams) and liver disfunction (presence of hepatitis B surface antigen; Hsueh et al., 1995).

  The IRIS data base record for arsenic indicates that in calculating the RfD for noncarcinogenic effects an attempt was made to incorporate arsenic from yams and rice; however, because experimental data were missing an arsenic contribution of 2 ug/day was assumed from these sources (U.S. EPA, 1995). By comparison, the average dietary intake (probably for the U.S.) is estimated by ATSDR (1993) as 50 ug/day. Consequently, the 2 ug/day additional dietary contribution for the Taiwan situation seems underestimated.

- Studies of United States **populations exposed to arsenic in drinking water** (e.g., Morton et al., 1976; Southwick et al., 1983; Valentine et al., 1992) have not yielded the cancer incidence and health effect rates noted in the Taiwan study or in Mexico or Chile. Whether this difference is due to smaller sample sizes in the U.S. studies than in Taiwan (although the exposed populations in

Mexico and Chile were also smaller than Taiwan), or because of better nutrition and socioeconomic conditions has not been resolved. Nevertheless, the weight of evidence from the number of studies suggests that the toxicity of arsenic may be overestimated at low doses for U.S. populations.

- Cancer slope factors, and therefore risk estimates, do not account for the differences in the **treatability** of different kinds of cancers. For example, skin cancer, which can be induced by arsenic, is considered to be much more treatable than other forms of cancer (U.S. EPA, 1984). Assuming all cancers have the same treatability does not affect the predictions of the potential incidence of excess cancers over background, but it does affect the predictions of the survival rate for cancer victims. Therefore, the risk of death is not the same for all types of cancer. On the other hand, arsenic is suspected to contribute to cancer in other organs based on data from Taiwan (see below for underestimation of risk).

- Uncertainties in the **arsenic inhalation slope factor** that tend to overestimate risk arise from confounding factors in the epidemiological studies used to determine this factor. These studies lack controls for other carcinogenic substances that smelter workers were exposed to, such as other toxic metals, chemicals in smoke, dust, irritants such as acid gases, as well as the higher incidence of smoking in this population as compared to the general population today.

- EPA **toxicity criteria** are typically developed from animal data because of insufficient data in humans. Adequate human data are available for a few chemicals including arsenic, cadmium, and lead by oral and inhalation routes. Accordingly, because of the numerous data gaps, conservative scaling factors and uncertainty factors are used in deriving RfDs. For example, scaling a dose from rodents to humans is often performed on a per body weight basis, whereas the actual dose is more related to surface area which results in a less conservative RfD (i.e., body weight to the 2/3 power; Klaassen and Eaton, 1991). In addition, a NOAEL from an animal study may be divided by an uncertainty factor of 1,000 or more, thus reducing the estimated reference dose.

5.2 Factors Leading to a Possible Underestimation of Risk

Potential underestimation of risk is always possible because sampling every square inch of a site is technically infeasible, toxicity data are often incomplete, and risk assessments must make simplifying assumptions and are unable to assess all hypothetically possible conditions and pathways. These potential sources of underestimation for Everett residential pathways are addressed below. The conservative assumptions presented above are intended to balance factors that tend to underestimate risk.

5.2.1 Data Collection and Evaluation

- Despite the amount of **sampling** of soil, groundwater, surface water, and house dust at the site, some unsampled areas could have higher concentrations than currently measured. The "peripheral" area, especially farther from the smelter, was sampled less frequently and for fewer chemicals. However, information from other smelter sites, such as Tacoma, indicate that offsite levels of other metals are not of concern even though they are elevated on the former smelter site (Glass and SAIC, 1992; Kleinfelder, 1993). These sources of uncertainty are balanced by the use of maximum soil and groundwater concentrations in assessing exposure and risk. Final remedial decisions will be based on more extensive sampling rather than on comparison of the current site data to cleanup levels and action levels. Decisions on chemicals of concern in groundwater may change depending on additional monitoring.

  Similarly, sampling of other chemicals might indicate additional chemicals of concern. This source of underestimation is also expected to be low based on information from other smelter sites.

