

**REMEDIAL INVESTIGATION REPORT  
(PHASE II)**

**OF J.H. BAXTER & CO.  
EUGENE, OREGON SITE**

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## 1.0 INTRODUCTION

This report presents the results of Phase II of the Remedial Investigation (RI) for the J.H. Baxter Wood Preserving (JHB) site located in Eugene, Oregon. This report was prepared by Keystone Environmental Ltd. (Keystone) on behalf of J.H. Baxter Wood Preserving. The information contained in this report was prepared pursuant to the Remedial Investigation Work Plan (Phase II) prepared by Keystone Environmental Ltd. in September 1991 (then Keystone Environmental Resource, Inc.).

The objectives of the Phase II Remedial Investigation as described in the Work Plan were to:

- o Define the nature and extent of Potential Constituents of Concern (PCOCs) that have migrated in the groundwater, surface waters and sediments beyond the J.H. Baxter site boundaries;
- o Define the nature and extent of PCOCs in the onsite soils;
- o Provide supplemental analytical data to refine the Phase I assessment of the potential risk to human health and the environment; and
- o Gather necessary data to support the evaluation of remedial alternatives and the selection of a remedy.

To achieve the objectives of the Phase II RI, nine additional monitoring wells were installed, thirty-two soil borings were drilled, four offsite sediment/surface water samples were collected and nine offsite surface soil samples were obtained. Two of the Phase II monitoring wells were installed on J.H. Baxter property and the remaining seven wells were installed north of the J.H. Baxter property in the city streets. As part of the Phase II RI, sampling and analyses were performed on;

- o Surface and subsurface soils onsite,
- o Groundwater onsite and offsite,
- o Sediment from offsite drainage ditches,
- o Surface water from offsite drainage ditches, and
- o Surface soils from offsite.

Results of the sampling and analyses have been used to evaluate the nature and extent of onsite soil contamination and offsite groundwater, surface soil, sediment and surface water contamination. The sampling results have also been used to refine the Public Health and Environmental Assessment (PHEA) of the "no action" alternative at the site performed in the Phase I RI.

### **1.1 Site Background**

For a detailed description of the site background refer to the Phase I RI report, dated August 1991.

### **1.2 Site History**

The site history of the J.H. Baxter facility is discussed in the Phase I RI Work Plan (March 1990), the Phase I RI report (August 1991) and the Phase II RI Work Plan (September 1991).

### **1.3 Site Features**

Two significant features have been constructed on the plant site since the completion of the Phase I RI work. These include a groundwater treatment plant which is located along the northern property boundary just west of the W-13 well nest and a recently constructed concrete drip pad and accompanying roof structure to shelter newly released charges.

### **1.4 Summary of Phase I RI Results**

The following is a summary of the findings of the Phase I RI. For a detailed discussion and presentation of the Phase I findings refer to the Phase I RI report.

#### **1.4.1 Site Geology and Hydrogeology**

Geologic information for the site, obtained during the Phase I RI, was determined through observations made during the monitoring well installations performed by Keystone in May/June of 1990.

The shallow geology of the site consists of quarternary age alluvial deposits. These deposits are composed of sand and gravel, with lesser amounts of silt and clay. The sand and gravel deposits overly a clay unit which is encountered at depths ranging from approximately 80 feet below grade to approximately 90 feet below grade. Beneath the clay layer in the northwest portion of the Baxter property are deposits of medium to coarse sand and gravel.

Based on the drilling program, the uppermost unconsolidated deposits which are comprised of silt, clay and gravel vary gradationally over the site. These deposits are relatively uniform in thickness over the site (approximately 10 to 15 feet thick).

Beneath these uppermost deposits are sediments which are dominated by gravels mixed with varying types and amounts of finer materials including sand, silt and clay. The deeper gravels in these sediments generally tend to have lower proportions of fine materials such as silt and clay than the shallower portion of the gravel sediment sequence. However, in the southern part of the site the gravel sediments contain a larger proportion of fines.

Although gravel dominates this geologic sequence there are sand and clay lenses within the gravels. The gravel sequence of sediments is approximately 60 to 70 feet thick beneath the western half of the Baxter property.

Underlying the gravel sediment sequence is a clay layer comprised of two distinct clay units. The shallower clay unit can be described as a brown to gray, plastic, moist clay. Immediately beneath the brown to gray clay is a blue or blue to gray clay unit which can be described as lean and of low to medium plasticity. The contact between these two clay units is sharp. Based on the drilling program it is evident that the brown to gray clay ranges in thickness from approximately 20 feet in the southern part of the site to approximately 3 feet near the western boundary of the site. Both clays were penetrated in the northern portion of the site during the Phase I RI well installations. The total clay thickness encountered in this area was approximately 30 to 35 feet. The top of the brown clay unit dips to the northwest beneath the Baxter property with a slope of approximately 1.25 percent.



Medium to coarse sands and gravels with minimal amounts of finer materials were discovered beneath the blue clay in the northern section of the site. Significant quantities of water under pressure were flowing into the boring during drilling. This geologic unit represents a confined artesian aquifer.

Groundwater is present beneath the site at a depth of approximately 5 to 8 feet below grade, depending on the season and area of the site. The shallow aquifer is semi-confined or leaky in nature (confirmed from two aquifer tests conducted as part of the Phase I RI). The groundwater flow direction in the shallow aquifer is to the north-northwest with an average hydraulic gradient of 0.006. An average linear groundwater velocity of approximately 80 ft/year was calculated for the shallow aquifer.

#### **1.4.2 Groundwater Characterization**

Pentachlorophenol (PCP) was detected in the majority of the monitoring wells. The highest concentrations of PCP were present in wells W-6I and W-7S (near chemical storage tanks and retorts), in well W-8S (situated at former burn pit), and in wells W-13I and W-13S (downgradient of the former burn pit and retort area). PCP concentrations in these wells varied from 778 ug/L in well W-6I to 1,300 ug/L in well W-13S. The PCP plume appeared to extend offsite to the north, and possibly west of the Baxter property boundary.

Volatile Organic Compounds (VOCs) were detected in four monitoring wells on the site (wells W-6I, W-7S, W-8S and W-13S). Dichloroethene, dichloroethane and benzene were detected in well W-13S which is situated at the northern property boundary of the Baxter site. It is reasonable to conclude that these 3 compounds have migrated off-site to the north (downgradient direction) in the groundwater. Wells W-8S and W-7S contained the highest concentrations of VOCs. W-7S is situated near the wood treating area of the plant which includes the plant maintenance shops. Well W-8S is located within the area of the former burnpit which is a potential source for VOCs.

Polycyclic Aromatic Hydrocarbons (PAHs) were detected in several of the monitoring wells. Wells W-7S, W-2S and W-8S had total PAH concentrations

greater than 1 mg/L. Naphthalene comprised approximately 43% to 87% of the total PAH concentration in these wells. PAHs were detected at low concentrations in wells W-13S and W-13I which are situated at the northern border of the site.

Metals associated with the wood treating chemicals and processes used at the plant were detected at a few well locations. Arsenic was detected in wells W-2S, W-7S and W-8S at concentrations (total) of 0.012 mg/L, 0.031 mg/L and 0.18 mg/L, respectively. Chromium was detected in well W-1S at a concentration (total) of 0.014 mg/L. Chromium was not detected in any of the other monitoring wells. Copper was also detected in only one of the monitoring wells during the Phase I RI sampling session. In well W-13S copper was present at a concentration (total) of 0.035 mg/L. Zinc was detected in several of the monitoring wells at concentrations (total) ranging from 0.022 mg/L (well W-4S) to 0.062 mg/L (W-13S).

#### **1.4.3 Surface Water Characterization**

Onsite surface water samples were collected from the surface water retention pond in the southwest corner of the site, from the ditch draining the pond and a drainage ditch that parallels the southern property boundary and exits the site at the southwest corner of the property.

The analytical results of the surface water samples indicate that the retention pond and the onsite drainage ditch downstream of the retention pond are contaminated with PAHs, PCP and arsenic. The furthest downstream surface water sample obtained in the drainage ditch had a total PAH concentration of 8.3 ug/L, a PCP concentration of 44 ug/L and an arsenic concentration (total) of 0.18 mg/L. This sampling point was approximately 100 feet east of the western property boundary for the site. The extent of PAHs, PCP and arsenic west of this point in the drainage ditch was not determined.

#### **1.4.4 Sediment Characterization**

Sediment samples were obtained at the identical locations as the surface water samples for the Phase I RI. The analytical results for the sediment samples correlate well with the analytical results of the surface water samples. The sediment recovered



from the bottom of the retention pond contained PAHs, PCP, arsenic, chromium, copper and zinc. The onsite sediment samples situated downstream of the retention pond had PAHs, PCP, arsenic, chromium, copper and zinc detected in them. The downstream extent of the sediment impacted by the constituents above was not determined in the first phase of the RI.

#### **1.4.5 Subsurface Soil Characterization**

The subsurface soils at the site were evaluated from samples taken during the drilling of the monitoring wells performed for the first phase of the RI. A total of six soil samples were retained for analysis from the well borings. The soil samples were obtained over either a 1 foot or 1.5 foot depth range at each location. The portion of the soil profile sampled was from approximately 1.5 feet below grade to 8 feet below grade.

PAHs, phenols and metals (arsenic, chromium, copper or zinc) were detected in some of the soil samples. PAHs were detected at low concentrations (ie. less than 1 mg/kg) in the samples obtained from borings W-9S, W-9I, W-12I and W-13S. Phenolic compounds were detected in four of the six soil samples. PCP was only detected in the sample taken from boring W-12I at 3 to 4.5 feet below grade. The PCP concentration in the soil was less than 1 mg/kg.

The sparse nature of the soil sampling during the Phase I RI prevent a reasonable evaluation of the general soil quality on the property.

#### **1.4.6 Public Health and Environmental Assessment**

As part of the Phase I RI, a Public Health and Environmental Assessment was performed for specific exposure to PCOCs detected at the site. The pathways investigated consisted of:

- o Current residents - offsite (adult and child): inhalation of airborne particulates from onsite soil;

- o Future residents - offsite (adult and child): inhalation of airborne particulates from onsite soil, and inhalation, ingestion and dermal exposure to PCOCs in on-site groundwater, assuming the contaminants in the groundwater plume are moving toward the residences unaltered;
- o Onsite workers (adult): inhalation of airborne particulates and ingestion of onsite subsurface soils, and;
- o Trespassers - onsite (adolescent): dermal exposure to on-site surface water and sediments from the drainage ditch.

The Phase I quantitative risk assessment indicated that ingestion of PCOCs in the groundwater plume which would travel from the site to the residential neighborhood (future offsite residents scenario for both the adult and child) was the most significant exposure, resulting in risk levels (for carcinogenic compounds) and hazard indices (for non-carcinogenic compounds) greater than the target risk ranges. (Assuming the groundwater plume will move off-site without mitigating effects on contaminants concentration). All other pathways investigated showed risk levels and hazard indices lower than or within target risk ranges.

Utilizing the available data, certain receptors and exposure pathways could not be assessed in the Phase I report. As well, onsite workers were assessed with data originating from subsurface soil instead of surface soil, thus the assessment exposure contains more uncertainties than if surface soil data (the actual media workers are potentially exposed to) were used for the quantification of the risks. This aspect will be addressed in the Phase II refined risk assessment.

**2.0    INVESTIGATIVE METHODS AND RESULTS**

This section discusses the site geology and hydrogeology incorporating the findings of the Phase I and Phase II investigation programs. The field methods employed in Phase II RI are also summarized.

Additionally, the analytical results of soil, groundwater, sediment and surface water samples are presented and discussed in this section.

**2.1    Investigative Methods**

Specific procedures used in the investigation to sample soils and groundwater, decontaminate equipment and record observations are detailed in the Phase I Work Plan document developed by Keystone in December 1989 and revised in March 1990. Some of the procedures outlined in the Work Plan are repeated in this section and any deviations in specific procedures from the Phase I or Phase II Work Plans are noted and discussed.

The chronology of Phase II RI field activities are summarized below.

| <u>Activity</u>               | <u>Date Performed</u>  |
|-------------------------------|------------------------|
| Monitoring Well Installation  | November/December 1991 |
| Groundwater Sampling          | January & May 1992     |
| Residential Well Sampling     | September 1992         |
| Residential Well Sampling     | December 1992          |
| Sediment Sampling             | March 1993             |
| Surface Water Sampling        | March 1993             |
| Residential Well Sampling     | March 1993             |
| Offsite Surface Soil Sampling | June 1993              |
| Residential Well Sampling     | June 1993              |
| Residential Well Sampling     | December 1993          |
| Onsite Soil Sampling          | January 1994           |
| Groundwater Sampling          | February 1994          |

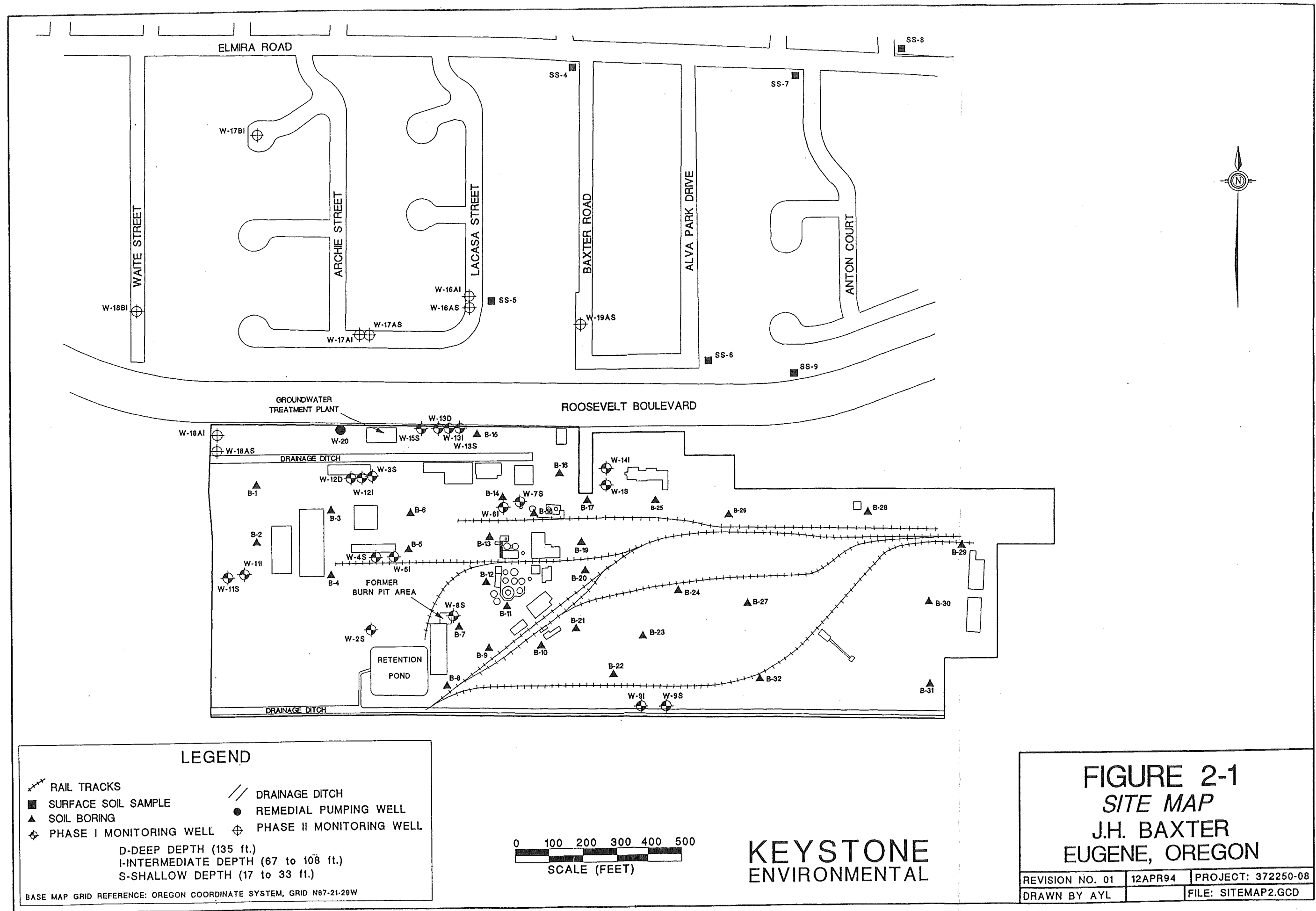
**Monitoring Well Installation**

Monitoring wells were installed to delineate the extent of contamination offsite and to further define the local geology and hydrogeology. A total of nine additional wells were installed at six locations. The nine wells installed were; W-16A(S), W-16A(I), W-17A(S), W-17A(I), W-17B(I), W-18A(S), W-18A(I), W-18B(I), and W-19A(S). The (S) designates a shallow well and (I) indicates that the well is an intermediate depth well (ie. bottom of well on top of clay layer). Although the W-18A wells are on J.H. Baxter property they are located in the northwest corner of the site which is remote from the active area of the property and historic operating and storage areas. Figure 2-1 shows the locations of the Phase II RI wells and the monitoring wells previously installed on the site.

Seven monitoring wells were installed offsite and two wells installed onsite to delineate the extent of detected contamination in the shallow alluvial aquifer present beneath the Baxter site. The Phase I RI determined that PCP was present in the majority of onsite monitoring wells, and that the offsite extent of PCP, may be greater than other site related PCOCs.

To investigate the downgradient extent of PCOCs in the groundwater, monitoring wells were installed progressively northwards from the site until PCP was not detected in a sample of the groundwater from the well. This determination was made during the field program using a new field screening procedure. The new field testing procedure was a Rapid Immunoassay Screen (RIS) technique, specific to PCP, supplied by Ensys Inc. of Raleigh, North Carolina. The RIS was capable of detecting PCP at concentrations as low as 5 ug/L and each test was performed in the Baxter laboratory in approximately thirty minutes. Documentation on the RIS sample analysis procedure, previous field test results, and advantages of the method are provided in Appendix A of the Phase II Work Plan.

The groundwater samples for the RIS analyses were collected subsequent to well purging. The shallow wells (eg. approximately 25 feet below grade) were purged by



using laboratory-cleaned dedicated stainless-steel bailers. A minimum of 3 casing volumes of water was removed during the purging procedure. The intermediate depth wells were developed using a Grundfos submersible pump which was decontaminated between each well location. A minimum of 3 casing volumes of water was removed prior to obtaining a sample to be analyzed by the RIS method. For detailed procedures and descriptions of well development and purging refer to the Standard Operating Procedures (SOP 201-Groundwater Sampling from monitoring wells and SOP 302-Monitoring Well Installation) provided in Appendix B of the Phase I RI Work Plan.

The W-13 well nest (ie. wells W-13S, W-13I and W-13D) was used as a reference point for the design of the Phase II well installation program because these wells are situated where concentrations of site contaminants, particularly PCP, are suspected of exiting the site. PCP concentrations in the shallow well, W-13S, and the intermediate well, W-13I, were approximately 1 mg/L. The proposed offsite monitoring well locations were positioned in a fan-like pattern extending from the approximate position of the W-13 well nest. To provide an efficient system for the well installations a strategy was developed utilizing the RIS field sampling technique. Wells installed were sampled for PCP in the field using the RIS screening technique. If PCP was detected in the well then another well was installed further downgradient from the site. The RIS screening results were:

- o Well W-18AS - negative for PCP (<5 ug/L);
- o Well W-16AS - negative for PCP (<5 ug/L);
- o Well W-17AS - negative for PCP (<5ug/L);
- o Well W-19AS - negative for PCP (<5 ug/L);
- o Well W-18AI - positive for PCP (>50 ug/L);
- o Well W-17AI - positive for PCP (>5ug/L);
- o Well W-16AI - negative for PCP (<5ug/L);
- o Well W-18BI - negative for PCP (<5ug/L); and
- o Well W-17BI - negative for PCP (<5ug/L).

In an effort to minimize impact on the offsite residents and to the offsite surface environment (fields, lawns, etc.) the offsite wells were installed in the City streets.



Subsurface soil samples were collected from well boreholes to characterize the offsite geology and determine the well screen placement location. Soils were classified according to the Unified Soil Classification system (ASTM D2488-84).

### **Monitoring Well Construction**

Phase II wells were installed in accordance with OAR-690-122 and the Guidelines for Monitoring Well Drilling, Construction, and Decommissioning (State of Oregon, Department of Environmental Quality, May, 1990). A summary of the well construction is provided below. Shallow monitoring wells were installed by using a hollow stem auger drilling rig and intermediate depth wells were installed using an air rotary drilling rig with a pneumatic casing driver.

The intermediate depth well construction differed from the intermediate well construction described in the Phase II Work Plan at each location except for well W-18A(I) which was the first intermediate well installed. During this well installation problems occurred in the placement of the sand pack and bentonite seal as a result of the limited annular space available between the 4-inch PVC pipe and the 6-inch diameter casing. It was decided that 8-inch casing would be used to set the remaining intermediate wells. The 8-inch casing provided an annular space large enough to reduce the potential for bridging of the sand or bentonite.

Intermediate well depths varied from approximately 80 to 90 feet below grade. However, at each intermediate well location drilling continued into a lower confined sand and gravel aquifer which resulted in drilling depths at intermediate well locations ranging from 90 to 110 feet below grade. Subsequent to reaching the termination depth of the boring, the 6-inch or 8-inch steel casing was pulled up to the desired depth of the well. Bentonite chips were then poured into the casing to fill the bottom of the open hole. The bentonite was brought up to within several feet of the desired well depth and left overnight to permit expansion prior to well construction. The well was set the following day.

Sand filter packs were installed to at least 2 feet above the top of the well screen. If necessary the sand was tremied into place (intermediate wells only). Approximately

2 feet of pelletized bentonite was added above the sand to isolate the sand pack and screen. The remaining annular space was grouted by tremie tube (intermediate wells only), from the bottom of the annulus as the casing strings were withdrawn. Grout consisted of a high solids bentonite grout or bentonite chips.

Shallow wells were installed to a depth of approximately 25 feet below grade through the hollow stem augers. The shallow well depth of 25 feet was chosen so that the well screens, which were 10 feet in length, would be entirely within the sand and gravel sequence beneath the surficial gravelly, silty clay layer present in the area of the site. Contaminants migrating in the shallow groundwater would spread faster in the sand and gravels than the silt or clay as a result of their higher hydraulic conductivity. Therefore, to evaluate the extent of contamination in the shallow groundwater zone it was more appropriate to examine the characteristics of the groundwater in the shallow aquifer rather than monitor the groundwater in the surficial aquitard. The sand pack, bentonite seal and grout were added incrementally as the augers were retrieved from the well boring. Each shallow well was constructed of schedule 40, 2-inch PVC screen (.01 inch slot size) and schedule 40, 2-inch PVC riser pipe.

Flush-mount steel bolt-down covers were installed at each offsite well head to protect and secure the offsite wells. Upon completion, the intermediate wells were developed by pumping with a submersible Grundfos pump. Drill water and development water was contained for processing through the plant wastewater system. Drill equipment was decontaminated before each well was drilled by steam-cleaning. The decon area was on the Baxter property in front of the mechanical shops (identical location as the Phase I RI). Since the drill rig had to travel back to the site for decontamination, the drilling rods, augers and sampling equipment were wrapped in plastic during transport. All drill cuttings were containerized and stored onsite in an approved storage area. All containers were labelled to identify the well and date collected.