5.2.2 Exposure Assessment

- Individuals within a population may have higher **exposure rates** than assumed by the separate exposure assumptions. For example, a child on a given day may ingest a handful of dirt rather than 200 mg. A recent evaluation by Stanek and Calabrese (1995) suggests that the 90th percentile level for the average daily soil ingestion rate may be as high as 1,100 mg/day assuming the variability measured in warmer seasons can be extrapolated over a year. Because the amount of variability is likely greatest in warmer seasons, this estimate over a year is probably overestimated (see also Section 4.1.2). The 90th percentile of the average soil ingestion rate during the measurement period was about 180 mg/day (Stanek and Calabrese, 1995). Few children, however, would continue this behavior every day of the year regardless of season. The soil ingestion rate is intended to be a daily average over the exposure period. An actual child may ingest more than 200 mg one day but less than 200 mg on other days.

- Although the MTCA **exposure period** of early childhood results in greater health risks (hazard quotients) for noncarcinogenic effects of chemicals, this assumption (seven out of 75 years) assumes less exposure for carcinogenic effects than under EPA guidelines (30 out of 70 years) because the period of exposure is averaged over a lifetime. Nevertheless, this lower exposure assumption is more than compensated for by a much more stringent risk goal required under MTCA (10^{-6} instead of as high as 10^{-4}). In addition, because the majority of one's exposure is assumed to occur in early childhood when the consumption of soil is the highest, excluding exposure past age six or seven has a small effect on the total amount of exposure assumed.

  Under EPA RME risk calculations, individuals are expected to be exposed to the upper-bound concentration of site chemicals for every exposure pathway for 30 years (i.e., birth to age 30). In assessing carcinogenic risk, this period may also underestimate exposure for lifetime residents at the site. The amount of underestimation, however, as stated above, is slight because the majority of exposure is assumed to occur during childhood. Assuming lifetime exposure instead of 30 years increases exposure and risk by only 1.5 times. Consequently, adding 40 more years as an adult on to the RME assumption contributes little additional exposure. Assuming less than lifetime exposure at the site has the opposite effect of increasing the amount of exposure for noncarcinogenic effects because fewer years at the lower adult dose are averaged with the higher dose during early childhood.

- Not all possible **pathways** were quantified. For example, the dermal pathway was not evaluated and ingestion of surface water by adults was not considered. Based on the calculations performed and the available information, these pathways that were not calculated are not expected to measurably affect the risk estimates. The risk assessment performed for the Tacoma site residential area did not find these pathways to be a concern for determining risks (Glass and SAIC, 1992).

Garden produce exposure was evaluated quantitatively for only root and leafy vegetables. Consumption of other vegetables which currently lack uptake data could increase exposure. Nevertheless, the available information indicates that uptake by these other vegetable types would be less than for leafy and root vegetables. Fruiting vegetables, legumes, and potatoes, which are reproductive or storage organs of plants, accumulate far less metals than roots or leaves (Sikora et al., 1980; U.S. EPA, 1981; U.S. EPA, 1985b,c,d). In fact, the U.S. EPA Standardized Default Guidance (U.S. EPA, 1991c) places tomatoes and legumes in the lowest of four categories for uptake of metals. Potential underestimation of exposure by evaluating only root and leafy vegetables would be offset by the conservative assumption that garden soil concentrations would be similar to the rest of the yard, and the use of higher percentages of home-grown produce and dietary vegetable consumption (see Section 4.1.2). Glass and SAIC (1992) evaluated three other vegetable classes in addition to leafy and root produce and concluded that home-grown vegetables were a minor pathway in comparison to the higher exposure assumed for soil ingestion for the residential area near the Tacoma smelter.

5.2.3 Toxicity Assessment and Risk Calculation

- Ingested arsenic may induce **cancer in other organs** besides skin. An association has been recognized between ingested arsenic and the occurrence of cancer of the bladder, kidney, lung, liver, and colon for the Taiwanese population exposed to arsenic in groundwater (Chen et al., 1985; 1986). Chen and Wang (1990) report a dose-response relationship between arsenic in well water and liver, nasal cavity, bladder, kidney, lung, liver and prostate. Chen and Chen (1991) estimated that risks are of similar magnitude (within a factor of two) for lung, liver, kidney, bladder, and skin. The U.S. EPA has not verified oral slope factors for these internal cancers. Skin and possibly other organ cancers have also been noted in patients treated with high doses of arsenic in medicinal preparations (U.S. EPA, 1992c), but these cancers were not noted for environmental exposures to well water or smelter emissions in the U.S. (e.g., see studies mentioned above in Section 5.1.3). This difference could be attributed to an interaction between low socioeconomic conditions and cancer, the much higher doses in Taiwan and for the patients receiving arsenic in medical treatments, or because the studies in the U.S. lack sufficient statistical power (U.S. EPA, 1988).