### **Groundwater Sampling**

The sampling procedure used for the Phase II well sampling was consistent with the procedures used to perform the Phase I RI well sampling and regular well sampling



required in the groundwater monitoring plan for the site. The sampling of the nine Phase II RI wells was conducted in January 1992 which coincided with the first quarter sampling event. An additional sampling round including the Phase II wells was conducted in May 1992 as part of the annual sampling for the J.H. Baxter site.

Water levels were obtained from all wells before groundwater samples were collected. Wells were checked for specific conductance, temperature, and pH prior to purging. Each well was checked for light and dense non-aqueous phase liquids (LNAPLS & DNAPLs) prior to purging. Purging was continued until specific conductance, temperature and pH had stabilized according to the criteria in the groundwater monitoring plan. Purging was conducted by portable submersible pumps which were decontaminated according to Keystone's standard operating procedures detailed in the Phase I RI Work Plan. A table summarizing purged well volumes, pH, temperature, specific conductance and samplers observations is included in Appendix B in the groundwater analytical results section. Sample container preparation, including preservatives used, and QA/QC samples collected (eg. trip blanks, field blanks, duplicates) during the sampling procedure are discussed and detailed in the Phase II Work Plan (section 5.2).

All Phase II wells were sampled and analyzed for the constituents of concern related to the wood treating activities at the site including PAHs, volatile aromatics (VOAs), phenols, total and dissolved arsenic, chromium, copper and zinc in January and May of 1992. The groundwater samples were packaged in coolers with ice and sealed for transportation to the laboratory. In January and May, the samples that were analyzed for VOAs, metals and phenols were shipped to Chester's laboratory in Portland, Oregon for analysis. The samples that were analyzed for PAHs were shipped via overnight express to Monroeville, Pennsylvania for analysis. Chain of custody procedures were followed through the collection, transference and receipt of samples at the laboratory.

#### **Onsite Soils Investigation**

A total of thirty-two soil borings were drilled on the plant site to evaluate the shallow soil quality. The soil borings were drilled using hollow-stem augers and soil samples

were collected using a split-spoon sampler. Geotech Exploration Ltd. of Portland performed the drilling of the borings. All soil sampling was performed under the supervision of a Keystone hydrogeologist. The soil boring locations are displayed on Figure 2-1.

The soil borings were advanced to the approximate depth of the water table. At the time of drilling, January 1994, the water table was encountered at a depth of approximately 5 feet below grade. Two soil samples were retained from each boring for chemical analysis. These generally consisted of a surface sample and a sample from just above the water table. At some locations coarse gravels and cobbles were present at grade which were not suitable for analysis. Therefore, a sample from immediately below the coarse fill was collected for analysis. The split-spoon samplers were washed thoroughly in soapy (alconox) water and rinsed thoroughly between samples. Enough augers were available to drill and sample three soil borings before decontaminating the equipment. A steam-cleaner was used to clean the augers, drill rods and split-spoons during each decontamination session.

All soil cuttings brought to the surface during the investigation were placed in 30 gallon steel drums for storage onsite. The drums were labeled with the borehole number and drilling date. The boreholes were sealed with bentonite chips to prevent surface water infiltration. Soil samples were field classified according to the Unified Soil Classification System (ASTM D2488-84) and any visible or odorous evidence of contamination was recorded (see drill logs in Appendix A).

#### **Surface Water/Sediment Characterization**

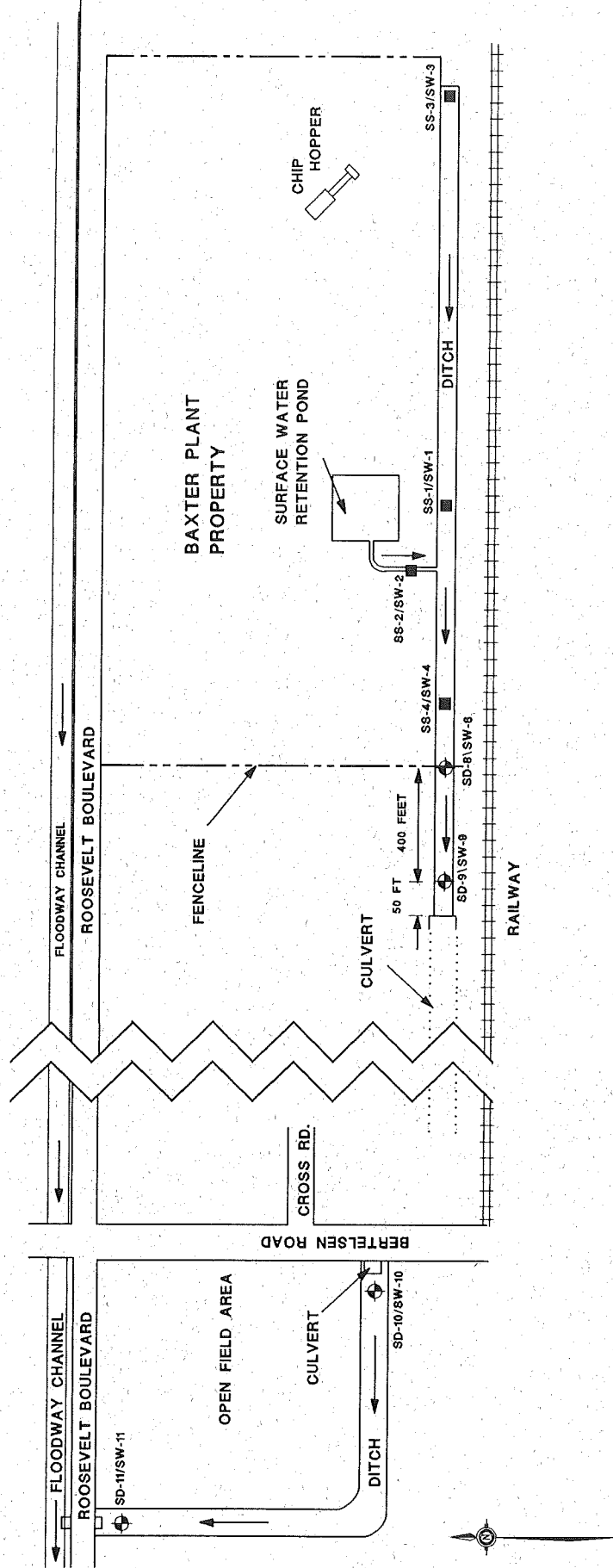
To assess the extent of PCOCs detected during the Phase I RI in the drainage ditch which parallels the southern border of the J.H. Baxter property and to which the storm water retention pond discharges, four additional surface water/sediment samples were collected offsite, downstream of the J.H. Baxter property. The surface water and sediment samples were collected at coincident locations. The first sediment and surface water sample was obtained in the ditch at the J.H. Baxter property boundary (samples SW-8 and SD-8). The next sampling location downstream of the J.H. Baxter property, SD-9 and SW-9, was just before the ditch

enters a culvert (approximately 400 feet downstream of J.H. Baxter property) and travels underground west towards Bertelsen Road. The third sediment and surface water samples, SD-10 and SW-10, were collected in a ditch immediately west of Bertelsen Road just south of the intersection of Bertelsen and Cross Street. This location is where the drainage ditch resurfaces and continues flowing westward as part of the local drainage system. The final sample location, SD-11/SW-11, was located just south of Roosevelt Boulevard before the ditch entered a culvert and the floodway channel on the north side of Roosevelt Blvd. The SD-11/SW-11 location was to be chosen beyond the extent of potential contamination in the offsite drainage ditch. To determine the sampling location the water in the ditch was tested for the presence of PCP using the Rapid Immunoassay Technique (RIS). The test result was negative for PCP at a detection limit of 5 ug/L (5 ppb). Therefore, this location was considered suitable for collecting the last sediment and surface water sample for laboratory analysis. A map showing the approximate surface water/sediment sampling locations is provided as Figure 2-2.

Surface water and sediment samples from the drainage ditch were sampled by Keystone personnel in accordance with Standard Operating Procedures presented in the Phase I RI Work Plan (eg. Surface-Water Sampling Techniques and Sediment Sampling Techniques). Chain of custody procedures were followed from initial collection through laboratory analysis. The drainage ditch samples were collected as grab samples. Following collection, samples were packaged in coolers with ice and sealed for transportation back to Chester Environmental's Analytical Division Laboratory located in Monroeville, Pennsylvania. The samples were analyzed for VOAs, PAHs, phenols, total copper, chromium, arsenic and zinc.

#### **Offsite Surface Soil Investigation**

As part of the Phase II RI, nine offsite surface soil samples were collected and analyzed. Six samples were obtained from the residential neighborhood north of the site (see Figure 2-1) and three samples were collected from 1st Avenue directly south of the J.H. Baxter plant property (see Figure 2-3 for approximate locations). The offsite surface soil sampling was performed to provide offsite soil data for the Phase II Public Health and Environmental Risk Assessment (PHEA).



## LEGEND

- SD-9/SW-9 SEDIMENT/SURFACE WATER SAMPLING LOCATION (MARCH 1993)
- SS-1/SW-1 SEDIMENT/SURFACE WATER SAMPLING LOCATION (MAY 1990)

Drawing is a schematic representation of the investigative area and is not to scale.  
\*NOTE: Location of structures on property are approximate.

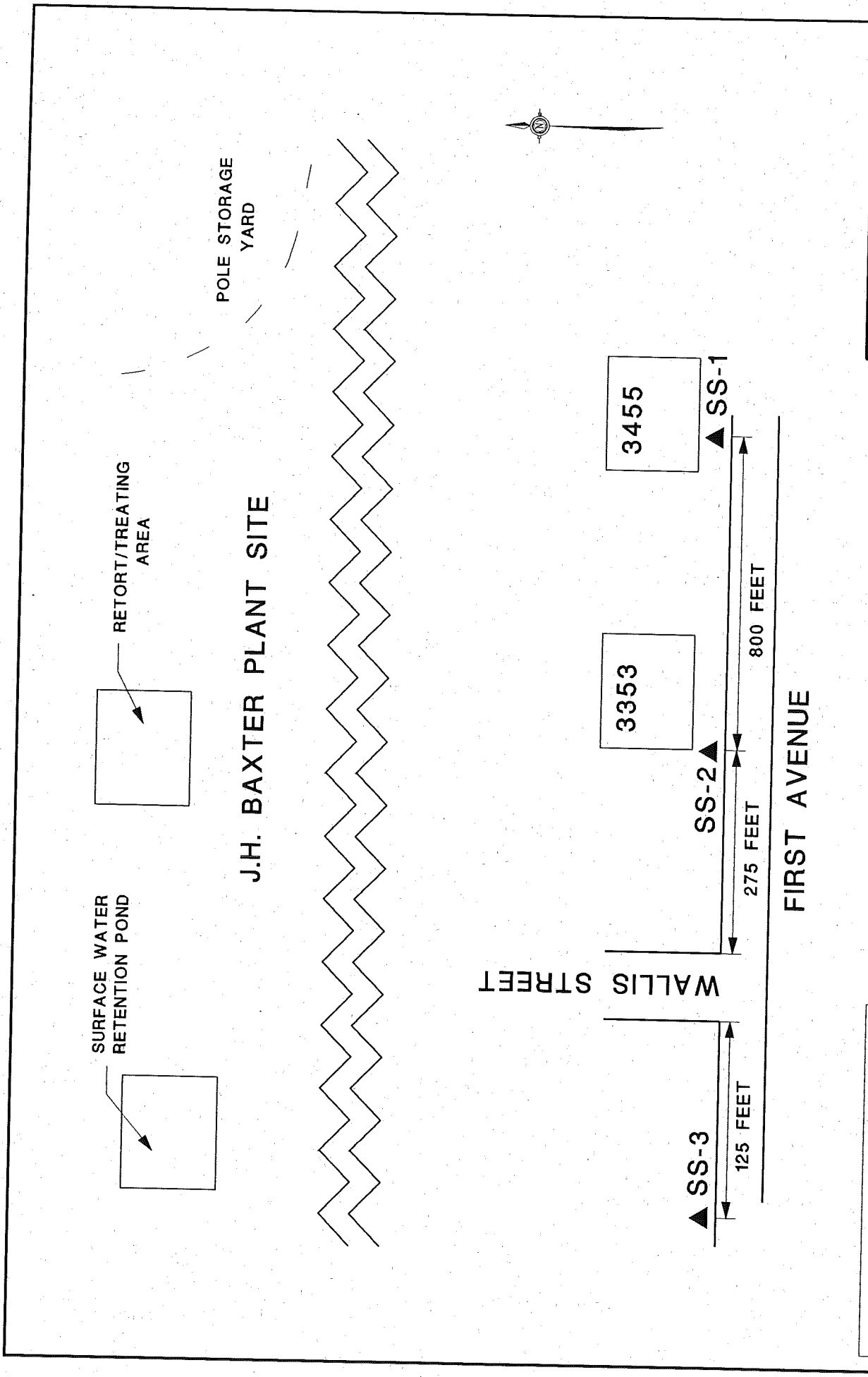
## FIGURE 2-2

SEDIMENT AND SURFACE WATER  
SAMPLE LOCATION MAP  
J.H. BAXTER  
EUGENE, OREGON

KEYSTONE  
ENVIRONMENTAL

|                 |         |                    |
|-----------------|---------|--------------------|
| REVISION NO. 01 | 04OCT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |         | FILE: SEDLOCAT.GCD |

J.H. Baxter  
372250 10/94



**LEGEND**

SS-3 ▲ OFFSITE SURFACE SAMPLE

Drawing is not to scale  
★ NOTE: Location of structures on property are approximate.

**FIGURE 2-3**  
OFFSITE SURFACE SAMPLE  
LOCATION MAP  
J.H. BAXTER  
EUGENE, OREGON

|                 |         |                    |
|-----------------|---------|--------------------|
| REVISION NO. 01 | 25APR94 | PROJECT: 372250-08 |
| DRAWN BY: AVL   | FILE    | 23.GCD             |

**KEYSTONE  
ENVIRONMENTAL**

Surface soils were sampled by Keystone personnel accompanied by an Oregon Department of Environmental Quality (DEQ) representative. The samples were collected in accordance with Standard Operating Procedures presented in the Phase I RI Work Plan (eg. Surface-Soil Sampling Techniques). Chain of custody procedures were followed from initial collection through laboratory analysis. Following collection, samples were packaged in coolers with ice and sealed for transportation back to Chester Environmental's Analytical Division Laboratory located in Monroeville, Pennsylvania. The samples were analyzed for VOAs, PAHs, phenols, total copper, chromium, arsenic and zinc.

### **Survey**

The Phase II monitoring wells and soil borings were surveyed by Roberts Surveying Inc. in December 1991 and February 1994, respectively. The well survey consisted of obtaining the elevation of the top of each PVC well casing and the horizontal coordinate of each well. The well and soil boring coordinates were surveyed to the nearest one-tenth of a foot and the well elevations were surveyed to the nearest one-hundredth of a foot. Plans illustrating well horizontal coordinates and elevations were prepared by Roberts Surveying.

## **2.2 Geology**

### **2.2.1 Regional Geology**

For a description of the regional geology in the Eugene area refer to the Phase I RI report.

### **2.2.2 Site Geology**

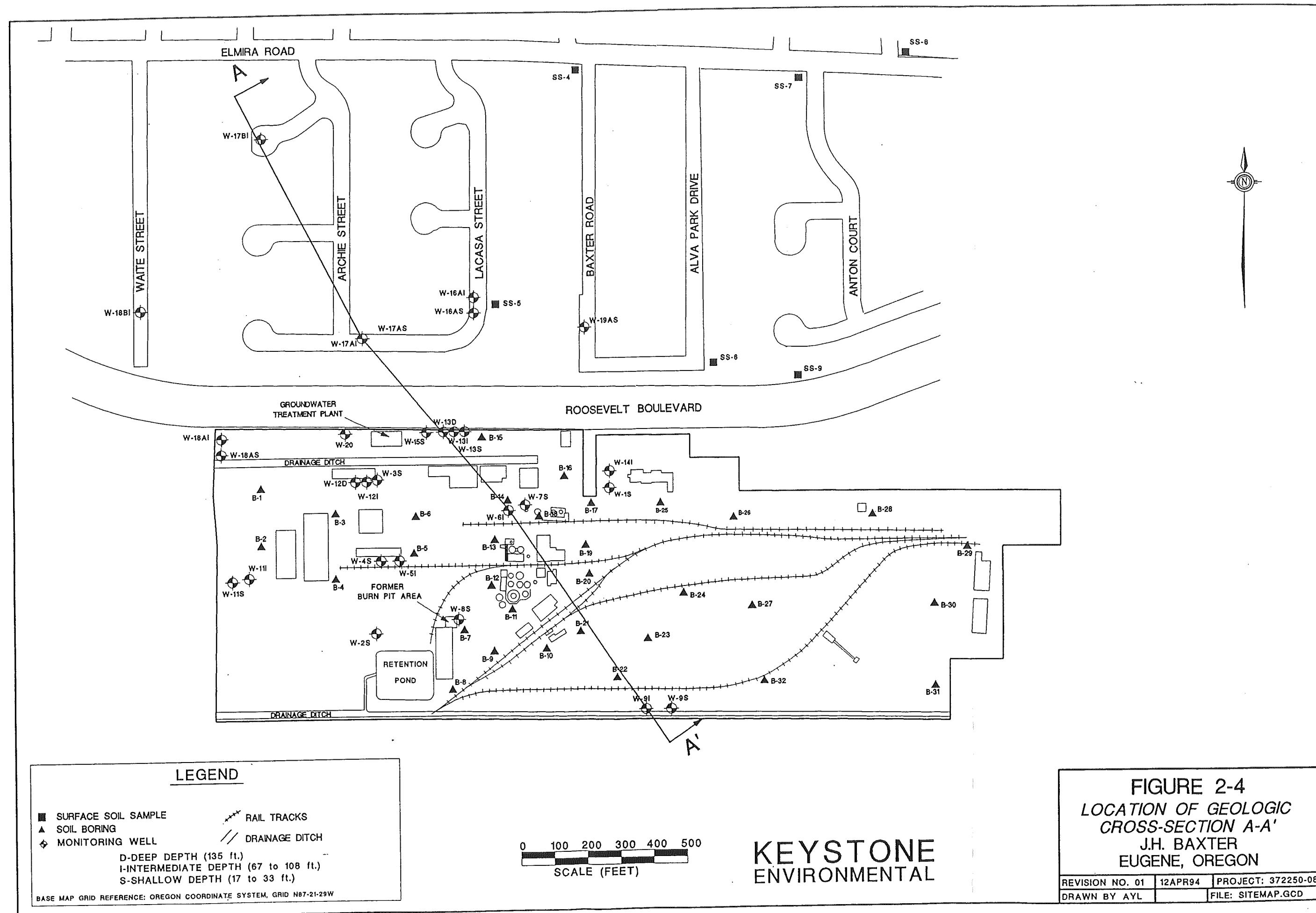
A detailed description of the onsite geology is presented in the Phase I RI report, section 2.2.2. All of the Phase II RI wells were installed offsite to the north of the Baxter property except for the two W-18A wells which were installed in the northwest corner of the site. The thirty-two soil borings drilled on the site in January



1994 provide more detailed information on the geology within the upper 5 feet. Geologic information was obtained through observations made during the drilling performed during the Phase I RI, the Phase II RI performed by Keystone and through the review of drilling logs for the monitoring wells installed by Brown and Caldwell in July and December of 1986.

The shallow onsite geology (0 to 6 feet below grade) was defined during the drilling of the thirty-two onsite soil borings. The upper approximately 1 to 2 feet was generally coarse gravel and cobbles. Below this was a moist grey relatively firm silty clay. Gravel was often encountered in the grey silty clay unit. Beneath the grey silty clay was a brown softer silty clay that regularly contained fine sand. The shallow geology encountered offsite is similar to that encountered onsite. The shallow geology was predominantly comprised of silt and clay with varying amounts of sand and gravel. This upper silty clay unit varies from approximately 10 to 15 feet in thickness. Immediately below this unit is the shallow aquifer which extends offsite and consists of sand and gravel, with lesser amounts of silt and clay. The geology at depth offsite, however, changes from that observed onsite. The thickness of the upper shallow aquifer remains relatively constant but the clay unit which bounds the aquifer below changes character offsite. The clay unit thins and at well W-17BI, which was the well installed the furthest north of the site, only a thin clayey gravel unit was found at the lower boundary of the shallow aquifer. At offsite well locations W-17AI and W-16AI the clay unit was approximately 5 to 8 feet thick whereas, onsite, at well W-13I the clay thickness was approximately 20 feet.

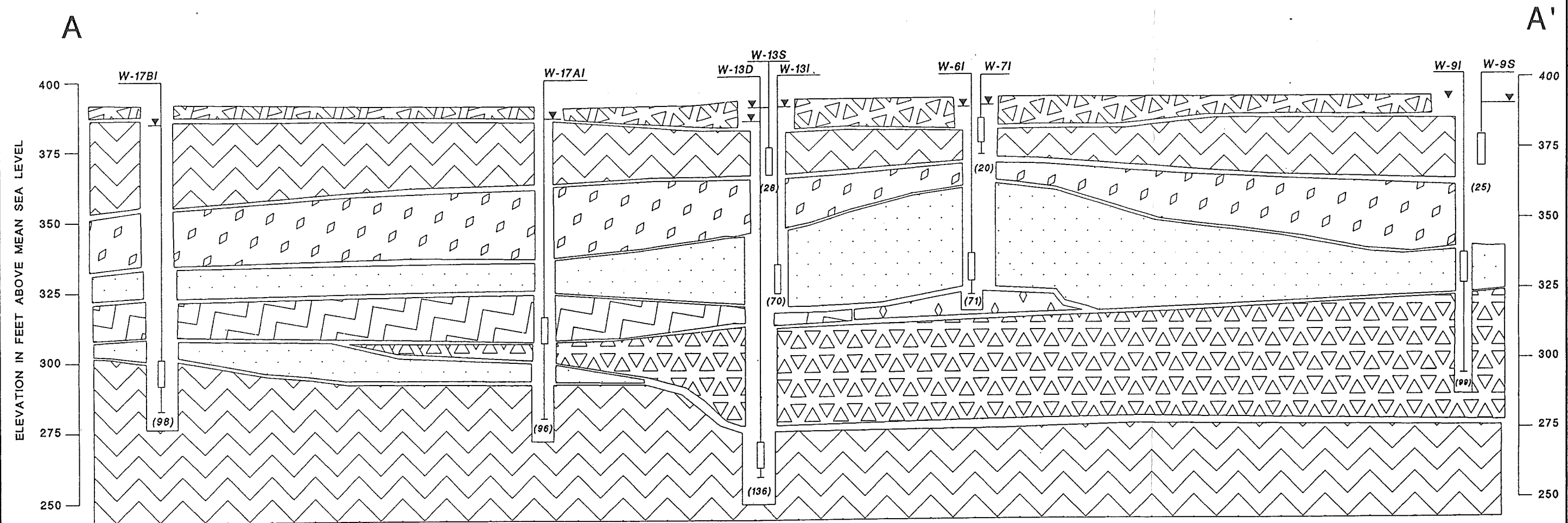
A geologic cross-section A-A' trending northwest to southeast (see Figure 2-4) was constructed to provide a graphic representation of the onsite and offsite geology parallel to the groundwater flow direction in the area. The cross-section incorporates the geologic data obtained from both the Phase I and Phase II monitoring well installations (see Figure 2-5). Geologic cross-sections (refer to Figures 2-2 and 2-3, Phase I RI report August 1991) were constructed in the Phase I report perpendicular to the direction profiled by cross-section A-A'. The Phase II monitoring well drilling logs are provided in Appendix A.