A factor that complicates comparisons of the Taiwan data to U.S. populations is the endemic occurrence of blackfoot disease, a peripheral vascular disorder, in this area of Taiwan. This disease has not been noted in U.S. populations consuming high arsenic concentrations in drinking water. Blackfoot disease in Taiwan is thought to be related to ingestion of high arsenic levels in well water along with other contributing factors characteristic for Taiwan. Blackfoot disease patients were at higher risk of developing and dying from cancers of the bladder, skin, lung, and liver compared to the general Taiwan population or residents without the disease in the blackfoot endemic area (Chen et al., 1988; Chiou et al., 1995).

The Taiwanese population exposed to arsenic may also be more at risk for liver cancer than other populations because the occurrence of endemic hepatitis in the area with high arsenic well water (Gibb, 1993). In addition to hepatitis increasing the risk of liver cancer, hepatitis and other liver diseases reduce the ability of the body to methylate arsenic (Buchet and Lauwerys, 1993). This reduced methylate ability would decrease the elimination of arsenic from the body and, perhaps, increase the carcinogenic risk.

Regarding the association of urinary (bladder) cancer with arsenic in drinking water in Taiwan, Guo et al. (1994, 1995) have recently conducted an ecological study to examine this relationship. Their findings show an association between arsenic concentration in well water and urinary cancer incidence only at very high arsenic levels. As a result, the investigators concluded that the findings imply a non-linear dose-response relationship between arsenic exposure and urinary cancer incidence, such that low dose exposures to arsenic would be associated with little cancer risk. Guo et al. (1995) also report that other risk factors may contribute to the dose-response observed, including some humic substances found in well water which have been shown to be mutagenic and associated with bladder cancer. Bladder cancer was also found to be positively correlated with the degree of urbanization, indicating some unmeasured occupational or environmental exposure.

5.3 Factors Leading to a Possible Under or Overestimation of Risk

Several factors, some of which are presented above, have the potential to over or underestimate risk. This section discusses these factors and the likely effect of combining uncertainties in risk assessment.

5.3.1 Data Collection and Evaluation

- A risk assessment depends heavily on the quality and representativeness of the **sampling data**. Uncertainties contributing to sample variation may involve the heterogeneity of the sample matrix (e.g., particle sizes in soil), number of samples taken in various locations, and the field or laboratory analytical techniques. These sampling uncertainties can under or overestimate risk as noted in the above sections.

- No data are available on current **airborne levels** of metals. Consequently, several conservative assumptions were made in modeling concentrations, such as wind erosion from bare soil. The estimated action levels using this model indicated that the contribution of exposure and risk from resuspended dust from soil was negligible relative to the soil ingestion pathway. Nevertheless, other sources of resuspension of metals in air may be possible--such as residents digging in their yards--that are not incorporated in the EPA model. These activities, however, would be short-term on average.

5.3.2 Exposure

- Information is lacking to assess the relative impact on exposure of the **particle size** of chemicals in soil. Chemical absorption and bioavailability increases with decreasing particle size. The smaller soil size fraction could be more enriched in metals in flue dust and from particulate emissions from the smelter. Arsenic and lead in soil from smelting processes and in ore, however, have been shown to be less than 100 percent absorbed in several studies (see above for overestimates of exposure). Metals in soil also bind to organic matter and form complexes with other metals such as iron and manganese. The amount of exposure to these metals in soil may thus depend on the source (e.g., stack emissions, ore handling emissions, or demolition debris), and amount of time since these metals were deposited in soil.

The important consideration for risk assessment is whether the particle size and absorption characteristics would change assumptions on the amount of soil ingested or the amount of chemical absorbed. Specifically, the RME soil ingestion rate for children is based on mass-balance studies using tracer elements in soil. Although soil ingested by children may be of relatively small particle size, soil samples for tracers in these studies and for chemicals at a site may include larger particle sizes as well. Sampling larger particle sizes would underestimate the fraction of tracer elements or chemicals in the soil by weight relative to the concentration in dust that children ingest incidentally. The effect of such inaccuracies in measurements and assumptions on exposure estimates is unclear. If the particle sizes of tracer elements in soil are similar to that of metals or metal complexes at the site, then under or overestimation would be slight.