NORTHWEST

SOUTHEAST



# LEGEND

- |                      |                       |
|----------------------|-----------------------|
| WATER LEVELS         | WELL DESIGNATION      |
| WELL SCREEN INTERVAL | DEPTH OF BORING       |
| CLAYEY GRAVEL (GC)   | SAND (SP)             |
| SANDY GRAVEL (GP)    | SANDY SILTY CLAY (ML) |
| GRAVEL (GP)          | CLAY (CL)             |
| SILTY GRAVEL (GM)    |                       |

0 50 100 150 200 250  
HORIZONTAL SCALE (FEET)

4 X VERTICAL EXAGGERATION

ELEVATION IN FEET ABOVE MEAN SEA LEVEL

KEYSTONE  
ENVIRONMENTAL

## FIGURE 2-5

GEOLOGIC  
CROSS-SECTION A-A'

J.H. BAXTER  
EUGENE, OREGON

|                 |         |                    |
|-----------------|---------|--------------------|
| REVISION NO. 01 | 15APR94 | PROJECT: 372250-08 |
| DRAWN BY AYL    |         | FILE: X-SECT.GCD   |

### 2.3 Site Hydrogeology

For a description of the regional hydrogeology in the Eugene area refer to section 2.3 of the Phase I RI report. The hydrogeology for the site and immediate vicinity north of the site was evaluated using water level data obtained from the Phase I and Phase II wells and from the geologic observations made during the drilling of the Phase II wells.

The hydrostratigraphy of the site consists of an uppermost shallow aquifer of silty, sandy, clayey gravels which extends from approximately 15 to 80 feet below grade. This aquifer is semi-confined or leaky in nature. The shallow aquifer is semi-confined by a surface aquitard comprised of clay, silt and gravels varying from approximately 10 to 15 feet in thickness. A lower aquitard provides a relatively impermeable boundary for the base of the shallow aquifer and separates the shallow aquifer from a deeper aquifer. The lower aquitard is comprised of clay. The deeper aquifer consists of medium to coarse sand and gravel was encountered at approximately 100 feet below grade. The aquifer below the aquitard represents a confined aquifer and the upper shallow aquifer is semi-confined based on pump tests results from the Phase I RI.

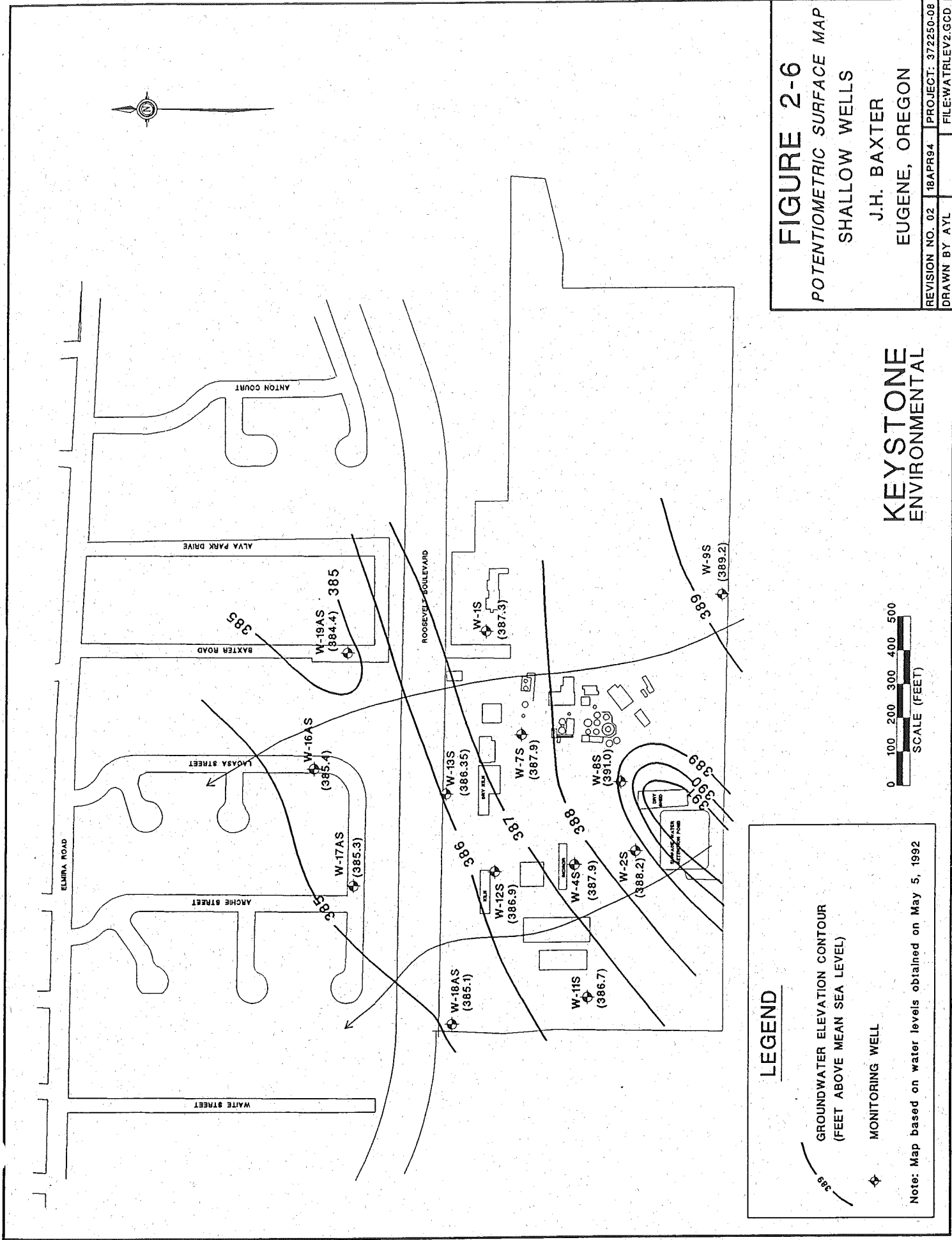
The groundwater flow directions beneath the site were assessed by examining water level data obtained from both, the existing onsite wells and the Phase II wells. The water levels used to construct potentiometric surface maps for the intermediate and shallow wells in the upper aquifer were obtained on May 5, 1992 and are presented in Table 2-1. The potentiometric surface maps are presented as Figure 2-6 and 2-7.

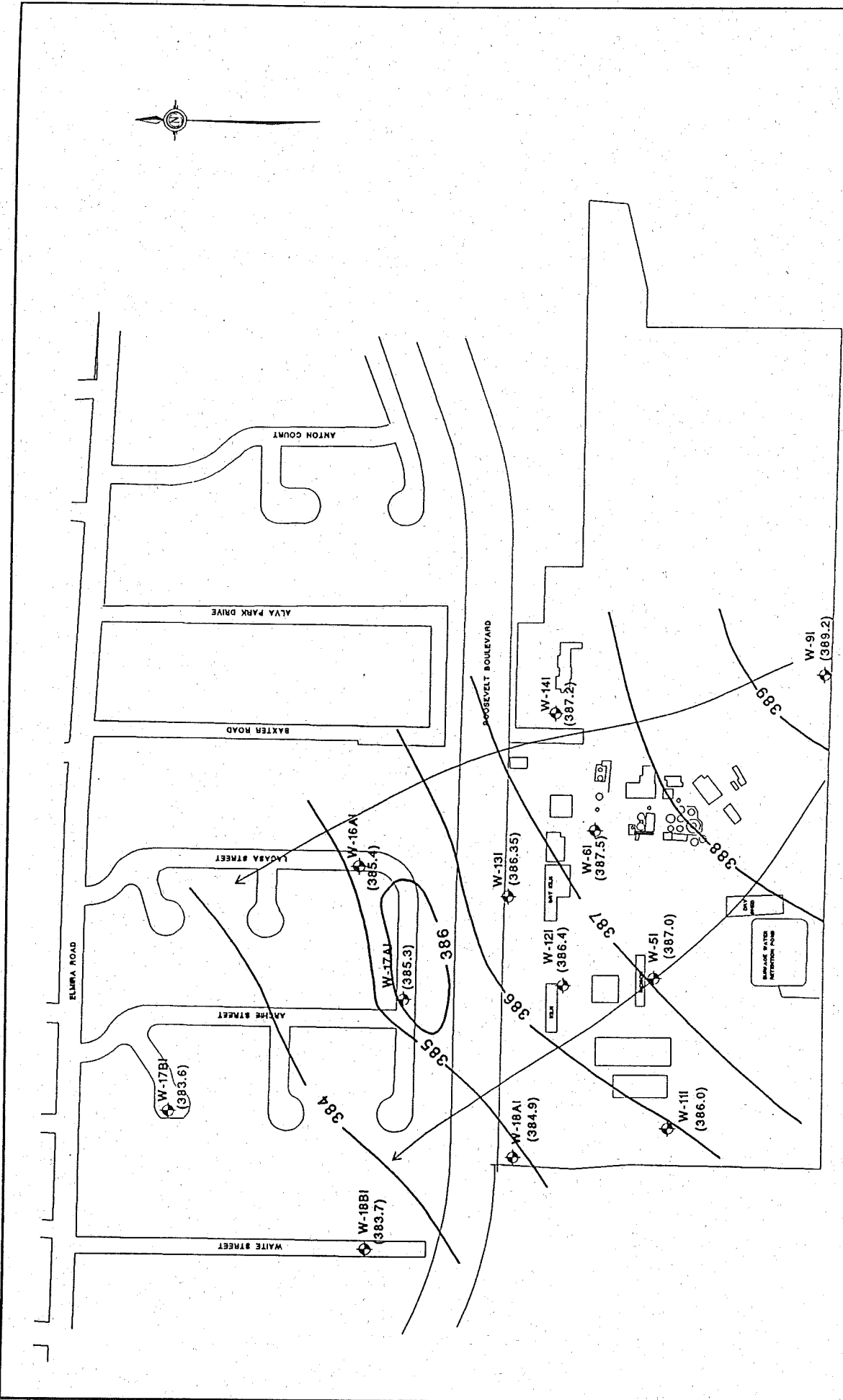
The potentiometric surface map displayed in Figure 2-6, which was constructed from water levels in the shallow wells, indicates that the shallow groundwater flow direction is generally north to northwest. This agrees with previous findings. An anomalous feature is evident in the shallow groundwater flow pattern in the vicinity of well W-8S and the surface water retention pond. This pattern which consists of a groundwater mound, is potentially caused by leakage from the surface water retention pond.

**TABLE 2-1**  
**GROUNDWATER ELEVATIONS**  
**J.H.BAXTER & COMPANY**  
**EUGENE, OREGON**

| WELL   | DEPTH OF WELL | SCREENED INTERVAL | TOP OF WELL ELEVATION | DEPTH TO WATER | GROUNDWATER ELEVATION |
|--------|---------------|-------------------|-----------------------|----------------|-----------------------|
|        |               |                   |                       |                |                       |
| W-1S   | 22            | 12-22             | 395.71                | 8.39           | 387.32                |
| W-2S   | 23            | 13-23             | 393.16                | 4.99           | 388.17                |
| W-3S   | 28            | 18-28             | 395.01                | 8.15           | 386.86                |
| W-4S   | 19            | 9-19              | 396.56                | 8.69           | 387.87                |
| W-5I   | 73            | 63-73             | 396.71                | 9.72           | 386.99                |
| W-6I   | 67            | 57-67             | 397.77                | 10.23          | 387.54                |
| W-7S   | 17            | 7-17              | 397.66                | 9.76           | 387.90                |
| W-8S   | 17.5          | 7-17              | 395.90                | 4.90           | 391.00                |
| W-9S   | 25            | 15-25             | 396.45                | 7.26           | 389.19                |
| W-9I   | 67            | 57-67             | 396.19                | 6.89           | 389.30                |
| W-11S  | 25            | 15-25             | 394.17                | 7.43           | 386.74                |
| W-11I  | 83            | 73-83             | 394.17                | 8.15           | 386.02                |
| W-12I  | 78.5          | 69-79             | 395.62                | 9.20           | 386.42                |
| W-12D  | 135           | 123-133           | 395.54                | 15.30          | 380.24                |
| W-13S  | 28            | 18-28             | 396.71                | 10.71          | 386.00                |
| W-13I  | 70            | 60-70             | 396.14                | 9.79           | 386.35                |
| W-13D  | 133           | 123-133           | 396.40                | 16.10          | 380.30                |
| W-14I  | 77.5          | 67-77             | 395.60                | 8.41           | 387.19                |
|        |               |                   |                       |                |                       |
| W-16AS | 25            | 15-25             | 391.86                | 6.50           | 385.36                |
| W-16AI | 82            | 72-82             | 391.86                | 6.45           | 385.41                |
| W-17AS | 24            | 14-24             | 390.29                | 5.03           | 385.26                |
| W-17AI | 87            | 77-87             | 390.60                | 5.36           | 385.24                |
| W-17BI | 85            | 75-85             | 392.09                | 8.52           | 383.57                |
| W-18AS | 25            | 15-25             | 392.84                | 7.74           | 385.10                |
| W-18AI | 87            | 77-87             | 393.70                | 8.80           | 384.90                |
| W-18BI | 87            | 77-87             | 391.98                | 8.30           | 383.68                |
| W-19AS | 24            | 14-24             | 393.82                | 9.40           | 384.42                |

NOTE:  
Depth to water obtained on May 5,1992.  
All elevations in feet above mean sea level.





**LEGEND**

— 385 —  
GROUNDWATER ELEVATION CONTOUR  
(FEET ABOVE MEAN SEA LEVEL)

◆  
MONITORING WELL

Note: Map based on water levels obtained on May 5, 1992



**KEYSTONE  
ENVIRONMENTAL**

**FIGURE 2-7**  
**POTENTIOMETRIC SURFACE MAP**  
**INTERMEDIATE WELLS**

J.H. BAXTER  
EUGENE, OREGON

|                 |         |                |
|-----------------|---------|----------------|
| REVISION NO. 02 | 18APR94 | ECT: 372250-08 |
| DRAWN BY AYL    |         | ATREVL.GCD     |

The potentiometric surface map for the intermediate wells (Figure 2-7) shows the same general groundwater flow direction as the shallow well potentiometric surface map. The groundwater flows in the shallow aquifer to the northwest. This map also displays an anomalous pattern which consists of a slight groundwater mound or ridge immediately north of Roosevelt Boulevard. This groundwater high may be the result of infiltration along the floodway channel and the exposed soil ridge which parallels the floodway channel on the north side.

An average horizontal hydraulic gradient was calculated from Figures 2-6 and 2-7. The calculated average horizontal hydraulic gradient from Figure 2-6 is approximately 0.0035 ft/ft. The groundwater flow pattern shown in Figure 2-7 for the intermediate wells is similar to that observed for the shallow wells in Figure 2-6. Groundwater flows to the northwest and has an average hydraulic gradient of 0.003 ft/ft. This gradient is marginally less than the gradient reported during the Phase I investigation which was 0.006 ft/ft.

The water levels in the shallow and intermediate wells at the nested locations on the site provided information on the vertical movement of groundwater in the shallow aquifer. The difference in the water levels in the shallow and corresponding intermediate wells vary from zero to 0.9 feet. Of the ten well nests available for comparison, onsite and offsite, seven of the ten indicated that vertical groundwater movement was downward. At the remaining three well nest locations one location did not display a difference in the shallow and intermediate water levels (W-16AS/W-16AI), and two identified upward flow (W-13S/W-13I, W-9S/W-9I). The calculated vertical hydraulic gradients ranged between 0.0 ft/ft to 0.012 ft/ft.

#### **2.4 Analytical Results**

This section of the report presents and discusses the analytical results of soil, groundwater, sediment and surface water samples collected as part of the Phase II RI work plan. Additionally, groundwater samples collected as part of a quarterly groundwater monitoring program associated with the interim groundwater pump and treat system were included. The analytical data has been summarized in Tables 2-2



to 2-10. The analytical results and QA/QC evaluations are presented in entirety in Appendix B. As part of the QA/QC procedures used during the sampling field blanks (equipment blanks) and trip blanks were submitted and analyzed. Blind duplicate samples were also submitted during various sample collection events.

#### **2.4.1 Groundwater Quality**

A total of 9 monitoring wells were installed in December 1991 as part of the Phase II program. All Phase II wells were subsequently sampled in January 1992, May 1992 and wells W-16AI, W-17AI, W-18AI and W-18BI have also been sampled in February and June of 1994. The January and May 1992 samples were analyzed for; PAHs (in accordance with EPA method 610), phenols (in accordance with EPA method 604), volatile aromatics (in accordance with EPA method 602), total and dissolved arsenic (in accordance with EPA method 206.2), total and dissolved chromium, copper and zinc (in accordance with EPA method 200.7). Groundwater samples collected in February and June of 1994 were not analyzed for volatile aromatics since they were not detected in January or May of 1992 in the offsite wells.

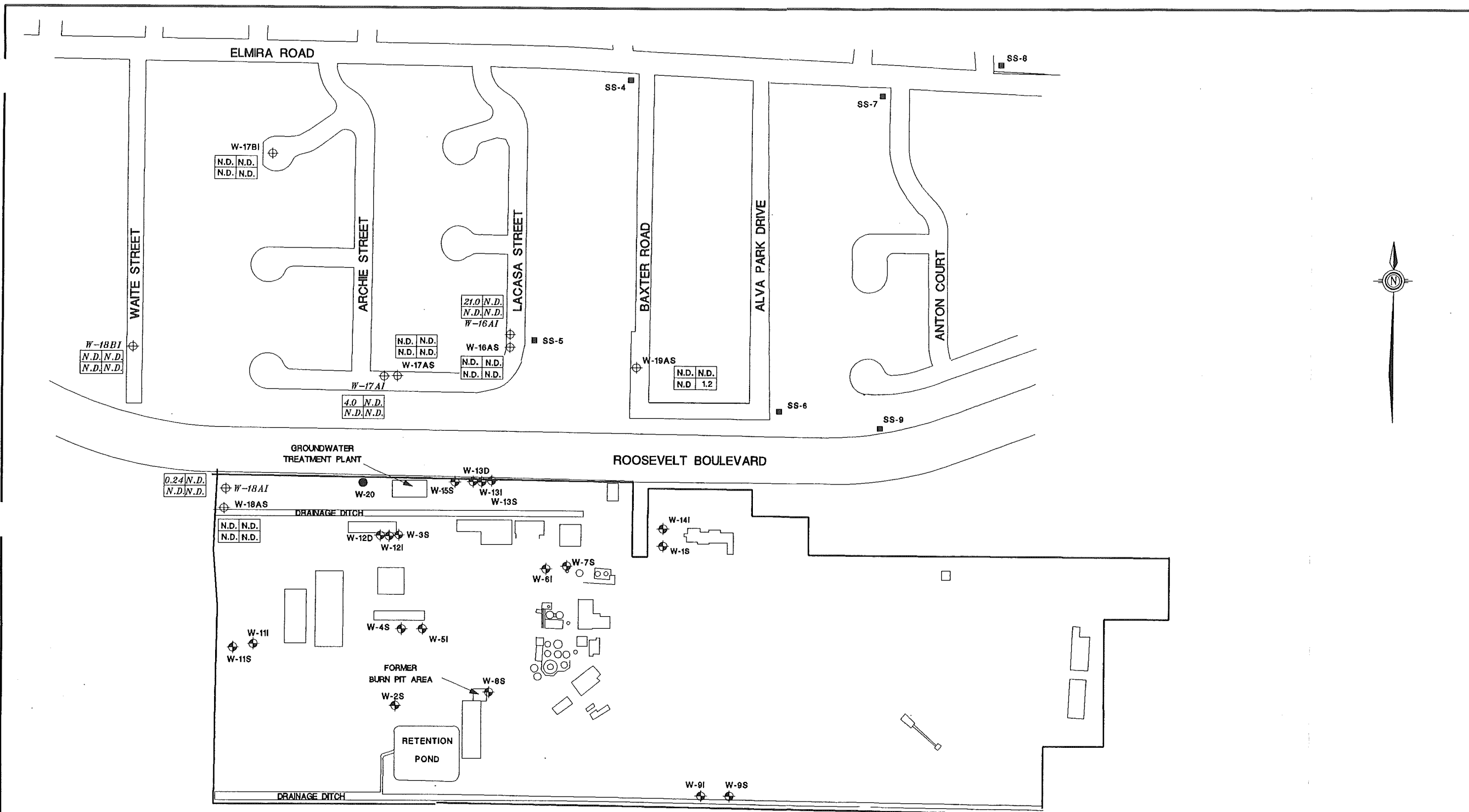
The analytical results are summarized in Tables 2-2 through 2-5 and the most recent results from each Phase II well are presented on Figures 2-8 and 2-9. Wells W-16AI, W-18AI, W-17AI and W-18BI are included in a quarterly groundwater monitoring program which was initiated in February 1994. The analytical results for these wells from quarterly sampling conducted in February and June 1994 are also included in Tables 2-2, 2-3 and 2-5. Volatile aromatics are not included in the quarterly sampling.

##### **2.4.1.1 PAHs**

PAHs have been detected sporadically over time, at low concentrations, in several of the Phase II wells as evident in Table 2-2. The highest PAH concentration to date was observed in W-16AI from the recent June 1994 sampling session. The total PAH concentration in the well was approximately 20 ug/L. Naphthalene comprised approximately half of the total PAH concentration at 11 ug/L. Naphthalene has also







### LEGEND

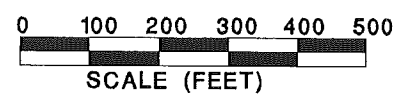
- SURFACE SOIL SAMPLE
- ⊕ PHASE I MONITORING WELL
- REMEDIAL PUMPING WELL
- /// DRAINAGE DITCH
- ⊕ PHASE II MONITORING WELL
- D-DEEP DEPTH (135 ft.)
- I-INTERMEDIATE DEPTH (67 to 108 ft.)
- S-SHALLOW DEPTH (17 to 33 ft.)

### ORGANICS CONCENTRATIONS

|                    |      |    |                          |
|--------------------|------|----|--------------------------|
| TOTAL PAHs         | 1.4  | 12 | TOTAL VOLATILE AROMATICS |
| PENTACHLOROPHENOLS | N.D. | 8  | TOTAL CHLOROPHENOLS      |

N.D. NOT DETECTED 4.0 1992 RESULTS 21 1994 RESULTS

Organic concentrations are reported as ug/L (ppb).  
 Most recent data shown for wells: W-16AS, W-17AS, W-17BI, W-18AS and W-19AS, May 1992.  
 Most recent data shown for wells: W-16AI, W-17AI, W-18AI and W-18BI, June 1994.



**KEYSTONE  
ENVIRONMENTAL**

BASE MAP GRID REFERENCE: OREGON COORDINATE SYSTEM, GRID N87-21-29W

**FIGURE 2-8**  
**GROUNDWATER QUALITY MAP**  
**ORGANICS**  
**J.H. BAXTER**  
**EUGENE, OREGON**

|                 |        |                    |
|-----------------|--------|--------------------|
| REVISION NO. 01 | 3OCT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |        | FILE: WATRQUAL.GCD |

been recently detected in wells W-17AI (June 1994) and W-18BI (February and June 1994). PAHs have not been detected in any of the shallow Phase II wells.

The source of the detected PAH is unknown. The interim groundwater pump and treat system which has been operating at 50 gpm has reversed the offsite hydraulic gradient in the vicinity of these wells. PAHs, which were only detected at very low concentrations prior to pumping, are potentially being mobilized towards the site from unknown offsite sources. Future quarterly monitoring results will provide needed additional information to more accurately assess the potential source and nature of the PAHs in the offsite groundwater.

#### **2.4.1.2 Phenols**

The analytical results for phenols are summarized in Table 2-3. Phenolic compounds were detected in several of the Phase II wells over time. Phenol compounds were detected in most of the Phase II wells during the initial sampling performed in January of 1992. Dichlorophenol, trichlorophenol and dinitrophenol were detected in W-18AI in January 1992 at 2.05 ug/L, 2.52 ug/L and 13.98 ug/L, respectively, and dichlorophenol and trichlorophenol were detected at 2.1 ug/L and 2.4 ug/L, respectively, in W-18AI in May of 1992. Dichlorophenol and trichlorophenol were detected at 2.56 ug/L and 1.49 ug/L, respectively, in W-19AS in January but only trichlorophenol was detected in W-19AS in May of 1992 at 1.2 ug/L.

PCP has been detected in only well W-17AI on only one sampling occasion (January 1992). It was detected in a duplicate sample at a concentration of 5.42 ug/L. PCP was not detected in the well on subsequent sampling sessions. The analytical report including QA/QC data did not indicate a reason for the discrepancy in the results of the two samples from the same well.

The most recent data from each well suggests that phenols are no longer present in the Phase II wells. The exception to this is well W-19AS, where trichlorophenol was detected at 1.2 ug/L in May 1992. Since then, however, the groundwater pump and treat system has been activated (January 1994) and continues to operate. It's

TABLE 2-3  
Ground Water Analytical Results-Phenols

| Well No.                   | W-16AS    | W-16AS   | W-16AI    | W-16AI   | W-16AI    | W-16AI    | W-16AI    | W-17AS   | W-17AI    | W-17AI    | W-17AI    | W-17AI    | W-17AI    | W-17AI   | W-17AI    | W-17BI    |
|----------------------------|-----------|----------|-----------|----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|-----------|
| Date Sampled               | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 | Jan 10/92 | May 8/92 | Jan 10/92 | Jan 10/92 | Jan 10/92 | Jan 10/92 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 |
| Phenol                     | 0.82      | <.5      | 0.46      | <.5      | <.5       | <.5       | <.29      | <.5      | <.32      | 0.16      | <.44      | <.5       | <.5       | <.5      | <.5       | <.42      |
| 2-Chlorophenol             | <.38      | <.5      | <.32      | <.5      | <.5       | <.5       | <.41      | <.5      | <.44      | <.44      | <.5       | <.5       | <.5       | <.5      | <.5       | <.59      |
| 2-Nitrophenol              | <.46      | <.5      | <.39      | <.5      | <.5       | <.5       | <.5       | <.5      | <.53      | <.53      | <.5       | <.5       | <.5       | <.5      | <.5       | <.71      |
| 2,4-Dimethylphenol         | <.25      | <.5      | <.21      | <.5      | <.5       | <.5       | <.27      | <.5      | <.29      | 1.63      | <.55      | <.5       | <.5       | <.5      | <.5       | <.38      |
| 2,4-Dichlorophenol         | <.47      | <.5      | <.4       | <.5      | <.5       | <.5       | <.51      | <.5      | <.55      | <.55      | <.4       | <.5       | <.5       | <.5      | <.5       | <.72      |
| 4-Chloro-3-Methylphenol    | <.34      | <.5      | <.29      | <.5      | <.5       | <.5       | <.37      | <.5      | <.5       | <.5       | <.4       | <.5       | <.5       | <.5      | <.5       | <.52      |
| 2,4,6-Trichlorophenol      | <.56      | <.1      | <.47      | <.1      | <.1       | <.1       | <.6       | <.1      | <.65      | <.65      | <.65      | <.1       | <.1       | <.1      | <.1       | <.86      |
| 2,4-Dinitrophenol          | <.88      | <.1      | <.74      | <.1      | <.1       | <.1       | <.95      | <.1      | <.1.03    | 24.15     | <.72      | <.1       | <.1       | <.1      | <.1       | <.36      |
| 4-Nitrophenol              | <.62      | <.1      | <.52      | <.1      | <.1       | <.1       | <.67      | <.1      | <.72      | <.72      | <.67      | <.1       | <.1       | <.1      | <.1       | <.95      |
| 2-Methyl-4,6-Dinitrophenol | <.58      | <.1      | <.48      | <.1      | <.1       | <.1       | <.62      | <.1      | <.67      | <.67      | <.67      | <.1       | <.1       | <.1      | <.1       | <.88      |
| Pentachlorophenol          | <.84      | <.1      | <.71      | <.1      | <.1       | <.1       | <.91      | <.1      | <.98      | 5.42      | <.5       | <.1       | <.1       | <.1      | <.1       | <.29      |
| Well No.                   | W-18AS    | W-18AS   | W-18AI    | W-18AI   | W-18AI    | W-18AI    | W-18BI    | W-18BI   | W-18BI    | W-18BI    | W-18BI    | W-18BI    | W-18BI    | W-19AS   | W-19AS    | W-17BI    |
| Date Sampled               | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Feb 22/94 | Jun 21/94 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 | Jan 10/92 | Jan 10/92 | Jan 10/92 | May 8/92 | May 8/92  | May 8/92  |
| Phenol                     | 1.97      | <.5      | 1.7       | <.5      | <.5       | <.5       | 0.3       | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | 1.64     | <.5       | <.5       |
| 2-Chlorophenol             | <.68      | <.5      | <.69      | <.5      | <.5       | <.5       | <.41      | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | <.54     | <.5       | <.5       |
| 2-Nitrophenol              | <.82      | <.5      | <.81      | <.5      | <.5       | <.5       | <.5       | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | <.65     | <.5       | <.5       |
| 2,4-Dimethylphenol         | <.45      | <.5      | <.45      | <.5      | <.5       | <.5       | <.27      | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | <.83     | <.5       | <.5       |
| 2,4-Dichlorophenol         | <.84      | <.5      | 2.05      | <.5      | <.5       | <.5       | <.51      | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | 2.56     | <.5       | <.5       |
| 4-Chloro-3-Methylphenol    | <.61      | <.5      | <.6       | <.5      | <.5       | <.5       | <.37      | <.5      | <.5       | <.5       | <.5       | <.5       | <.5       | <.48     | <.5       | <.5       |
| 2,4,6-Trichlorophenol      | <.1       | <.1      | 2.52      | <.1      | <.1       | <.1       | <.6       | <.1      | <.1       | <.1       | <.1       | <.1       | <.1       | 1.49     | 1.2       | <.1       |
| 2,4-Dinitrophenol          | <1.58     | <.1      | 13.98     | <.1      | <.1       | <.1       | <.95      | <.1      | <.1       | <.1       | <.1       | <.1       | <.1       | <1.26    | <.1       | <.1       |
| 4-Nitrophenol              | <1.11     | <.1      | <1.11     | <.1      | <.1       | <.1       | <.67      | <.1      | <.1       | <.1       | <.1       | <.1       | <.1       | <.88     | <.1       | <.1       |
| 2-Methyl-4,6-Dinitrophenol | <1.03     | <.1      | <1.02     | <.1      | <.1       | <.1       | <.62      | <.1      | <.1       | <.1       | <.1       | <.1       | <.1       | <.82     | <.1       | <.1       |
| Pentachlorophenol          | <1.51     | <.1      | <1.05     | <.1      | <.1       | <.1       | <.91      | <.1      | <.1       | <.1       | <.1       | <.1       | <.1       | <1.19    | <.1       | <.1       |

All values reported as ug/L.  
" <" not detected at detection limit given.  
\* duplicate sample.

operation is likely responsible for the elimination of phenol compounds in the offsite wells.

#### **2.4.1.3 Volatile Aromatics (VOAs)**

Volatile aromatics were not detected in any of the Phase II wells, either in January or May 1992. VOA results are presented in Table 2-4. Volatile aromatic compounds are not part of the current quarterly groundwater monitoring program. Therefore, no data for VOAs are presented for February and June 1994.

#### **2.4.1.4 Total and Dissolved Metals**

Chromium and copper have never been detected in any of the Phase II wells. In January of 1992 total arsenic was detected in wells W-16AI, W-17AS, and W-17B at concentrations of 0.0023 mg/L, 0.0025 mg/L and 0.0023 mg/L, respectively. These concentrations are less than the drinking water MCL for arsenic which is 0.05 mg/L. In May of 1992 arsenic was only detected in well W-17AS. The arsenic concentration had decreased in the well to 0.0014 mg/L (total arsenic). Recent well sampling has not detected any arsenic in wells W-16AI, W-18AI, W-17AI and W-18BI.

Zinc, both total and dissolved, has been consistently detected in the Phase II wells at low concentrations. The highest zinc concentrations have been detected in wells W-16AI and W-18BI. In June 1994 the total and dissolved zinc concentrations in W-16AI were 0.25 mg/L and 0.08 mg/L, respectively. Similarly, in June of 1994 the total and dissolved zinc concentrations in W-18BI were 0.15 mg/L and 0.044 mg/L, respectively. These zinc concentrations in W-18BI were lower slightly than observed in February of 1994. An MCL for zinc is not available.

Background metal concentrations in the local groundwater can be estimated by examining their concentration in wells W-9S and W-9I, which are the upgradient site wells. Arsenic, chromium, copper and zinc were below detection limits of 0.01 mg/L, 0.01 mg/L, 0.025 mg/L and 0.02 mg/L, respectively, in these wells (May 1992).

TABLE 2-4  
Ground Water Analytical Results-Volatile Aromatics

| Well No.            | W-16AS    | W-16AS   | W-16AI    | W-16AI   | W-17AS    | W-17AS   | W-17AS    | W-17AI   | W-17AI    | W-17BI   | W-17BI   |
|---------------------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|----------|
| Date Sampled        | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | May 8/92 |
| Benzene             | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| Toluene             | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| Chlorobenzene       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| Ethylbenzene        | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| 1,3-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| 1,4-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| 1,2-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1       |
| Well No.            | W-18AS    | W-18AS   | W-18AI    | W-18AI   | W-18BI    | W-18BI   | W-19AS    | W-19AS   | W-19AS    |          |          |
| Date Sampled        | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | May 8/92  |          |          |
| Benzene             | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| Toluene             | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| Chlorobenzene       | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| Ethylbenzene        | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| 1,3-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| 1,4-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |
| 1,2-Dichlorobenzene | <1        | <1       | <1        | <1       | <1        | <1       | <1        | <1       | <1        |          |          |

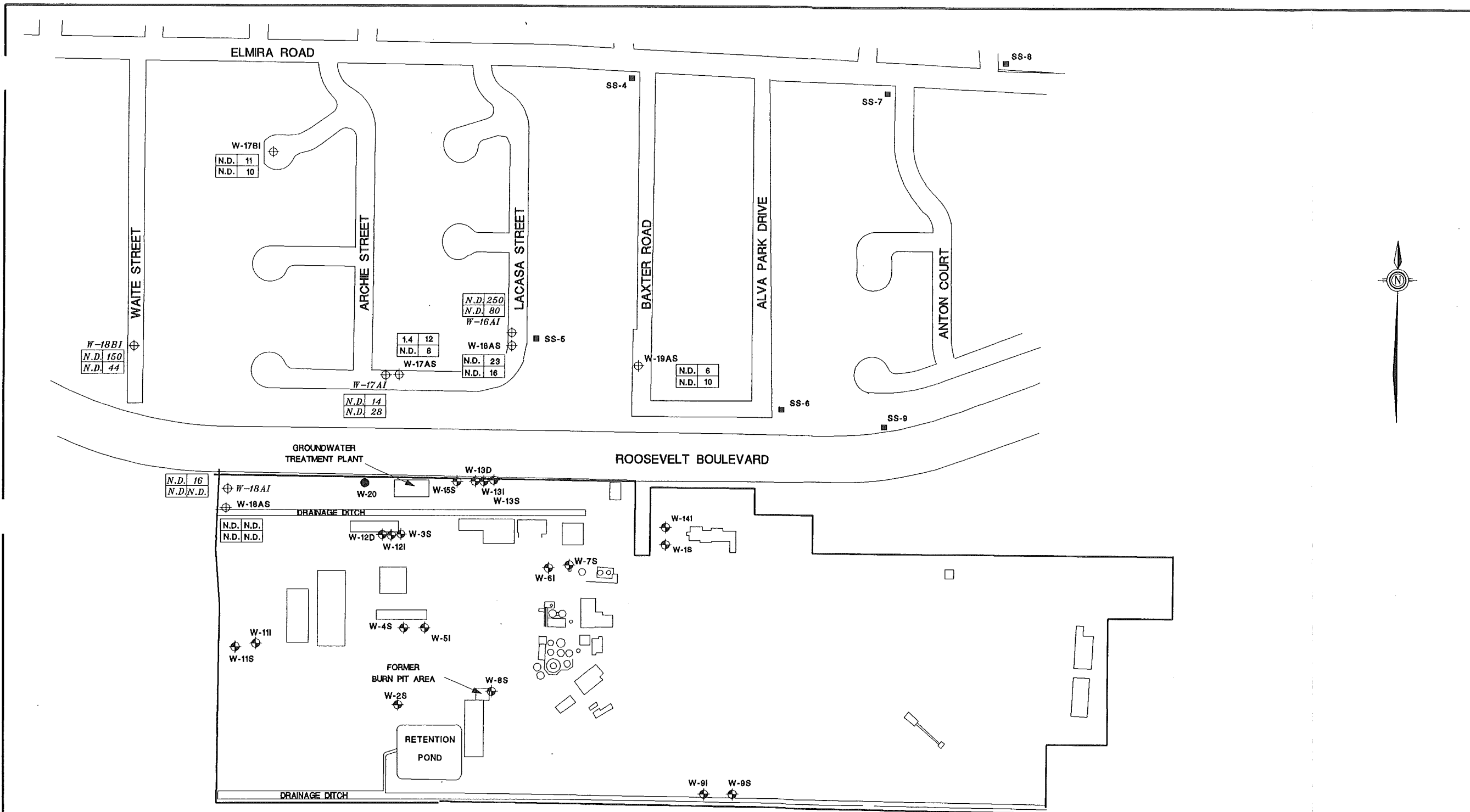
All values reported as ug/L.  
" <" not detected at detection limit given.

TABLE 2-5  
Ground Water Analytical Results—Metals

| Well No.           | W-16AS    | W-16AS   | W-16AI    | W-16AI   | W-16AI    | W-16AI    | W-16AI    | W-16AI   | W-17AS    | W-17AI    | W-17AI    | W-17AI   | W-17AI    | W-17AI    | W-17AI    | W-17AI    | W-17BI    | W-17BI    |
|--------------------|-----------|----------|-----------|----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Date Sampled       | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92  | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92  | Feb 21/94 | Jun 20/94 | Jan 10/92 | Jan 10/92 |
| Total Chromium     | <.02      | <.02     | <.02      | <.02     | <.01      | <.01      | <.02      | <.02     | <.02      | <.02      | <.02      | <.02     | <.02      | <.02      | <.01      | <.01      | <.02      | <.02      |
| Dissolved Chromium | <.02      | <.02     | <.02      | <.02     | <.01      | <.01      | <.02      | <.02     | <.02      | <.02      | <.02      | <.02     | <.02      | <.02      | <.01      | <.01      | <.02      | <.02      |
| Total Copper       | <.008     | 0.008    | <.008     | <.008    | <.03      | <.01      | <.008     | <.008    | <.008     | <.008     | <.008     | <.008    | <.008     | <.008     | <.03      | <.01      | <.008     | <.008     |
| Dissolved Copper   | <.008     | <.008    | <.008     | <.008    | <.03      | <.01      | <.008     | <.008    | <.008     | <.008     | <.008     | <.008    | <.008     | <.008     | <.03      | <.01      | <.008     | <.008     |
| Total Zinc         | 0.007     | 0.023    | 0.027     | 0.02     | <.02      | 0.25      | 0.015     | 0.012    | 0.017     | 0.018     | 0.017     | 0.018    | 0.017     | 0.018     | <.02      | 0.014     | 0.026     | 0.026     |
| Dissolved Zinc     | 0.006     | 0.016    | 0.017     | 0.011    | <.02      | 0.08      | 0.01      | 0.008    | 0.017     | 0.016     | 0.017     | 0.016    | 0.017     | 0.016     | <.02      | 0.028     | 0.008     | 0.008     |
| Total Arsenic      | <.0012    | <.0012   | 0.0023    | <.0012   | <.01      | <.005     | 0.0025    | 0.0014   | <.0012    | <.0012    | <.0012    | <.0012   | <.0012    | <.0012    | <.01      | <.005     | 0.0023    | 0.0023    |
| Dissolved Arsenic  | <.0012    | <.0012   | <.0012    | <.0012   | <.01      | <.005     | <.0012    | <.0012   | <.0012    | <.0012    | <.0012    | <.0012   | <.0012    | <.0012    | <.01      | <.005     | 0.002     | 0.002     |
| Well No.           | W-18AS    | W-18AS   | W-18AI    | W-18AI   | W-18AI    | W-18AI    | W-18BI    | W-18BI   | W-18BI    | W-18BI    | W-18BI    | W-18BI   | W-18BI    | W-18BI    | W-19AS    | W-19AS    | W-17BI    | W-17BI    |
| Date Sampled       | Jan 10/92 | May 8/92 | Jan 10/92 | May 8/92 | Feb 22/94 | Jun 21/94 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 | Jan 10/92 | May 8/92 | Feb 21/94 | Jun 20/94 | Jan 10/92 | May 8/92  | May 8/92  | May 8/92  |
| Total Chromium     | <.02      | <.02     | <.02      | <.02     | <.01      | <.01      | <.02      | <.02     | <.02      | <.01      | <.01      | <.02     | <.01      | <.01      | <.02      | <.02      | <.02      | <.02      |
| Dissolved Chromium | <.02      | <.02     | <.02      | <.02     | <.01      | <.01      | <.02      | <.02     | <.02      | <.01      | <.01      | <.02     | <.01      | <.01      | <.02      | <.02      | <.02      | <.02      |
| Total Copper       | <.008     | <.008    | <.008     | <.008    | <.03      | <.01      | <.008     | <.008    | <.008     | <.03      | <.01      | <.008    | <.03      | <.01      | <.008     | <.008     | <.008     | <.008     |
| Dissolved Copper   | <.008     | <.008    | <.008     | <.008    | <.03      | <.01      | <.008     | <.008    | <.008     | <.03      | <.01      | <.008    | <.03      | <.01      | <.008     | <.008     | <.008     | <.008     |
| Total Zinc         | <.006     | <.006    | 0.012     | 0.018    | <.02      | 0.016     | 0.029     | 0.013    | 0.4       | 0.15      | 0.012     | 0.013    | 0.4       | 0.15      | 0.012     | 0.006     | 0.011     | 0.011     |
| Dissolved Zinc     | <.006     | <.006    | 0.012     | 0.006    | <.02      | <.01      | 0.013     | 0.008    | 0.3       | 0.044     | 0.007     | 0.008    | 0.3       | 0.044     | 0.007     | 0.01      | 0.01      | 0.01      |
| Total Arsenic      | <.0012    | <.0012   | <.0012    | <.0012   | <.01      | <.005     | <.0012    | <.0012   | <.01      | <.005     | 0.0012    | <.0012   | <.01      | <.005     | 0.0012    | <.0012    | <.0012    | <.0012    |
| Dissolved Arsenic  | <.0012    | <.0012   | <.0012    | <.0012   | <.01      | <.005     | <.0012    | <.0012   | <.01      | <.005     | <.0012    | <.0012   | <.01      | <.005     | <.0012    | <.0012    | <.0012    | <.0012    |

All values reported as mg/L.  
" <" not detected at detection limit given.





### LEGEND

- SURFACE SOIL SAMPLE
  - ⊕ PHASE I MONITORING WELL
  - REMEDIAL PUMPING WELL
  - /// DRAINAGE DITCH
  - ⊕ PHASE II MONITORING WELL
- D-DEEP DEPTH (135 ft.)  
 I-INTERMEDIATE DEPTH (67 to 108 ft.)  
 S-SHALLOW DEPTH (17 to 33 ft.)

### METAL CONCENTRATIONS

|                   |      |    |                |
|-------------------|------|----|----------------|
| TOTAL ARSENIC     | 1.4  | 12 | TOTAL ZINC     |
| DISSOLVED ARSENIC | N.D. | 8  | DISSOLVED ZINC |

N.D. NOT DETECTED 4.0 1992 RESULTS 2.1 1994 RESULTS

Metal concentrations are reported as ug/L (ppb).  
 Most recent data shown for wells: W-16AS, W-17AS, W-17BI, W-18AS and W-19AS, May 1992.  
 Most recent data shown for wells: W-16AI, W-17AI, W-18AI and W-18BI, June 1994.



**KEYSTONE  
ENVIRONMENTAL**

BASE MAP GRID REFERENCE: OREGON COORDINATE SYSTEM, GRID N87-21-29W

**FIGURE 2-9**  
**GROUNDWATER QUALITY MAP**  
**METALS**  
**J.H. BAXTER**  
**EUGENE, OREGON**

|                 |        |                    |
|-----------------|--------|--------------------|
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#### **2.4.2 Soil Quality**

Phase II included an onsite and offsite soils study. Offsite surface soil samples were collected for the purpose of providing soils data for the refining of the Phase I Public Health and Environmental Risk Assessment (PHEA). Onsite surface soil and near surface soils were also obtained to ascertain the quality of soil on the plant site and provide supplementary data for the refining of the PHEA. Soil samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) (EPA method 8310), phenols (EPA method 8040), volatile aromatics (EPA method 8020), chromium, copper, iron, manganese and zinc (EPA method 6010) and arsenic (EPA method 7060). Three soil samples were also analyzed for dioxin/furan (EPA method 8290).