- MTCA and EPA residential exposure assumes that the current site conditions remain the same over 75, 70, or 30 years of exposure. In actuality, exposed soil could be covered by landscaping and paving. Conversely, covered areas could be disturbed. Any of these conditions could affect the actual amount of exposure.

5.3.3 Toxicity Assessment and Risk Calculations

- The exact **absorbed dose by inhalation** for the toxicity criteria of the chemicals of concern is unknown. Chemicals in resuspended dust were evaluated using a standard EPA model that estimated the fraction of fine particles (PM_{10}) resuspended in air. Accordingly, an attempt was made to correct the slope factors for arsenic and cadmium to absorbed doses that might be more representative of exposure to fine particulates. U.S. EPA has calculated an inhalation slope factor for arsenic based on an absorbed dose by assuming smelter workers in the epidemiological studies had 30 percent lung absorption (U.S. EPA, 1984). This assumption may under or overestimate risk. The 30 percent rate is based on a study of arsenic absorption from cigarette smoke (ATSDR, 1993), which presumably may be composed of smaller particles than would be encountered from smelter operations. By contrast, attempts to correlate air concentrations to urinary arsenic levels in smelter workers have indicated that arsenic absorption may be as high as 40 percent to 60 percent (U.S. EPA, 1984). This estimate could have been increased by ingestion of larger arsenic particles that are coughed up and swallowed or incidentally ingested. The differences in relative particle sizes and bioavailability between arsenic in the work place for a smelter, and arsenic in resuspended dust at the site, are thus uncertain.

- The effect of **combining uncertainties** from the various assumptions in the risk assessment is partially demonstrated by the difference between "typical" (average) and RME risk calculations. To address potential uncertainties, a number of conservative estimates were used for the RME calculations, which combined could overestimate risk considerably for most individuals. As noted by Habicht (1992), maximizing all variables will result in an estimate that is above the actual values seen in the population in virtually all cases. This recent guidance therefore recommends the use of near maximum values for one or a few variables with the majority being mean values, and recommends that an average case be evaluated as a comparison.

  The "typical" assumptions are based on more average exposure assumptions that may underestimate risk for some individuals. The "typical" case for this site, however, still incorporates several conservative assumptions such as in the toxicity criteria.

- **Interaction effects** from simultaneous exposure to chemicals can be additive, antagonistic (less than expected), or synergistic (more than expected). Whether chemical effects interact depends on the dose and mechanism of chemical action. For example, at high doses, arsenic, lead, cadmium and mercury may all affect the kidneys. At the low doses expected at the cleanup levels, however, none of the relevant chemicals are expected to interact. Interactions among metals are often antagonistic (i.e., tending to cancel each other out) by competition for gastrointestinal absorption or by mechanisms related to detoxification processes (summarized by Goyer, 1991). For example, iron, calcium, and zinc decrease absorption and toxicity of cadmium and lead. Selenium may decrease the toxicity of arsenic.

  The additive effect of hazards by all pathways and chemicals was considered. EPA guidelines for risk assessment (U.S. EPA, 1989b) state that "dose additivity is most properly applied to compounds that induce the same effect by the same mechanism of action." Doses from different pathways also may or may not be additive. Uncertainties associated with additivity have a minor effect on the overall results because one chemical, arsenic, is primarily associated with the majority of risk by one pathway or at most two pathways.

- The measured **blood lead and urinary arsenic levels** of children may be higher or lower in actuality. Sources of variation include the measurement technique, season, and differences among children.

  Blood lead studies have been criticized as being representative of only very recent exposure prior to measurement. Nevertheless, as summarized by Bornschein et al. (1991), blood lead measurements in children have shown a high degree of inter-correlation among repeated sampling, even after a period of five years (r=0.72). Consequently, a random sampling of a large part (e.g., 75% or more) of a population would be representative of average blood lead levels and the amount of variation in the community.

- The **estimated areas of concern** which potentially exceed the cleanup levels and action levels are approximations, based on the sampling data to date. Because every yard was not extensively sampled, the exact yards and areas exceed the levels of concern are unknown at this time.