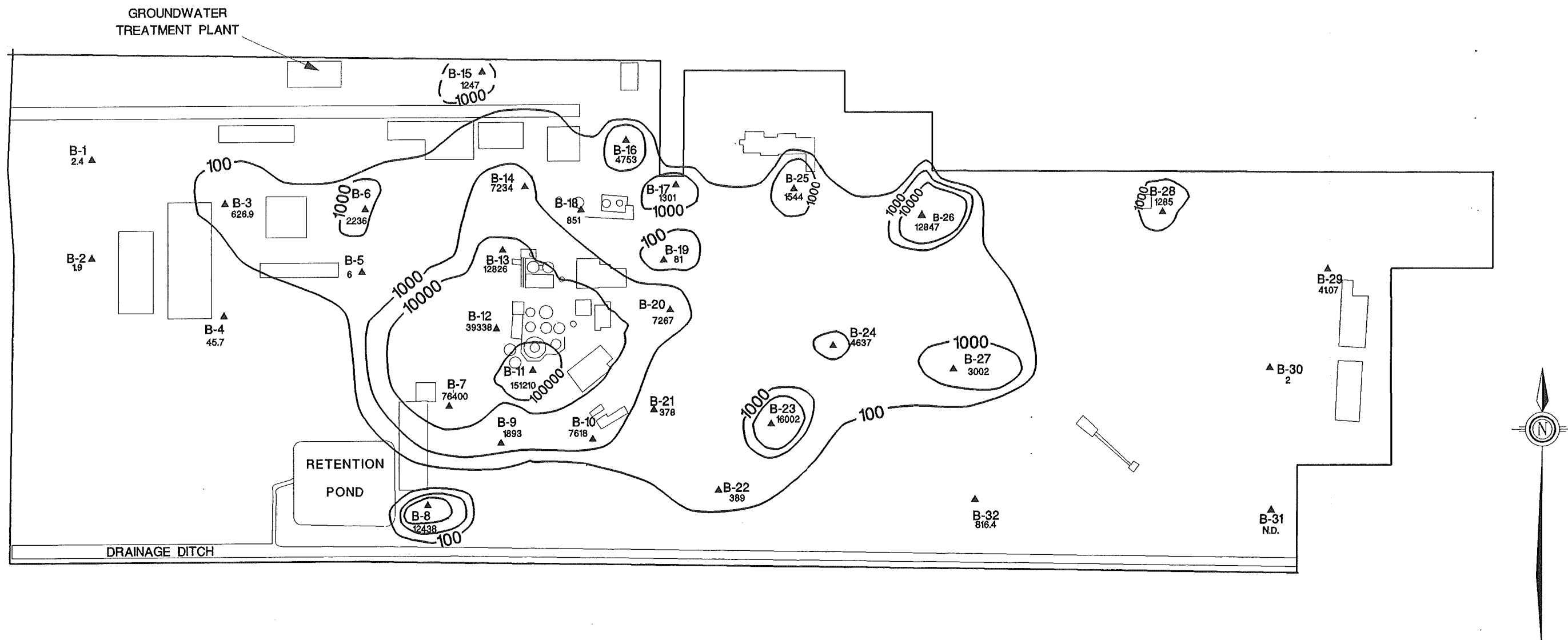
##### **2.4.2.1 Onsite Soil Quality**

A series of thirty-two shallow soil borings were drilled on the Baxter property to provide data for the evaluation of soil quality over the entire plant site. The boreholes were drilled to a depth of approximately 4 to 6 feet at each location. A surface sample and a sample from just above the water table were collected for analysis at each borehole location. The soil analytical results are presented in Table 2-6 and Table 2-7. Table 2-6 is provided at the end of the Section. Figures 2-10 to 2-25 summarize the organic and metal analytical results for the shallow (0 to 2.5 feet below grade) and deeper (2.5 to 6.5 feet below grade) soil zones. Isopleths have been drawn on the figures to assist in visualizing the extent and levels of PCOCs in the soils.

##### **2.4.2.1.1 PAHs**

Figures 2-10 and 2-11 present the PAH data for the onsite soils. PAHs were detected in the majority of soil samples. In general, total PAH concentrations were significantly higher in the sample taken at grade than the sample taken from approximately 4 to 6 feet below grade. The highest total PAH concentrations were in soil samples obtained from borings B-7, B-8, B-11 and B-12. B-7 is located on the edge of the former burn pit. B-8 is situated near the onsite rail-spur and the surface





### LEGEND

B-9 ▲ SOIL BORING

/// DRAINAGE DITCH

### TOTAL PAH CONCENTRATIONS

40 — INFERRED TOTAL PAH CONCENTRATION CONTOURS (ug/Kg)

5.0 — TOTAL PAH CONCENTRATION (ug/Kg)  
N.D. — SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
Soil samples were collected during January, 1994.

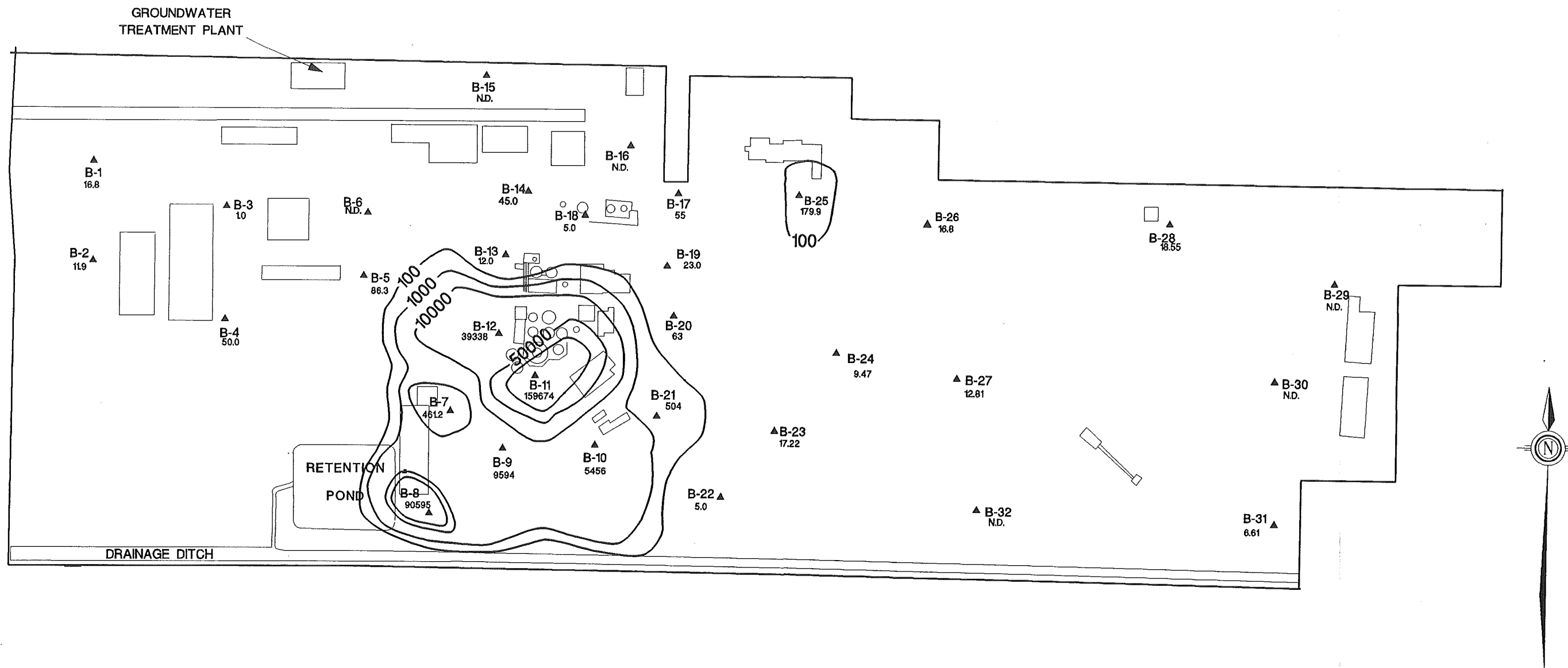
0 100 200 300 400 500  
SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

## FIGURE 2-10 CONTOUR MAP OF INFERRED TOTAL PAH CONCENTRATIONS (SOILS: 0 TO 2.5 FEET)

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### LEGEND

B-9 ▲ SOIL BORING

/// DRAINAGE DITCH

### TOTAL PAH CONCENTRATIONS

40 — INFERRED TOTAL PAH CONCENTRATION CONTOURS (ug/Kg)

5.0 TOTAL PAH CONCENTRATION (ug/Kg)

N.D. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

0 100 200 300 400 500  
SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-11**  
**CONTOUR MAP OF INFERRED**  
**TOTAL PAH CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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water retention pond in the southwest portion of the site. B-11 and B-12 are located immediately south and west of the treating plant tank farm, respectively. The total PAH concentrations in samples taken from boring B-11 were 151,000 ug/kg, 160,000 ug/kg and 256,000 ug/kg. These were the only samples with total PAH concentrations exceeding 100,000 ug/kg on the site.

#### **2.4.2.1.2     Phenols**

Chlorophenols were detected at several borehole locations on the site. The highest concentrations of PCP were found in borings B-7 (66,400 ug/kg), B-11 (182,000 ug/kg) and B-12 (46,700 ug/kg). B-7 is located near the former burnpit and boreholes B-11 and B-12 are situated close to the treating plant tank farm. Chlorophenols were also detected at boreholes B-8, B-10, B-13 and B-23.

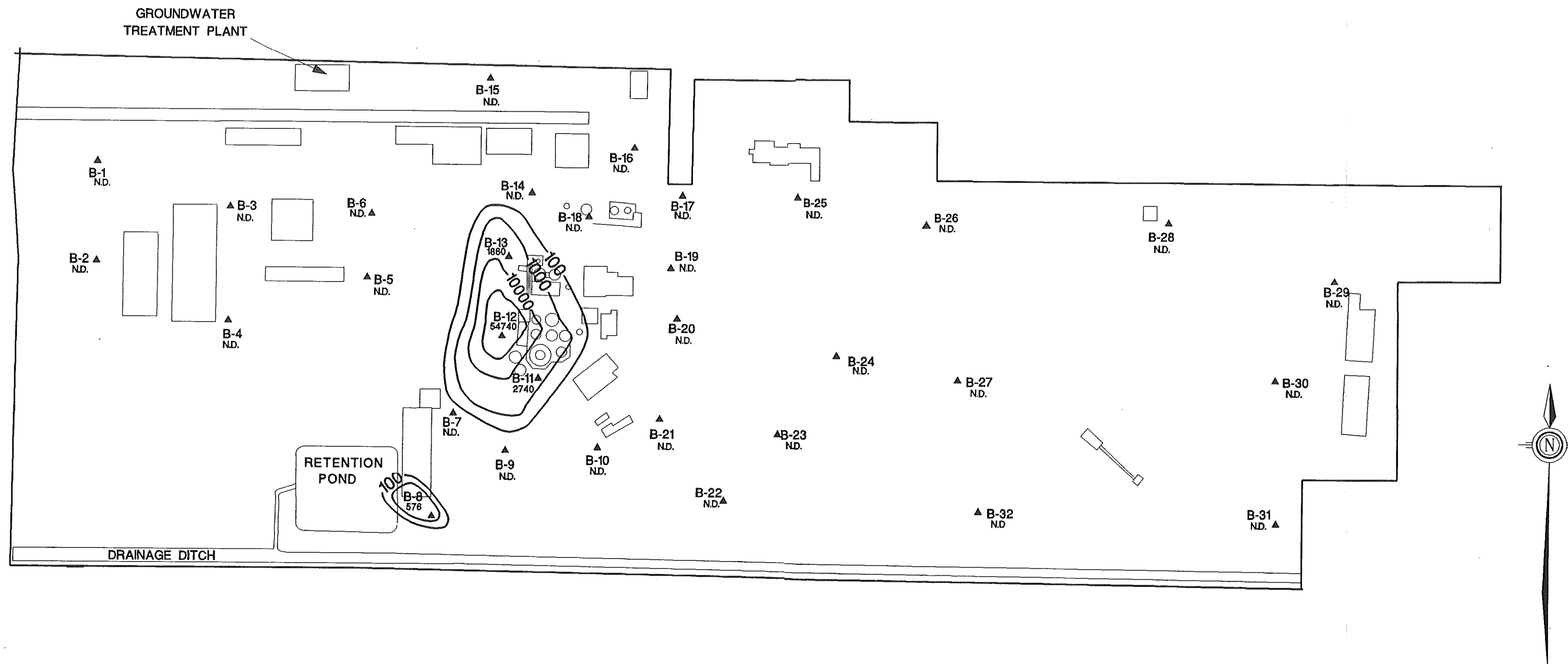
At B-8, tetrachlorophenol was detected in the surface soil sample (8,110 ug/kg) and trichlorophenol (576 ug/kg) in a sample from 4 to 5.5 feet below grade. At B-10, 4-chloro-methyl phenol was detected in both the surface soil sample (56 ug/kg) and the sample collected from 4 to 5.5 feet below grade (102 ug/kg). This was the only phenol detected in the soil at this location. PCP was detected in the surface soil sample at B-23 (1,930 ug/kg) but not in the deeper sample.

Conversely, at borehole B-13, PCP was detected in the deeper soil sample (1880 ug/kg) and not in the surface sample. This borehole is located near a former underground PCP line. The detection at depth suggests there may have been a historic subsurface leak in the line. Figures 2-12 through 2-15 present isopleth maps for total chlorophenols and pentachlorophenol in the onsite soils.

#### **2.4.2.1.3     Volatile Aromatics**

Volatile aromatics were detected at 21 of the 32 soil boring locations. In general, the compounds detected were BTEX (benzene, toluene, ethylbenzene and xylenes). Only at B-11 and B-12 were chlorobenzenes and styrene detected in addition to BTEX. BTEX was also usually found in the surface soil sample and not in the deeper sample. The BTEX, chlorobenzenes and styrene detected at B-11 and B-12





### LEGEND

B-9 ▲ SOIL BORING

/// DRAINAGE DITCH

### TOTAL CHLOROPHENOL CONCENTRATIONS

40 INFERRED TOTAL CHLOROPHENOL CONCENTRATION CONTOURS (ug/Kg)

50 TOTAL CHLOROPHENOL CONCENTRATION (ug/Kg)  
ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

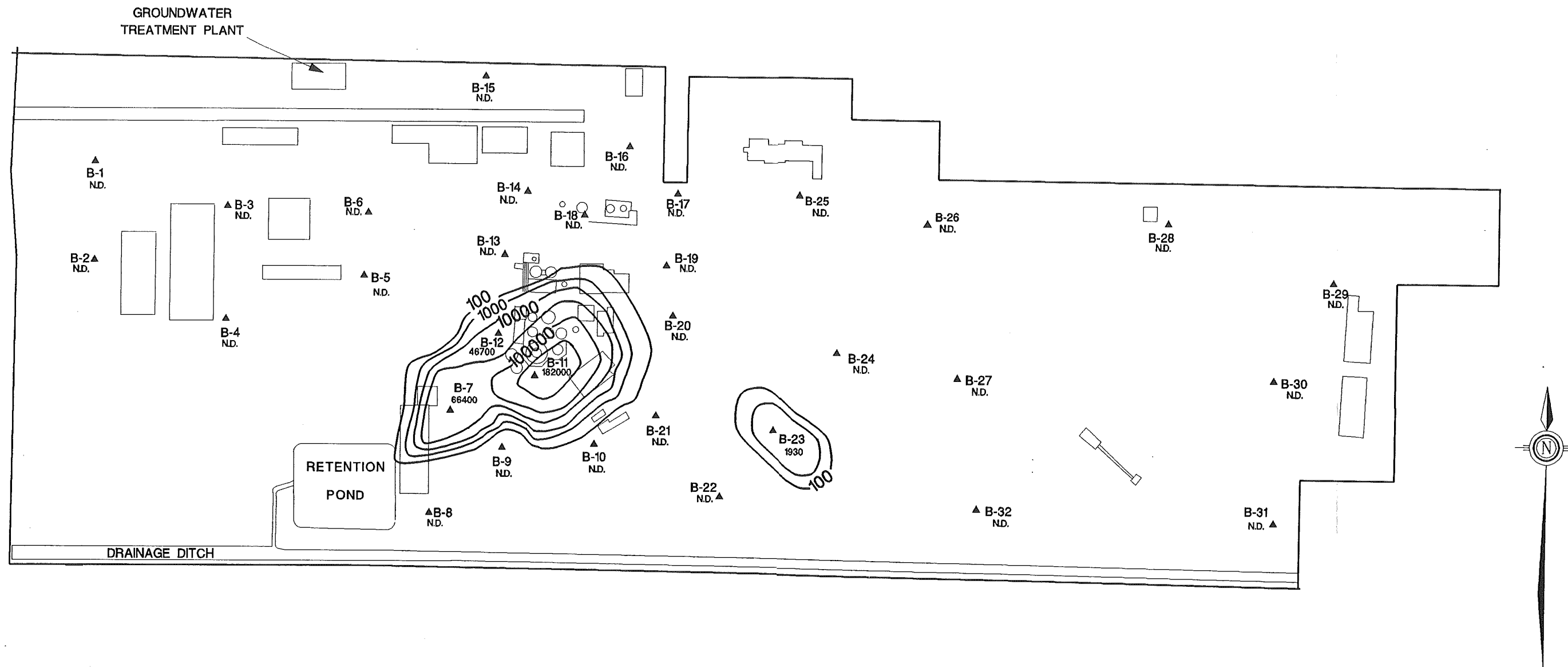
Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

0 100 200 300 400 500  
SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-13**  
**CONTOUR MAP OF INFERRED**  
**TOTAL CHLOROPHENOLS**  
**CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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### LEGEND

B-9▲ SOIL BORING

/// DRAINAGE DITCH

### PENTACHLOROPHENOL CONCENTRATIONS

40 / INFERRED PENTACHLOROPHENOL CONCENTRATION CONTOURS (ug/Kg)

50 PENTACHLOROPHENOL CONCENTRATION (ug/Kg)  
N.D. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
Soil samples were collected during January, 1994.

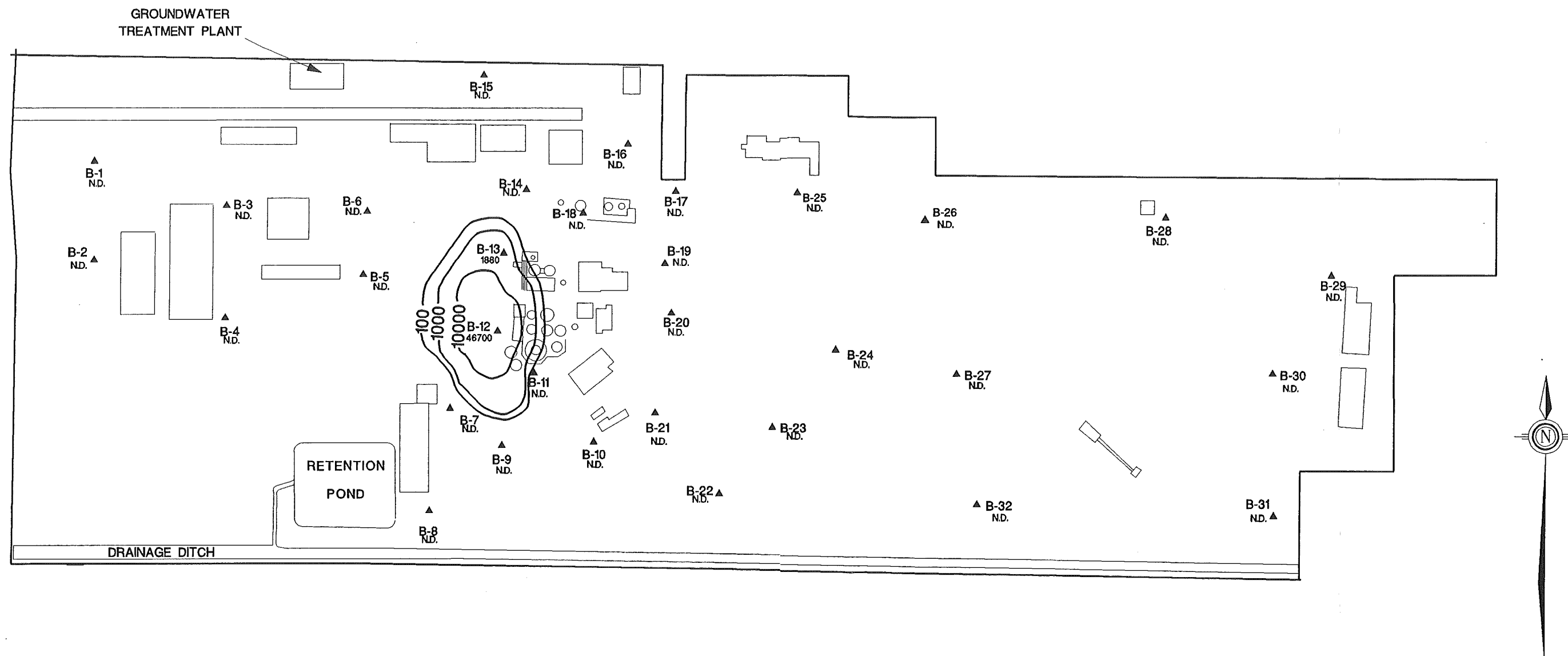
0 100 200 300 400 500  
SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-14**  
**CONTOUR MAP OF INFERRED**  
**PENTACHLOROPHENOL CONCENTRATIONS**  
**(SOILS: 0 TO 2.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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| DRAWN BY AYL    |          | FILE: PENTA.GCD    |





### LEGEND

B-9▲ SOIL BORING

/// DRAINAGE DITCH

### PENTACHLOROPHENOL CONCENTRATIONS

40 INFERRED PENTACHLOROPHENOL CONCENTRATION CONTOURS (ug/Kg)

50 PENTACHLOROPHENOL CONCENTRATION (ug/Kg)  
ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

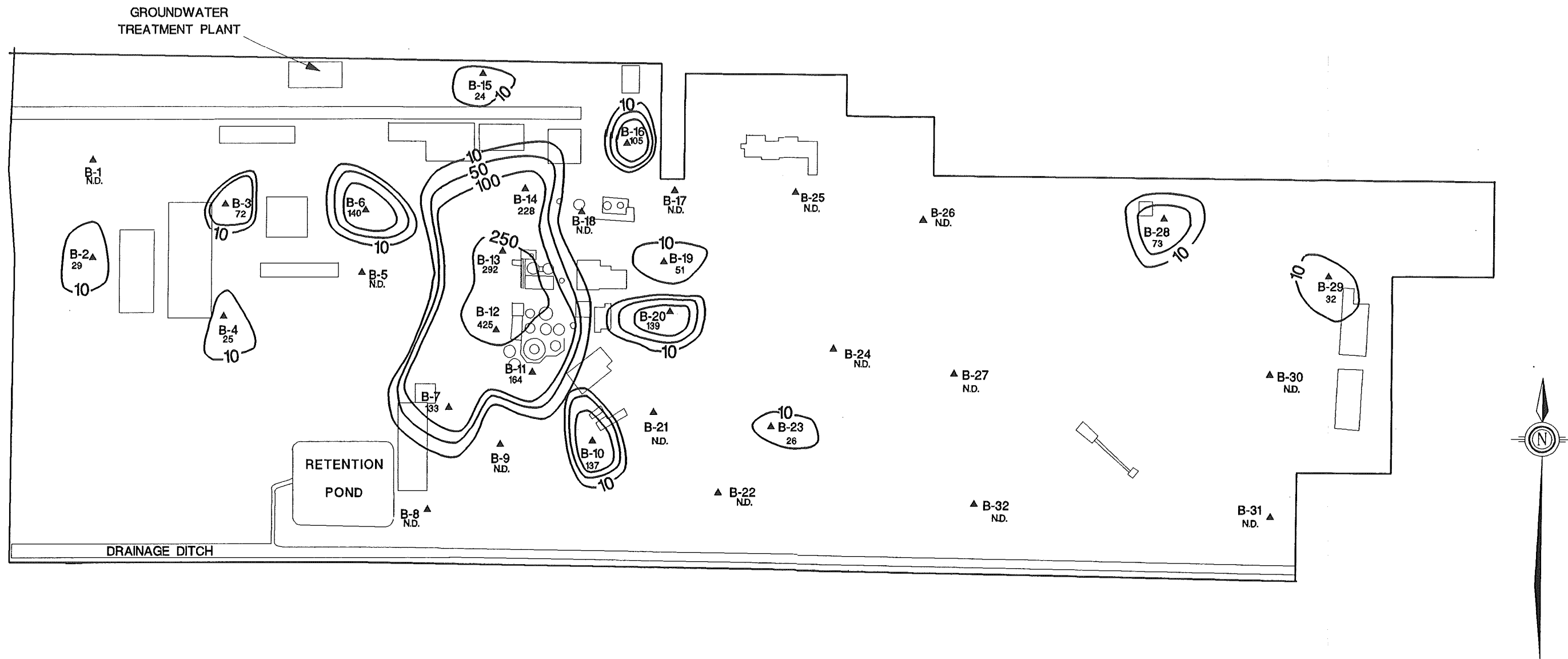
Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

0 100 200 300 400 500  
SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-15**  
**CONTOUR MAP OF INFERRED**  
**PENTACHLOROPHENOL CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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# LEGEND

B-9▲ SOIL BORING  
 TOTAL VOLATILE AROMATICS CONCENTRATIONS

40// DRAINAGE DITCH  
 INFERRED TOTAL VOLATILE AROMATIC CONCENTRATION CONTOURS (ug/Kg)

50 TOTAL VOLATILE AROMATICS CONCENTRATION (ug/Kg)  
 ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Organic concentrations are reported as ug/kg (ppb).  
 Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
 Soil samples were collected during January, 1994.

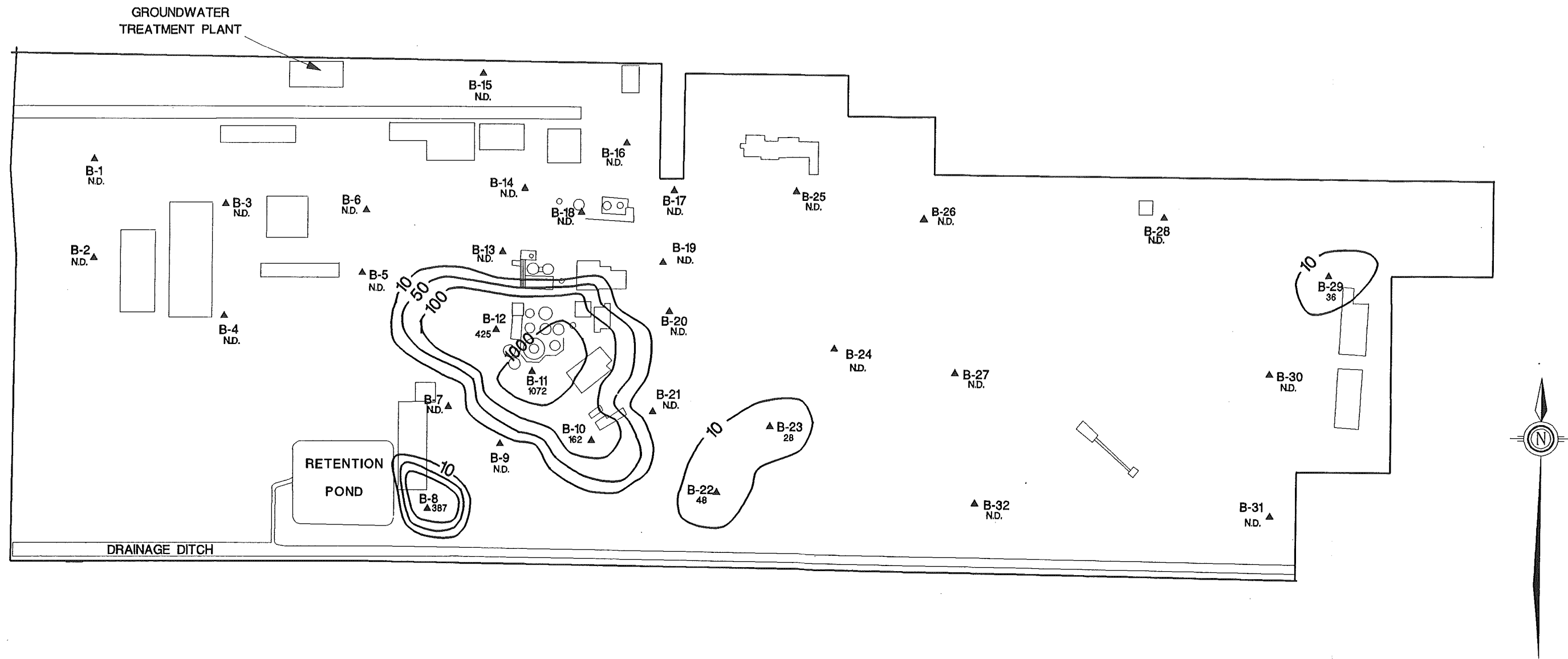
0 100 200 300 400 500  
 SCALE (FEET)

KEYSTONE  
 ENVIRONMENTAL

FIGURE 2-16  
 CONTOUR MAP OF INFERRED  
 TOTAL VOLATILE AROMATICS  
 CONCENTRATIONS  
 (SOILS: 0 TO 2.5 FEET)  
 J.H. BAXTER  
 EUGENE, OREGON

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| DRAWN BY AYL    |          | FILE: VOC.GCD      |





### LEGEND

B-9▲ SOIL BORING      // DRAINAGE DITCH

TOTAL VOLATILE AROMATICS CONCENTRATIONS

40 — INFERRED TOTAL VOLATILE AROMATICS CONCENTRATION CONTOURS (ug/Kg)

50 — TOTAL VOLATILE AROMATICS CONCENTRATION (ug/Kg)

N.D. — SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Organic concentrations are reported as ug/kg (ppb).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

0 100 200 300 400 500

SCALE (FEET)

KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-17**  
**CONTOUR MAP OF INFERRED**  
**TOTAL VOLATILE AROMATICS**  
**CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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| DRAWN BY AYL    |          | FILE: VOC2-6.GCD   |

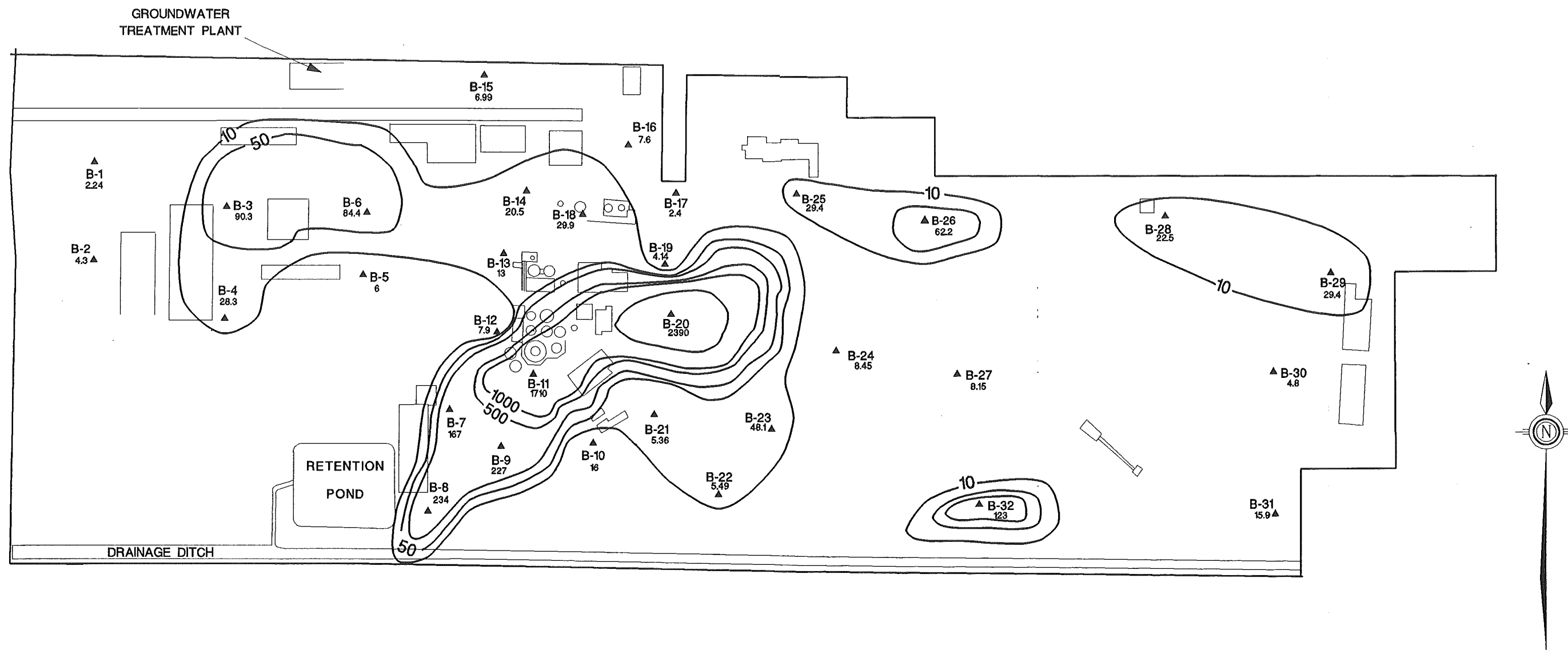
may be associated with the chemical storage tank farm. Figures 2-16 and 2-17 present the volatile aromatics data and isopleth contours.

#### 2.4.2.1.4 Metals

Table 2-6 presents the metals data in onsite soils and Figures 2-18 to 2-25 present contour maps of individual metal concentrations in both the surface soils and soils collected from immediately above the water table. The metals of potential concern at the site (arsenic, chromium, copper and zinc) were detected, above background concentrations in the soil, at several locations on the site. Background metal concentrations in the onsite soils were estimated to be approximately 5 to 10 ug/g for arsenic, 25 to 50 ug/g for chromium, 25 to 50 ug/g for copper and 50 to 100 ug/g for zinc. These values are based on analytical results from soil samples collected at upgradient locations (ie. W-9) and areas not used to store treated wood (ie. B-1, B-31).

The surface sample from boring B-20, which is located just to the east of the plant maintenance shops, had the highest metal concentrations. The arsenic, chromium, copper and zinc concentrations in the sample were respectively 2,390 ug/g, 468 ug/g, 4090 ug/g and 1790 ug/g. However, the soil sample taken from only 1 foot below this sample in B-20 had arsenic, chromium, copper and zinc concentrations of 5.3 ug/g, 40 ug/g, 45.2 ug/g and 360 ug/g, respectively.

Geometric mean concentrations of the four metals were determined for both the shallow soil samples (0 to 2.5 feet below grade) and the deeper samples (2.5 to 6.5 feet below grade) to assess the overall soil quality on the plant site. The geometric mean concentration for chromium in the shallow soil was 28.5 ug/g and 35.1 ug/g in the deeper soil zone. The mean concentration of copper in the shallow samples (55.8 ug/g) was approximately twice the mean concentration of copper in the deeper samples (27.5 ug/g). Arsenic was detected at 17 of the 32 soil boring locations at concentrations ranging from 20 ug/g (B-14) to 2,390 ug/g (B-20). The geometric mean concentration of arsenic in the shallow and deeper soil zones were 25.1 ug/g and 6.1 ug/g, respectively. This indicates that the near surface soils on the plant site



### LEGEND

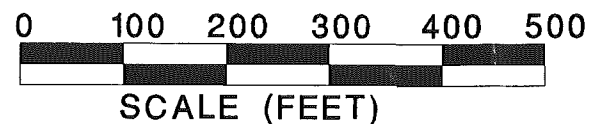
B-9 ▲ SOIL BORING      // DRAINAGE DITCH

#### ARSENIC CONCENTRATIONS

40 — INFERRED ARSENIC CONCENTRATION CONTOURS (ug/g)

5.0 ARSENIC CONCENTRATIONS (ug/g)  
ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Metal concentrations are reported as ug/g (ppm).  
Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
Soil samples were collected during January, 1994.

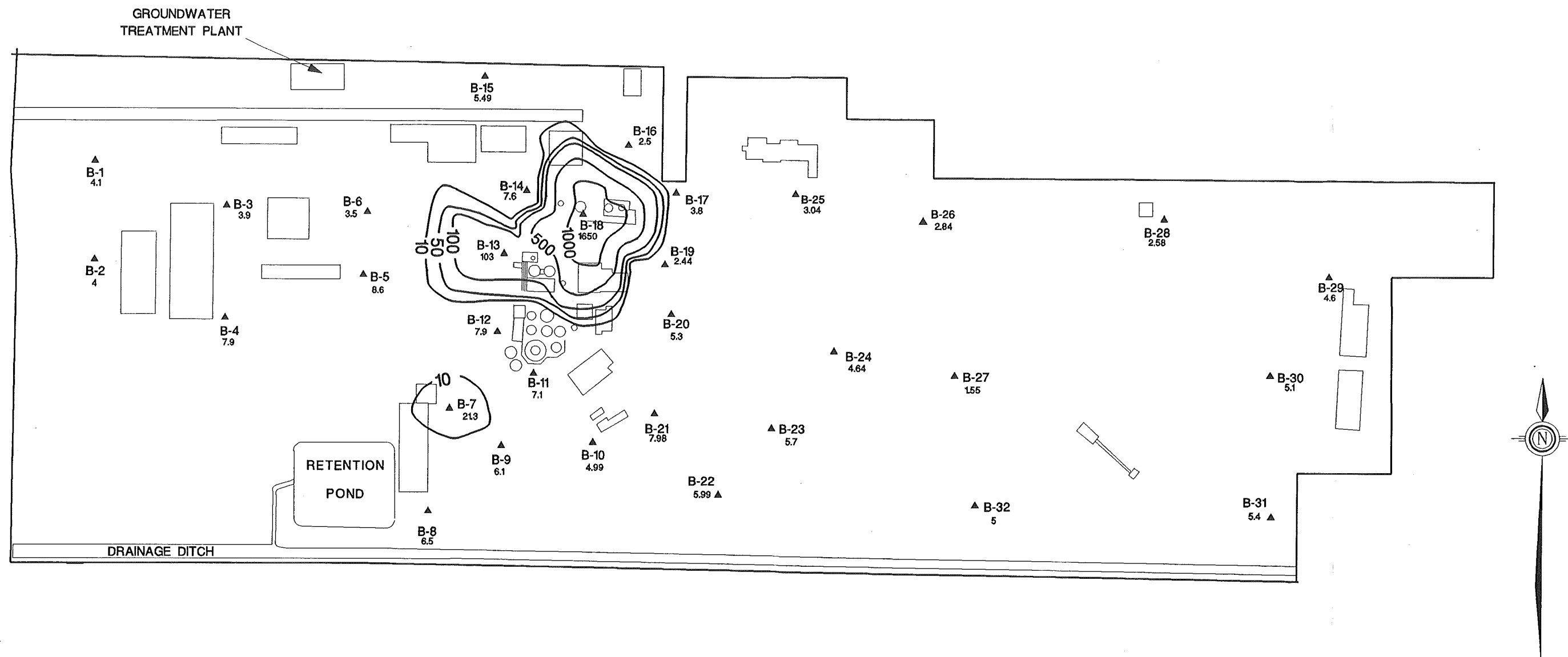


**KEYSTONE  
ENVIRONMENTAL**

**FIGURE 2-18**  
**CONTOUR MAP OF INFERRED**  
**ARSENIC CONCENTRATIONS**  
**(SOILS: 0 TO 2.5 FEET)**

**J.H. BAXTER**  
**EUGENE, OREGON**

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| REVISION NO. 01 | 19APR94 | PROJECT: 372250-08 |
| DRAWN BY AYL    |         | FILE: ARSENIC.GCD  |



### LEGEND

B-9 ▲ SOIL BORING  
 // DRAINAGE DITCH  
ARSENIC CONCENTRATIONS

40 — INFERRED ARSENIC CONCENTRATION CONTOURS (ug/g)

50 ARSENIC CONCENTRATIONS (ug/g)  
 ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

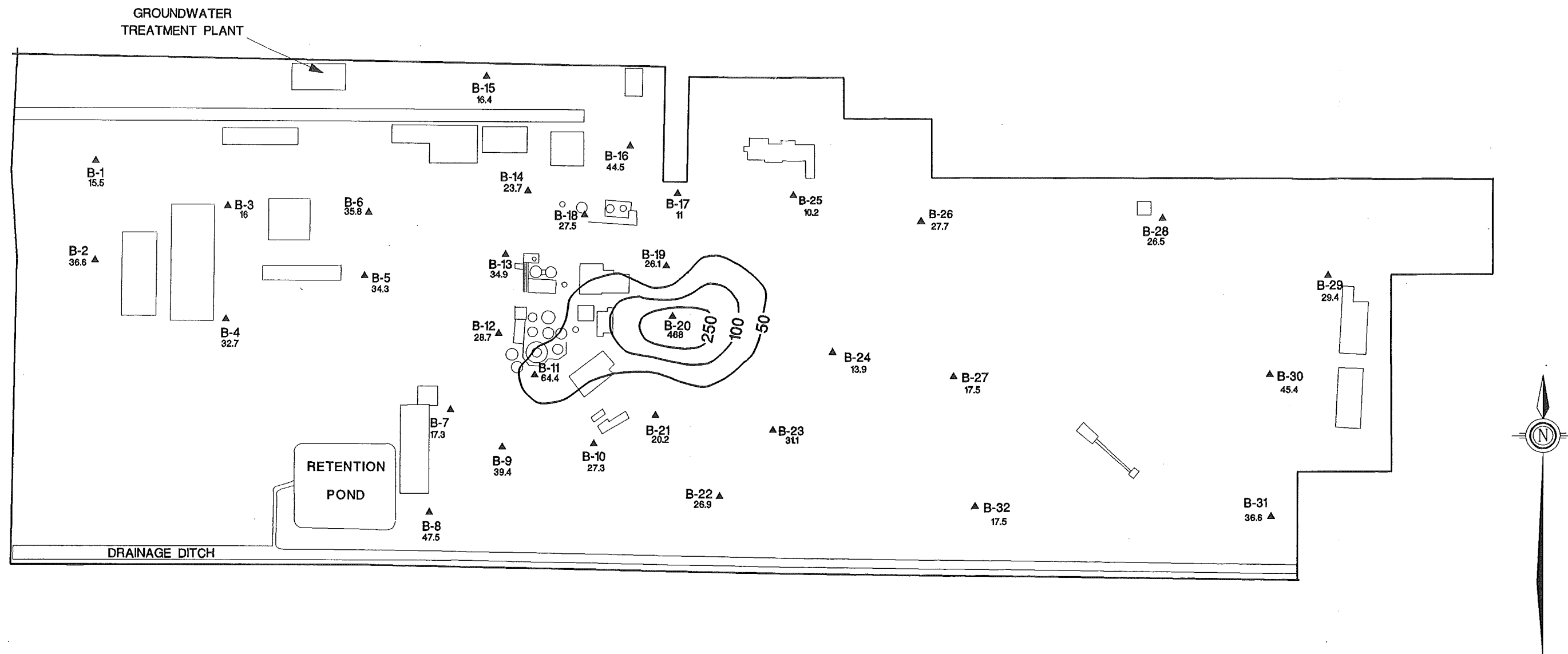
Metal concentrations are reported as ug/g (ppm).  
 Soil samples were collected from a depth interval from 0.25 to 6.5 feet below grade.  
 Soil samples were collected during January, 1994.

0 100 200 300 400 500  
 SCALE (FEET)

KEYSTONE  
 ENVIRONMENTAL

**FIGURE 2-19**  
**CONTOUR MAP OF INFERRED**  
**ARSENIC CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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| DRAWN BY AYL    |          | FILE: AS2-6.GCD    |



### LEGEND

B-9 ▲ SOIL BORING      // DRAINAGE DITCH

#### CHROMIUM CONCENTRATIONS

— 40 — INFERRED CHROMIUM CONCENTRATION CONTOURS (ug/g)

5.0 CHROMIUM CONCENTRATIONS (ug/g)  
ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

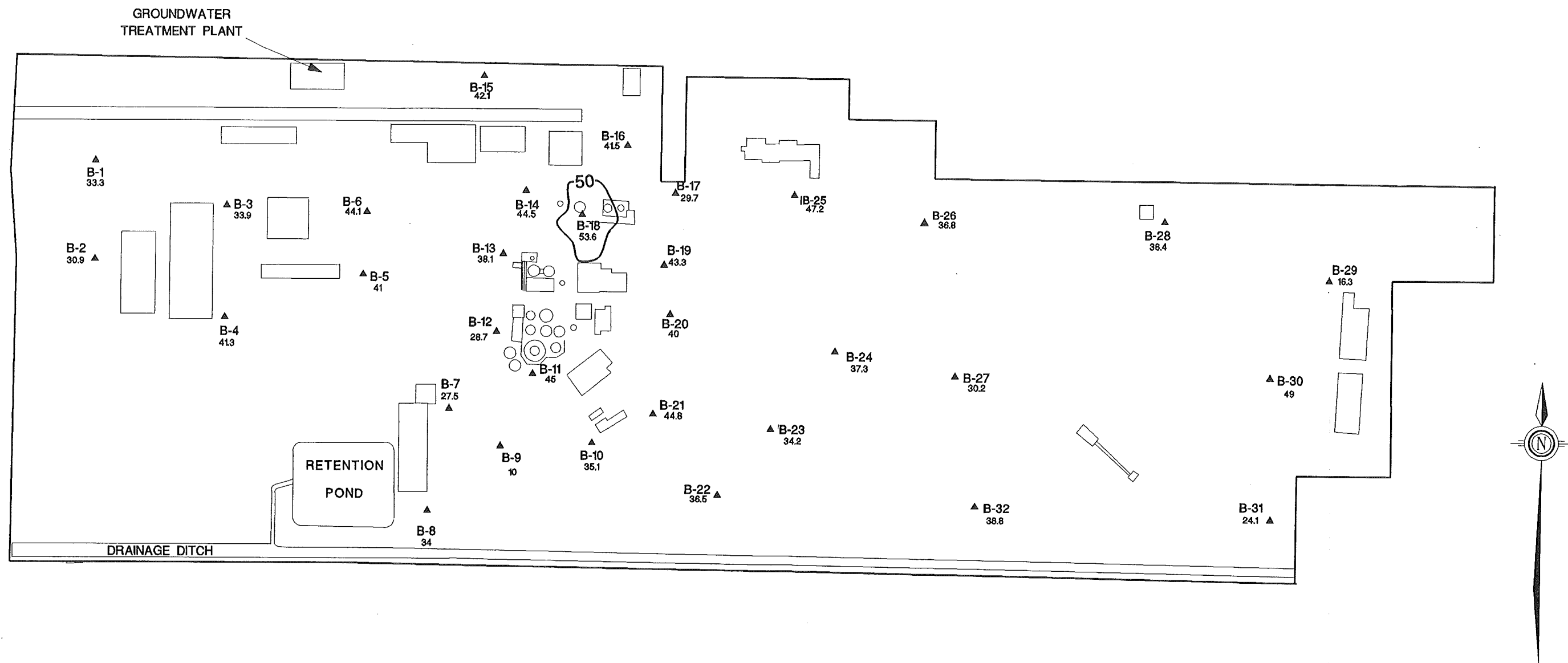
Metal concentrations are reported as ug/g (ppm).  
Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
Soil samples were collected during January, 1994.