5.4 Conclusions

Every aspect of risk assessment contains multiple sources of uncertainty. Because the exact amount of uncertainty is impossible to quantify, reasonable maximum exposure is intended to overestimate rather than underestimate risk, although the probability that such a combination of assumptions would occur may be remote. "Typical" exposures are calculated as a comparison to provide conservative estimates that are closer to what individuals within a possible exposed population might experience. The results of this risk assessment therefore are unlikely to underestimate the actual risks to public health despite the inherent uncertainties in the process.

as paint. Cleanup actions for arsenic below 500 ppm would result in few lead levels in excess of the 400 ppm screening level under EPA guidelines

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TABLE J1-A
RISKS FROM SOIL INGESTION

RME SUMMARY INTAKE FACTORS

Exposure Pathway	Contact Rate CR	Conversion Factor CF	Frequency EF (days/years)	Duration ED (years)	Body Weight BW (kg)	AT (days)		Summary Intake Factor[a] SIF	
						noncarcin.	carcinogen	noncarcinogen	carcinogen
soil 1	200 (mg/day)	1E-06 (kg/mg)	350	6	15	10,950	25,550	3.65E-06 (kg soil)	1.57E-06 (kg soil)
ingestion 2	100 (mg/day)		350	24	70			(kg BW*day)	(kg BW*day)

RISKS & HAZARDS FOR INGESTION EXPOSURES

Chemical	Soil Conc. (mg/kg)	Slope Factor SF (mg/kg/day)$^{-1}$	Risk[b]	RfD (mg/kg/day)	Hazard Quotient[c] HQ
Arsenic[d]	7	1.5	4.1E-06		
	20		1.2E-05		
	50		2.9E-05		
	76		4.5E-05		
	100		5.9E-05		
	152		8.9E-05		
	230		1.4E-04		
	500		2.9E-04		
	1,000		5.9E-04		
Cadmium	1			0.001	0.0037
	14				0.051

NOTES

[a] Soil Ingestion SIF = $CF \times [(CR_1 \times EF_1 \times ED_1 / BW_1) + (CR_2 \times EF_2 \times ED_2 / BW_2)] / AT$

[b] Risk for carcinogens = (Soil Conc. x SIF x SF x Absorption)

[c] Hazard Quotient for noncarcinogens = (Soil Conc. x SIF) / RfD

[d] Calculated including a 25% gastrointestinal absorption rate.

TABLE J1–C
RISKS FROM EATING HOME–GROWN VEGETABLES

SUMMARY INTAKE FACTOR[a]

Exposure Pathway		Contact Rate CR		Conversion Factor CF		Frequency EF (days/years)	Duration ED (years)	Body Weight BW (kg)	AT (days)		Summary Intake Factor	
									noncarcin	carcinogen	noncarcinogen	carcinogen
leafy vegs.	1	0.3	(g/day)	1E–03	(kg/g)	40	6	15	10,950	25,550	2.19E–06 (kg soil)	9.39E–07 (kg soil)
	2	1.4	(g/day)			40	24	70			(kg BW x day)	(kg BW x day)
root vegs.	1	1.5	(g/day)	1E–03	(kg/g)	69	6	15	10,950	25,550	9.18E–06 (kg soil)	3.94E–06 (kg soil)
	2	2.5	(g/day)			69	24	70			(kg BW x day)	(kg BW x day)

UPTAKE RATIOS[b]

Chemical	Intercept Slope	Beet Greens	Lettuce	Beets
Arsenic	Intercept			–3.51
	Slope			–0.61
Cadmium	Intercept	1.31	1.33	–0.42
	Slope	–0.72	–0.64	–0.64

UPTAKE FACTORS

Chemical	Soil Conc. ppm	Uptake Factor[c]			
		Beet Greens	Lettuce	Beets	Average of Beet Greens & Lettuce
Arsenic	17,500			0.0000772	0.02[d]
Cadmium	1	3.70617	3.781043	0.6570468	3.7436

TARGET SOIL CONCENTRATIONS FOR VEGETABLE INGESTION EXPOSURE

Chemical	Leafy Uptake	Root Uptake	Soil Conc. (mg/kg)	RfD (mg/kg/day)	SF (kg/mg–day)	HQ[e]	Risk[e]
Arsenic	0.02	0.000077	7	3.0E–04	1.5		2.0E–07
			20				5.7E–07
			50				1.4E–06
			76				2.2E–06
			100				2.9E–06
			152				4.4E–06
			230				6.6E–06
			500				1.4E–05
			1,000				2.9E–05
Cadmium	3.74361	0.65705	1	1.0E–03		0.01	
			14			0.20	

[a] Summary Intake Factor Vegetable (SIF) = $CF \times [(CR_1 \times EF_1 \times ED_1 / BW_1) + (CR_2 \times EF_2 \times ED_2 / BW_2)] / AT$

1 Children 2 Adults

[b] Calculated from log–log regression by Glass and SAIC (1992) from data by Heilman and Ekuan (1977).