0 100 200 300 400 500  
SCALE (FEET)

**KEYSTONE  
ENVIRONMENTAL**

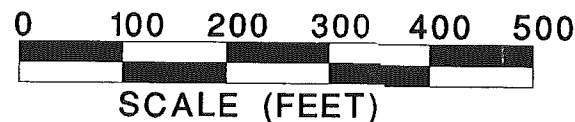
**FIGURE 2-20**  
**CONTOUR MAP OF INFERRED**  
**CHROMIUM CONCENTRATIONS**  
**(SOILS: 0 TO 2.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

|                 |          |                    |
|-----------------|----------|--------------------|
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| DRAWN BY AYL    |          | FILE: CHROMIUM.GCD |



### LEGEND

- B-9▲ SOIL BORING
- CHROMIUM CONCENTRATIONS
- 40 / INFERRED CHROMIUM CONCENTRATION CONTOURS (ug/g)
- 5.0 CHROMIUM CONCENTRATIONS (ug/g)
- ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS
- Metal concentrations are reported as ug/g (ppm).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

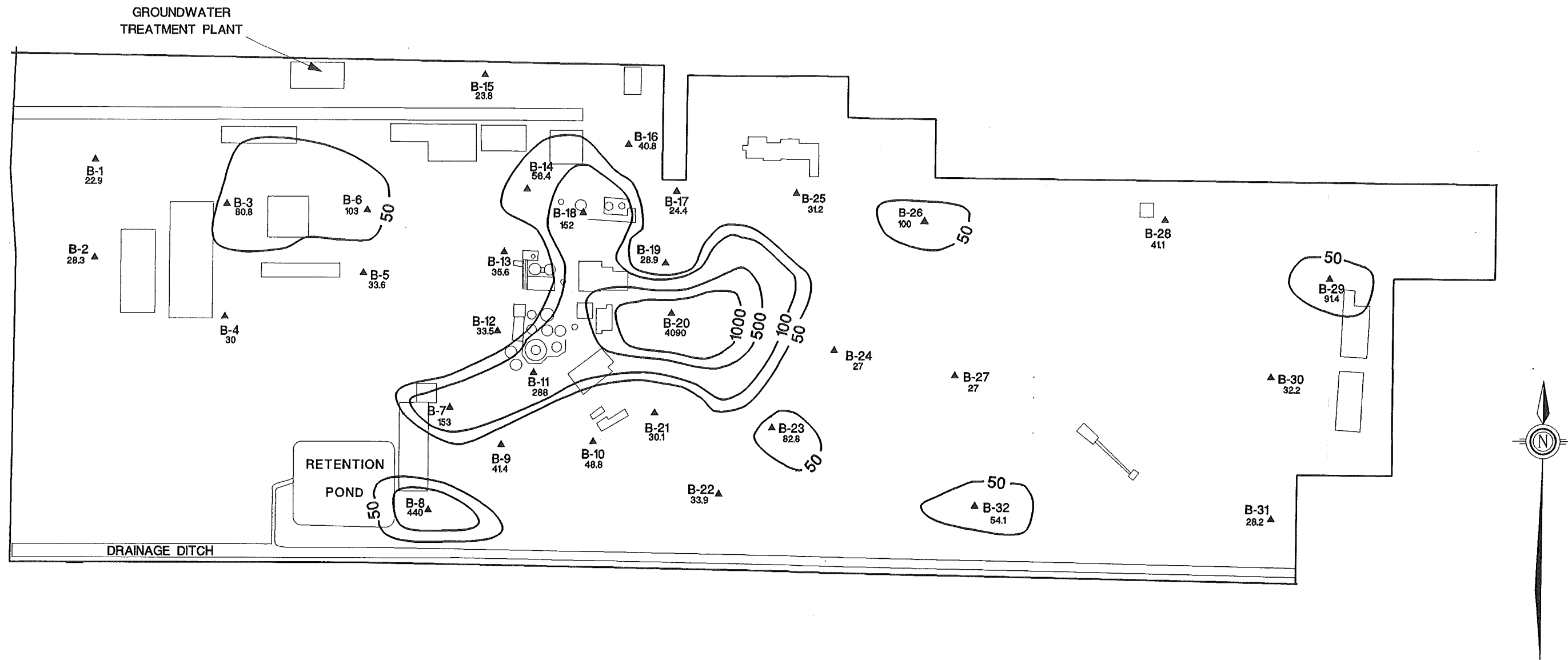


KEYSTONE  
ENVIRONMENTAL

**FIGURE 2-21**  
CONTOUR MAP OF INFERRED  
CHROMIUM CONCENTRATIONS  
(SOILS: 2.5 TO 6.5 FEET)  
J.H. BAXTER  
EUGENE, OREGON

|                 |          |                    |
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| DRAWN BY AYL    |          | FILE: CHROM2-6.GCD |





### LEGEND

B-9▲ SOIL BORING      // DRAINAGE DITCH  
COPPER CONCENTRATIONS

40 — INFERRED COPPER CONCENTRATION CONTOURS (ug/g)

5.0 COPPER CONCENTRATIONS (ug/g)  
 ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

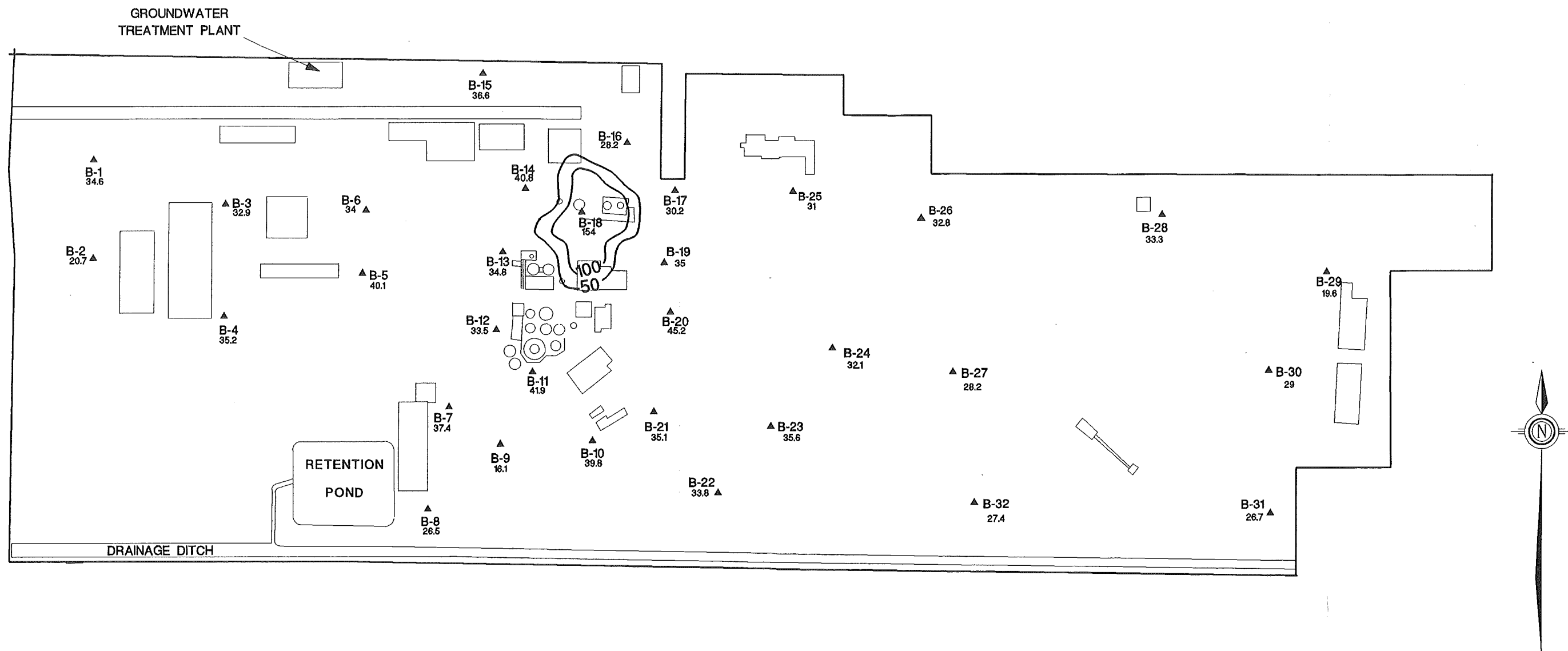
Metal concentrations are reported as ug/g (ppm).  
 Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
 Soil samples were collected during January, 1994.

0 100 200 300 400 500  
 SCALE (FEET)

KEYSTONE  
 ENVIRONMENTAL

**FIGURE 2-22**  
**CONTOUR MAP OF INFERRED**  
**COPPER CONCENTRATIONS**  
**(SOILS: 0 TO 2.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

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|-----------------|----------|--------------------|
| REVISION NO. 01 | 26SEPT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |          | FILE: COPPER.GCD   |



### LEGEND

B-9▲ SOIL BORING

/// DRAINAGE DITCH

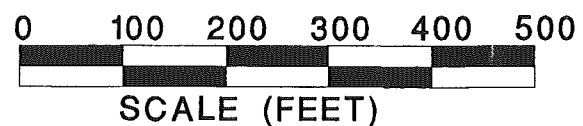
#### COPPER CONCENTRATIONS

40 — INFERRED COPPER CONCENTRATION CONTOURS (ug/g)

5.0 COPPER CONCENTRATIONS (ug/g)

ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Metal concentrations are reported as ug/g (ppm).  
Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
Soil samples were collected during January, 1994.

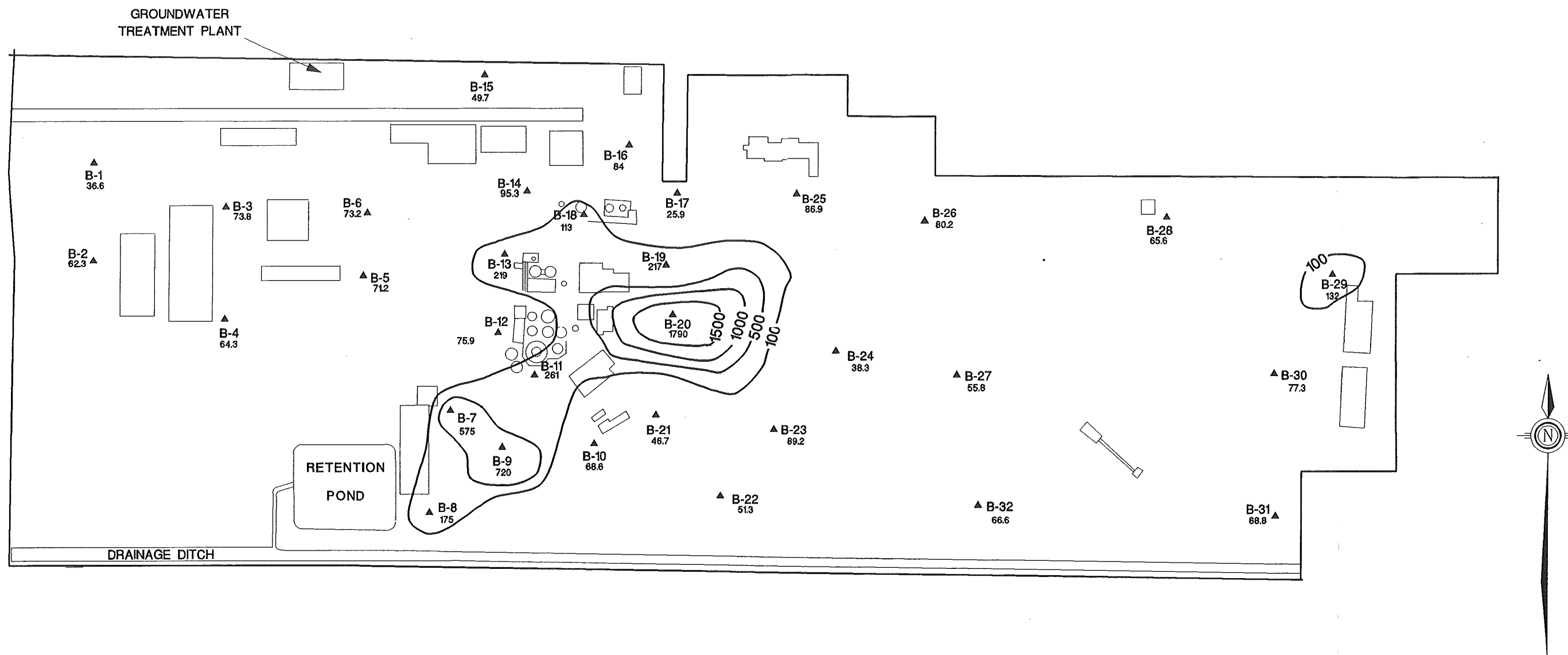


**KEYSTONE  
ENVIRONMENTAL**

**FIGURE 2-23**  
**CONTOUR MAP OF INFERRED**  
**COPPER CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

|                 |          |                    |
|-----------------|----------|--------------------|
| REVISION NO. 01 | 28SEPT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |          | FILE: CU2-6.GCD    |





### LEGEND

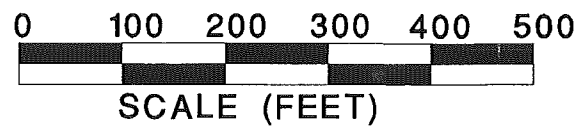
B-9▲ SOIL BORING      // DRAINAGE DITCH

### ZINC CONCENTRATIONS

40 — INFERRED ZINC CONCENTRATION CONTOURS (ug/g)

5.0 ZINC CONCENTRATIONS (ug/g)  
 ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

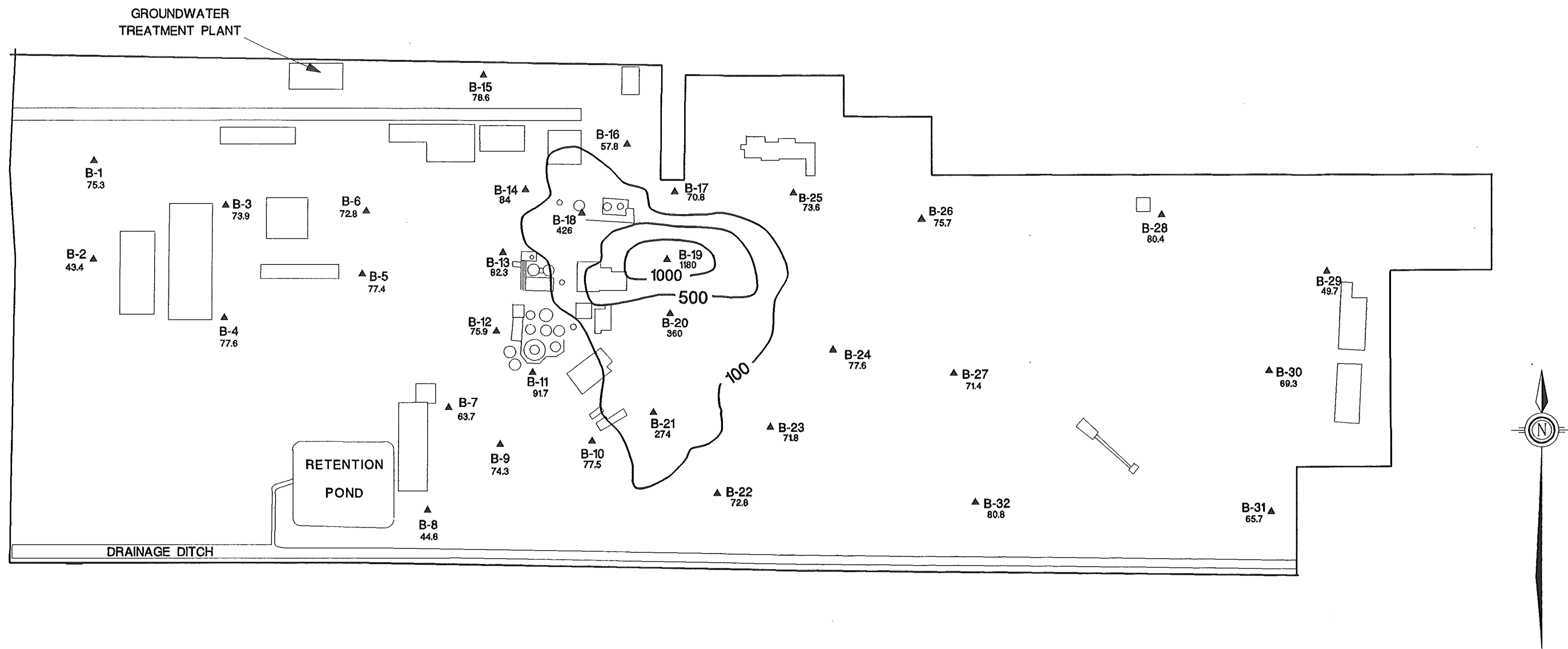
Metal concentrations are reported as ug/g (ppm).  
 Soil samples were collected from a depth interval from 0 to 2.5 feet below grade.  
 Soil samples were collected during January, 1994.



**KEYSTONE**  
ENVIRONMENTAL

**FIGURE 2-24**  
 CONTOUR MAP OF INFERRED  
 ZINC CONCENTRATIONS  
 (SOILS: 0 TO 2.5 FEET)  
 J.H. BAXTER  
 EUGENE, OREGON

|                 |          |                    |
|-----------------|----------|--------------------|
| REVISION NO. 01 | 26SEPT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |          | FILE: ZINC.GCD     |



### LEGEND

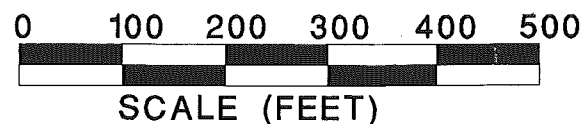
B-9 ▲ SOIL BORING      // DRAINAGE DITCH

#### ZINC CONCENTRATIONS

40 — INFERRED ZINC CONCENTRATION CONTOURS (ug/g)

5.0 ZINC CONCENTRATIONS (ug/g)  
 ND. SAMPLE CONCENTRATION WAS BELOW DETECTION LIMITS

Metal concentrations are reported as ug/g (ppm).  
 Soil samples were collected from a depth interval from 2.5 to 6.5 feet below grade.  
 Soil samples were collected during January, 1994.



**KEYSTONE  
 ENVIRONMENTAL**

**FIGURE 2-25**  
**CONTOUR MAP OF INFERRED**  
**ZINC CONCENTRATIONS**  
**(SOILS: 2.5 TO 6.5 FEET)**  
**J.H. BAXTER**  
**EUGENE, OREGON**

|                 |          |                    |
|-----------------|----------|--------------------|
| REVISION NO. 01 | 27SEPT94 | PROJECT: 372250-09 |
| DRAWN BY AYL    |          | FILE: ZINC2-6.GCD  |

contain arsenic at approximately four times the concentration as arsenic in deeper soils.

At boring B-18, the deeper soil sample contained higher metal concentrations, particularly arsenic, than the surface soil sample. This is not consistent with the concentration depth pattern observed at other borehole locations on the site. The probable cause for the observed variance with other locations is that, at B-18, the surface soils were recently placed sand fill. The sand was used as a base for the concrete drip pad upgrade for the retort located near B-18. The deeper sample at this location would correspond with the native soils.

#### **2.4.2.1.5 Dioxin/Furans**

Three surface soil samples (0 to 2.5 feet below grade) were sampled and analyzed for dioxin/furans. The samples were taken at borings B-7, B-17 and B-23, which are located near the former burn pit, adjacent to the main retort drip pad and in the treated pole storage yard, respectively. Dioxins and furans were detected in all three samples. The total dioxin/furan concentrations in B-7, B-17 and B-23 were 12,004 parts per trillion (ppt), 8,374 ppt and 57,574 ppt, respectively. The equivalent concentrations of TCDD, calculated from the concentrations of the other dioxin/furan compounds and relative toxicity factors are 21 ppt TCDD at B-7, 13 ppt TCDD at B-17 and 150 ppt TCDD at B-23. TCDD was not detected in any of the soil samples tested. The dioxin/furan analytical results are summarized in Table 2-7.

#### **2.4.2.2 Offsite Surface Soil Quality**

Nine surface soil samples were collected from offsite locations for chemical analysis. Six of the samples were taken from locations north of the Baxter property and three were collected along First Avenue south of the site. The soil samples were analyzed for PAH, VOAs, phenols and arsenic, chromium, copper, iron, manganese and zinc. The offsite surface soil results are summarized in Table 2-8 and the approximate sampling locations are shown on Figures 2-1 and 2-3.