[c] Uptake Factor = $e^{\text{intercept}} \times \text{soil conc.}^{\text{slope}}$

[d] Based on Glass and SAIC (1992).

[e] HQ = [(LU x LIF x SC) + (RU x RIF x SC)]/RfD

HQ = Hazard Quotient
LU = Leafy uptake (Average lettuce and beet greens)
LIF = Leafy Intake Factor

Risk = [(LU x LIF x SC) + (RU x RIF x SC)] x SF
RU = Root uptake (Beet Uptake Factor)
RIF = Root Intake Factor
SC = Soil concentration

TABLE J1 – D
RISKS FROM DUST INHALATION

SUMMARY INTAKE FACTOR

Contact Rate CR (m^3/day)	Frequency EF (days/years)	Duration ED (years)	Body Weight BW (kg)	Averaging Time AT (days)	Summary Intake Factor SIF
				carcinogen	carcinogen
20	350	30	70	25,550	1.17E–01 (m^3/kg–day)

TARGET SOIL CONCENTRATIONS FOR INHALATION EXPOSURES

Chemical	Soil Conc. SC	Slope Factor SF $(mg/kg/day)^{-1}$	Particulate Emission Factor PEF (m^3/kg)	Risk (mg/kg/day)
Arsenic	7	50.0	4.63E+09	8.87E–09
	20			2.54E–08
	50			6.34E–08
	76			9.64E–08
	100			1.27E–07
	152			1.93E–07
	230			2.92E–07
	500			6.34E–07
	1,000			1.27E–06
Cadmium	1	6.3	4.63E+09	1.60E–10
	14			2.24E–09

NOTES
Summary Intake Factor (SIF) = (CR x CF x EF x ED) / (BW x AT)
Carcinogenic Risk = (SC x SIF x SF) / (PEF)
PEF = Particulate Emission Factor (see next page)

TABLE J1–D (cont'd)
RISKS FROM DUST INHALATION

Particulate Emission Factor (PEF) Formula

$$\text{PEF } (m^3/kg) = \frac{LS \times V \times DH \times 3600 \text{ s/hr}}{A} \times \frac{1000 \text{ g/kg}}{0.036 \times (1-G) \times (U_m/U_t)^3 \times F(x)} = 4.63E+09 \quad m^3/kg$$

Where:	Default Values[a]
LS = width of contaminated area (m)	45
V = wind speed in mixing zone (m/s)	2.25
DH = diffusion height (m)	2
A = area of contamination (m^2)	2025
0.036 = respirable fraction (g/m^2–hr)	0.036
G = fraction of veg. cover (unitless)	0
U_m = mean annual wind speed (m/s)	4.5
U_t = equivalent threshold value of wind speed at 10 m (m/s)	12.8
F(x) = function dependent on U_m/U_t (unitless)	0.0497

NOTES:

[a] Default values obtained from U.S. EPA (1991d).

TABLE J1 – E
ACUTE EXPOSURES FOR CHILDREN PLAYING IN SURFACE WATER

Chemical	Min Site Conc. (mg/L)	Max Site Conc. (mg/L)	Maximum Concentration Location	Min Dose (mg/kg)	Max Dose (mg/kg)	Toxicity Value	Min HR	Max HR
Arsenic	0.006	6.2	SW–10	2.00E–05	2.07E–02	0.01 [a] (mg/kg)	0.002	2
Cadmium	0.025	0.025	SW–10	8.33E–05	8.33E–05	0.2 [b] (mg/kg)	0.0004	0.7
Lead	0.007	0.116	SW–9			0.17 [c] (mg/L)	0.04	0.7

NOTE
Dose = (Max. Concentration x 50 ml of water) / 15 kg
HR = Hazard Ratio = (Dose / Toxicity Value)

[a] Based on an acute exposure LOAEL in humans, with a factor of 10 each for use of a LOAEL and for serious effects (ATSDR, 1993).

[b] Based on acute exposure NOAEL in humans (U.S. EPA, 1985a).

[c] Based on the uptake/biokinetic model for lead using a target blood lead level of 30 ug/dl to arrrive at a target water concentration.