TABLE 2-7  
SOIL ANALYTICAL RESULTS  
DIOXIN/FURANS

| EPA METHOD 8290                                   |  | B-7<br>(0-1.5')<br>Jan 26/94 | B-7<br>Detection<br>Limit | B-17<br>(0.5-2')<br>Jan 27/94 | B-17<br>Detection<br>Limit | B-23<br>(0-1')<br>Jan 26/94 | B-23<br>Detection<br>Limit | Field Blank<br>(PPQ)<br>Jan 27/94 | Field Blank<br>Detection<br>Limit(PPQ) |
|---------------------------------------------------|--|------------------------------|---------------------------|-------------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------------|----------------------------------------|
| INDIVIDUAL ANALYTES                               |  |                              |                           |                               |                            |                             |                            |                                   |                                        |
| 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)        |  | -                            | 2.3                       | -                             | 6.8                        | -                           | 1.9                        | -                                 | 5.9                                    |
| 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD)     |  | -                            | 4.7                       | -                             | 18.4                       | -                           | 3.5                        | -                                 | 10.3                                   |
| 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin (HxCDD)    |  | -                            | 6.3                       | -                             | 27.8                       | 30.4                        | 5.6                        | -                                 | 14.1                                   |
| 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin (HxCDD)    |  | -                            | 6.2                       | -                             | 20.4                       | 251.6                       | 5.8                        | -                                 | 14.5                                   |
| 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin (HxCDD)    |  | 43.4                         | 1.2                       | -                             | 3.2                        | 143.4                       | 1.1                        | -                                 | 2.7                                    |
| 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (HpCDD) |  | 764                          | 2.5                       | 613                           | 14.4                       | 5894.1                      | 2.3                        | -                                 | 24.5                                   |
| octachlorodibenzo-p-dioxin (OCDD)                 |  | 7112.9                       | 3.5                       | 7064.3                        | 16.8                       | 35325.5                     | 3.1                        | 409.4                             | 23.9                                   |
| 2,3,7,8-tetrachlorodibenzofuran (TCDF)            |  | -                            | 1.2                       | -                             | 8.0                        | 2.9                         | 1.6                        | -                                 | 2.5                                    |
| 1,2,3,7,8-pentachlorodibenzofuran (PeCDF)         |  | -                            | 2.6                       | -                             | 11.6                       | 9.4                         | 2.0                        | -                                 | 4.9                                    |
| 2,3,4,7,8-pentachlorodibenzofuran (PeCDF)         |  | -                            | 2.6                       | -                             | 9.7                        | -                           | 2.1                        | -                                 | 4.7                                    |
| 1,2,3,4,7,8-hexachlorodibenzofuran (HxCDF)        |  | -                            | 2.0                       | -                             | 16.3                       | -                           | 4.5                        | -                                 | 8.9                                    |
| 1,2,3,6,7,8-hexachlorodibenzofuran (HxCDF)        |  | -                            | 1.8                       | -                             | 15.5                       | -                           | 4.5                        | -                                 | 8.6                                    |
| 1,2,3,7,8,9-hexachlorodibenzofuran (HxCDF)        |  | -                            | 1.7                       | -                             | 14.0                       | -                           | 3.5                        | -                                 | 8.8                                    |
| 2,3,4,6,7,8-hexachlorodibenzofuran (HxCDF)        |  | -                            | 1.7                       | -                             | 12.9                       | -                           | 3.1                        | -                                 | 8.2                                    |
| 1,2,3,4,6,7,8-heptachlorodibenzofuran (HpCDF)     |  | 128.9                        | 2.2                       | 38.4                          | 16.7                       | 878.8                       | 1.6                        | -                                 | 9.6                                    |
| 1,2,3,4,7,8,9-heptachlorodibenzofuran (HpCDF)     |  | -                            | 2.3                       | -                             | 14.2                       | -                           | 1.8                        | -                                 | 9.1                                    |
| octachlorodibenzofuran (OCDF)                     |  | 626.1                        | 2.1                       | 100                           | 12.8                       | 2928.8                      | 2.2                        | -                                 | 16.7                                   |
| TOTAL ANALYTES                                    |  |                              |                           |                               |                            |                             |                            |                                   |                                        |
| TOTAL TCDD                                        |  | -                            | 2.3                       | -                             | 6.8                        | -                           | 1.9                        | -                                 | 5.9                                    |
| TOTAL PeCDD                                       |  | -                            | 4.7                       | -                             | 18.4                       | -                           | 3.5                        | -                                 | 10.3                                   |
| TOTAL HxCDD                                       |  | 366.6                        | 6.3                       | -                             | 27.8                       | 1680.7                      | 5.8                        | -                                 | 14.5                                   |
| TOTAL HpCDD                                       |  | 3310.7                       | 2.5                       | 1075.4                        | 14.4                       | 12974.7                     | 2.3                        | -                                 | 24.5                                   |
| TOTAL OCDD                                        |  | 7112.9                       | 3.5                       | 7063.4                        | 16.8                       | 35326.5                     | 3.1                        | 409.4                             | 23.9                                   |
| TOTAL TCDF                                        |  | -                            | 1.2                       | -                             | 8.0                        | 2.9                         | 1.6                        | -                                 | 2.5                                    |
| TOTAL PeCDF                                       |  | -                            | 2.6                       | -                             | 11.6                       | 177                         | 2.1                        | -                                 | 4.9                                    |
| TOTAL HxCDF                                       |  | -                            | 2.0                       | -                             | 16.3                       | 1254.9                      | 4.5                        | -                                 | 8.9                                    |
| TOTAL HpCDF                                       |  | 589.5                        | 2.3                       | 144.2                         | 16.7                       | 3329                        | 1.8                        | -                                 | 9.6                                    |
| TOTAL OCDF                                        |  | 626.1                        | 2.1                       | 100                           | 12.8                       | 2928.8                      | 2.2                        | -                                 | 16.7                                   |
| TOTAL DIOXIN/FURANS                               |  | 12004.91                     |                           | 8373.9                        |                            | 57573.7                     |                            | 409.4                             |                                        |
| TOTAL 2,3,7,8-TCDD TOXICITY EQUIVALENT            |  | 21                           |                           | 13                            |                            | 150                         |                            | 0.41                              |                                        |

NOTE:

ALL SOIL CONCENTRATIONS IN PARTS PER TRILLION (PPT)  
FIELD BLANK CONCENTRATIONS IN PARTS PER QUADRILLION (PPQ)

**TABLE 2-8**  
**Offsite Surface Soil Results**

| SURFACE SOIL SAMPLE<br>DATE SAMPLED | SS-1<br>6/24/93 | SS-2<br>6/24/93 | SS-3<br>6/24/93 | SS-4<br>6/24/93 | SS-5<br>6/24/93 | SS-6<br>6/24/93 |
|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>PAHs EPA Method 8310</b>         |                 |                 |                 |                 |                 |                 |
| Naphthalene                         | <70             | 108.00          | <70             | <70             | <70             | <70             |
| Acenaphthylene                      | <70             | <70             | <70             | <70             | <70             | <70             |
| Acenaphthene                        | <70             | <70             | <70             | <70             | <70             | <70             |
| Fluorene                            | <7              | 23.30           | <7              | <7              | <7              | 7.17            |
| Phenanthrene                        | 24.80           | 145.00          | 21.90           | 5.01            | 6.82            | 24.40           |
| Anthracene                          | 3.91            | 15.60           | <3.5            | <3.5            | <3.5            | 5.12            |
| Fluoranthene                        | 35.50           | 256.00          | 20.80           | 11.90           | 8.34            | 41.40           |
| Pyrene                              | 12.50           | 94.50           | 18.10           | 8.65            | <7              | 14.00           |
| Benzo(a)anthracene                  | 7.03            | 77.60           | 11.00           | 3.08            | 2.22            | 13.50           |
| Chrysene                            | 12.70           | 113.00          | 15.60           | 5.69            | <5              | 17.30           |
| Benzo(b)fluoranthene                | 17.20           | 72.90           | 10.10           | 6.26            | 3.32            | 10.30           |
| Benzo(k)fluoranthene                | 2.57            | 74.20           | 5.65            | 1.65            | <.7             | 3.10            |
| Benzo(a)pyrene                      | 1.93            | 50.80           | 10.10           | 4.47            | 1.19            | 5.01            |
| Dibenzo(a,h)anthracene              | 5.90            | 36.10           | 10.70           | 4.66            | 3.66            | 6.17            |
| Benzo(g,h,i)perylene                | <1.7            | 54.00           | 7.05            | 4.46            | <1.7            | 2.50            |
| Indeno(1,2,3-cd)pyrene              | 8.79            | 109.00          | 7.44            | 6.08            | <1.7            | 6.58            |
| <b>Total PAHs(detected)</b>         | <b>133</b>      | <b>1230</b>     | <b>138</b>      | <b>62</b>       | <b>26</b>       | <b>157</b>      |
| <b>Phenols EPA Method 8040</b>      |                 |                 |                 |                 |                 |                 |
| Phenol                              | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           |
| 2-Chlorophenol                      | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           |
| 2-Nitrophenol                       | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           |
| 2,4-Dimethylphenol                  | <17.0           | <17.0           | <17.0           | <170.0          | <17.0           | <17.0           |
| 2,4-Dichlorophenol                  | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           | <17.0           |
| 4-Chloro-3-Methylphenol             | <17.0           | 32.0            | <17.0           | <17.0           | <17.0           | <17.0           |
| 2,4,6-Trichlorophenol               | <33.0           | <33.0           | <33.0           | 245.0           | <33.0           | <33.0           |
| 2,4-Dinitrophenol                   | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           |
| 4-Nitrophenol                       | 51.0            | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           |
| 2,3,5,6-Tetrachlorophenol           | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           |
| 2-Methyl-4,6-Dinitrophenol          | 64.0            | <33.0           | <33.0           | <33.0           | <33.0           | <33.0           |
| Pentachlorophenol                   | <33.0           | 550.0           | <33.0           | <330.0          | <33.0           | 104.0           |
| <b>Volatiles EPA No. 8020</b>       |                 |                 |                 |                 |                 |                 |
| Benzene                             | <20             | <200            | <20             | <20             | <20             | <20             |
| Toluene                             | <20             | <200            | <20             | <20             | <20             | <20             |
| Chlorobenzene                       | <20             | <200            | <20             | <20             | <20             | <20             |
| Ethylbenzene                        | <20             | <200            | <20             | <20             | <20             | <20             |
| Xylenes                             | <30             | <300            | <30             | <30             | <30             | <30             |
| Styrene                             | <30             | <300            | <30             | <30             | <30             | <30             |
| 1,3-Dichlorobenzene                 | <40             | <400            | <40             | <40             | <40             | <40             |
| 1,4-Dichlorobenzene                 | <40             | <400            | <40             | <40             | <40             | <40             |
| 1,2-Dichlorobenzene                 | <40             | <400            | <40             | <40             | <40             | <40             |
| <b>Metals</b>                       |                 |                 |                 |                 |                 |                 |
| Arsenic                             | <1              | 3               | <5              | 5.3             | 7               | <5              |
| Chromium                            | 4               | 45.6            | 22.8            | 24              | 36.1            | 24.8            |
| Copper                              | 8.54            | 45.4            | 28.5            | 25.8            | 31.9            | 27.9            |
| Iron                                | 3600            | 20400           | 29800           | 24200           | 41400           | 28000           |
| Manganese                           | 399             | 534             | 545             | 646             | 978             | 457             |
| Zinc                                | 24.1            | 440             | 58.4            | 77.2            | 76.6            | 65.8            |

"<" below quantitation limit given.DUP refers to duplicate sample.

PAH, volatiles and phenol concentrations in ug/Kg.Metals concentrations in ug/g.

TABLE 2-8 (CONT.)  
Offsite Surface Soil Results

| SURFACE SOIL SAMPLE<br>DATE SAMPLED | SS-7<br>6/24/93 | SS-8<br>6/24/93 | SS-9<br>6/24/93 | DUP<br>6/24/93 | FIELD BLANK<br>6/24/93 | TRIP BLANK<br>6/24/93 |
|-------------------------------------|-----------------|-----------------|-----------------|----------------|------------------------|-----------------------|
| PAHs EPA Method 8310                |                 |                 |                 |                | **(ug/L)**             | **(ug/L)**            |
| Naphthalene                         | <70             | 108.00          | 78.40           | <70            | <2.0                   | NA                    |
| Acenaphthylene                      | <70             | <70             | 77.70           | <70            | <2.0                   | NA                    |
| Acenaphthene                        | <70             | <70             | <70             | <70            | <2.0                   | NA                    |
| Fluorene                            | <7              | <7              | 12.40           | <7             | <.2                    | NA                    |
| Phenanthrene                        | 4.80            | <3.5            | 27.10           | 5.10           | <.1                    | NA                    |
| Anthracene                          | <3.5            | <3.5            | 17.10           | <3.5           | <.1                    | NA                    |
| Fluoranthene                        | 8.20            | <7              | 86.30           | 8.40           | <.2                    | NA                    |
| Pyrene                              | <7              | <7              | 83.40           | <7             | <.2                    | NA                    |
| Benzo(a)anthracene                  | 2.60            | 2.60            | 31.10           | 5.80           | <.02                   | NA                    |
| Chrysene                            | <5              | <5              | 49.70           | 5.50           | <.2                    | NA                    |
| Benzo(b)fluoranthene                | 4.10            | 3.40            | 45.90           | 1.90           | <.02                   | NA                    |
| Benzo(k)fluoranthene                | 1.30            | <.7             | 19.70           | 2.40           | <.02                   | NA                    |
| Benzo(a)pyrene                      | 1.60            | 2.20            | 22.10           | 1.20           | <.02                   | NA                    |
| Dibenzo(a,h)anthracene              | 3.20            | <1.0            | 19.20           | 4.80           | <.03                   | NA                    |
| Benzo(g,h,i,)perylene               | <1.7            | <1.7            | 6.50            | <1.7           | <.05                   | NA                    |
| Indeno(1,2,3-cd)pyrene              | 4.90            | 2.10            | 15.00           | 4.10           | <.05                   | NA                    |
| Total PAHs(detected)                | 31              | 118             | 592             | 39             | 0                      |                       |
| Phenols EPA Method 8040             |                 |                 |                 |                |                        |                       |
| Phenol                              | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 2-Chlorophenol                      | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 2-Nitrophenol                       | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 2,4-Dimethylphenol                  | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 2,4-Dichlorophenol                  | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 4-Chloro-3-Methylphenol             | <17.0           | <17.0           | <17.0           | <17.0          | <.5                    | NA                    |
| 2,4,6-Trichlorophenol               | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| 2,4-Dinitrophenol                   | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| 4-Nitrophenol                       | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| 2,3,5,6-Tetrachlorophenol           | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| 2-Methyl-4,6-Dinitrophenol          | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| Pentachlorophenol                   | <33.0           | <33.0           | <33.0           | <33.0          | <1.0                   | NA                    |
| Volatiles EPA No. 8020              |                 |                 |                 |                |                        |                       |
| Benzene                             | <20             | <20             | <20             | <20            | <.2                    | <.2                   |
| Toluene                             | <20             | <20             | <20             | <20            | <.2                    | <.2                   |
| Chlorobenzene                       | <20             | <20             | <20             | <20            | <.2                    | <.2                   |
| Ethylbenzene                        | <20             | <20             | <20             | <20            | <.2                    | <.2                   |
| Xylenes                             | <30             | <30             | <30             | <30            | <.3                    | <.3                   |
| Styrene                             | <30             | <30             | <30             | <30            | <.3                    | <.3                   |
| 1,3-Dichlorobenzene                 | <40             | <40             | <40             | <40            | <.4                    | <.4                   |
| 1,4-Dichlorobenzene                 | <40             | <40             | <40             | <40            | <.4                    | <.4                   |
| 1,2-Dichlorobenzene                 | <40             | <40             | <40             | <40            | <.4                    | <.4                   |
| Metals                              |                 |                 |                 |                |                        |                       |
| Arsenic                             | 5.1             | 5.6             | 6.9             | <5             | <10                    | NA                    |
| Chromium                            | 27              | 24.6            | 23.7            | 20.6           | <10                    | NA                    |
| Copper                              | 24.5            | 27.3            | 47.5            | 34.1           | <30                    | NA                    |
| Iron                                | 27800           | 30400           | 27200           | 26400          | <100                   | NA                    |
| Manganese                           | 780             | 559             | 659             | 551            | <20                    | NA                    |
| Zinc                                | 69.1            | 56.8            | 56              | 52             | <20                    | NA                    |

"<" below quantitation limit given.DUP refers to duplicate sample.  
PAH, volatiles and phenol soil concentrations in ug/Kg.Metals in ug/g.  
Blank concentrations in ug/L. NA indicates not analyzed.



PAHs were detected in all of the offsite surface soil samples. Total PAH concentrations ranged from 26 ug/kg in sample SS-5 to 1,230 ug/kg in sample SS-2. In the samples taken north of the site, SS-9, had the highest total PAH concentration (592 ug/kg).

PCP was detected in two of the offsite surface soil samples. Sample SS-6, which is the closest downwind location from the treatment area north of the site, had a PCP concentration of 104 ug/Kg. Sample SS-2 which is located almost directly south of the treating plant facility had a PCP concentration of 550 ug/Kg. SS-2 also had 4-chloro-3-methylphenol present at 32 ug/Kg. Sample SS-1, located south of the site along First Avenue, contained two nitro-phenol compounds but chlorophenols were not detected. SS-4, located on Lacasa Street north of the site had trichlorophenol in the soil at 245 ug/Kg but PCP was not detected.

Volatiles aromatic compounds were not detected in any of the offsite surface soil samples. Arsenic was detected in six of the nine samples at relatively low concentrations (less than 10 ug/g). Copper, chromium and zinc were detected in each of the surface soil samples. Copper and chromium concentrations were less than 50 ug/g in all the samples. Zinc concentrations were less than 100 ug/g except in sample SS-2 which had a zinc concentration of 440 ug/g. With the exception of zinc at SS-2 all are within background metal concentrations defined previously (section 2.4.2.1.4).

### **2.4.3 Offsite Sediment Quality**

Four sediment samples were obtained from downstream of the J.H. Baxter property. The sediment samples were analyzed for PAHs, VOAs, phenols and arsenic, chromium, copper and zinc. Table 2-9 summarizes the analytical results. The sediment sampling locations are shown on Figure 2-2.

#### **2.4.3.1 PAHs**

PAHs were detected in each sediment sample collected from the ditch. The highest concentration of PAHs occurred in sediment sample SD-8, which was obtained near

TABLE 2-9  
Sediment Analytical Results

|                            | SD-8    | SD-9    | SD-10   | SD-11   | DUP(SD-8) |
|----------------------------|---------|---------|---------|---------|-----------|
| Date Sampled               | 30/3/93 | 30/3/93 | 30/3/93 | 30/3/93 | 30/3/93   |
| PAHs EPA Method 8310       |         |         |         |         |           |
| Naphthalene                | 123     | 105     | <70     | <70     | 160       |
| Acenaphthylene             | 106     | 145     | <70     | <70     | <70       |
| Acenaphthene               | 252     | 140     | <70     | <70     | <70       |
| Fluorene                   | 24.1    | 14.7    | <7      | <7      | 17        |
| Phenanthrene               | 19.4    | 13.2    | <3.5    | <3.5    | 57.1      |
| Anthracene                 | 19.4    | 6.2     | <3.5    | <3.5    | 23.2      |
| Fluoranthene               | 31.3    | 45.9    | <7      | <7      | 86.3      |
| Pyrene                     | 168     | 56.2    | 8.21    | 9.9     | 203       |
| Benzo(a)anthracene         | 29.9    | 22.8    | 1.58    | 1.46    | 64.9      |
| Chrysene                   | 393     | 278     | 9.24    | 11.2    | 509       |
| Benzo(b)fluoranthene       | 89.2    | 46.6    | 4.1     | 4.09    | 124       |
| Benzo(k)fluoranthene       | 25.5    | 18.2    | <.7     | <.7     | 36.4      |
| Benzo(a)pyrene             | 80.7    | 24.7    | 1.17    | 1.37    | 126       |
| Dibenzo(a,h)anthracene     | 362     | 227     | 8.82    | 10.9    | 239       |
| Benzo(g,h,i,)perylene      | 98.4    | 54.3    | 2.93    | 3.44    | 165       |
| Indeno(1,2,3-cd)pyrene     | 79      | 33      | 2.43    | 3.19    | 104       |
| Phenols EPA Method 8040    |         |         |         |         |           |
| Phenol                     | <170    | <170    | <170    | <170    | <170      |
| 2-Chlorophenol             | 1900    | <170    | <170    | <170    | 1320      |
| 2-Nitrophenol              | <170    | <170    | <170    | <170    | <170      |
| 2,4-Dimethylphenol         | <170    | <170    | <170    | <170    | <170      |
| 2,4-Dichlorophenol         | <170    | 530     | 210     | 510     | <170      |
| 4-Chloro-3-Methylphenol    | <170    | <170    | <170    | <170    | <170      |
| 2,4,6-Trichlorophenol      | <330    | <330    | <330    | <330    | <330      |
| 2,4-Dinitrophenol          | <330    | <330    | <330    | 420     | <330      |
| 4-Nitrophenol              | <330    | <330    | <330    | <330    | <330      |
| 2,3,5,6-Tetrachlorophenol  | <330    | <330    | <330    | <330    | <330      |
| 2-Methyl-4,6-Dinitrophenol | <330    | <330    | <330    | <330    | <330      |
| Pentachlorophenol          | <330    | <330    | <330    | <330    | <330      |
| Volatiles EPA No. 8020     |         |         |         |         |           |
| Benzene                    | <20     | <20     | <20     | <20     | <20       |
| Toluene                    | <20     | <20     | <20     | <20     | <20       |
| Chlorobenzene              | <20     | <20     | <20     | <20     | <20       |
| Ethylbenzene               | <20     | <20     | <20     | <20     | <20       |
| Xylenes                    | <30     | <30     | <30     | <30     | <30       |
| Styrene                    | <30     | <30     | <30     | <30     | <30       |
| 1,3-Dichlorobenzene        | <40     | <40     | <40     | <40     | <40       |
| 1,4-Dichlorobenzene        | <40     | <40     | <40     | <40     | <40       |
| 1,2-Dichlorobenzene        | <40     | <40     | <40     | <40     | <40       |
| Metals                     |         |         |         |         |           |
| Arsenic                    | 104000  | 26200   | 6240    | 25100   | 81800     |
| Chromium                   | 24000   | 19500   | 13300   | 21100   | 25500     |
| Copper                     | 424000  | 61600   | 19600   | 52400   | 479000    |
| Zinc                       | 178000  | 69400   | 46100   | 107000  | 174000    |

"<" below quantitation limit given.  
All values in ug/kg  
DUP- duplicate



the Baxter property boundary. All sixteen PAH compounds analyzed were detected in SD-8. The total PAH concentration in the sample was approximately 1,900 ug/kg. A duplicate sample for SD-8 was taken which confirms the presence of PAHs and the total PAH concentration of approximately 1,900 ug/kg. Sediment sample SD-9 also contained all PAH compounds analyzed. The total PAH concentration in this sample was approximately 1,200 ug/kg. SD-9 is situated approximately 450 feet downstream of SD-8.

The two sediment samples collected west of Bertelsen Road, SD-10 and SD-11, also contained PAHs. However, the lighter PAH compounds such as naphthalene and fluorene were not detected in these samples. The total PAH concentrations in samples SD-10 and SD-11, were approximately 50 ug/kg.

#### **2.4.3.2 Phenols**

PCP was not detected in any of the sediment samples. However, chlorophenol was detected in SD-8 at 1,900 ug/kg and dichlorophenol was detected in sediment samples SD-9, SD-10 and SD-11 at concentrations of 530 ug/kg, 210 ug/kg and 510 ug/kg, respectively. SD-11 also had dinitrophenol present at a concentration of 420 ug/kg.

#### **2.4.3.3 Volatile Aromatics**

Volatile aromatics were not detected in any of the sediment samples.

#### **2.4.3.4 Arsenic, Chromium, Copper and Zinc**

The four metals of concern were detected in all of the sediment samples. Arsenic was present in samples SD-8, SD-9, SD-10 and SD-11 at concentrations of 104,000 ug/kg, 26,200 ug/kg, 6,250 ug/kg and 25,100 ug/kg, respectively. Chromium concentrations ranged from 24,000 ug/kg in SD-8 to 13,300 ug/kg in SD-10. Similarly, for copper and zinc, the highest and lowest concentrations of the metals were detected in samples SD-8 and SD-10, respectively.

#### **2.4.4 Offsite Surface Water Quality**

Surface water samples were obtained from the ditch at the same locations as the sediment samples and were analyzed for the same constituents as the sediment samples. The surface water analytical results are summarized in Table 2-10. The surface water sampling locations were coincident with the sediment sampling locations.

##### **2.4.4.1 PAHs**

PAHs were detected in all the surface water samples. As in the sediment samples the highest concentrations were observed in samples SW-8 and SW-9. The total PAH concentrations in the samples ranged from approximately 3.43 ug/L in SW-9 to 0.2 ug/L in SW-11.

##### **2.4.4.2 Phenols**

PCP was detected at each surface water sampling location. The concentrations ranged from 266 ug/L at SW-8 to 26 ug/L at SW-11. These PCP concentrations exceed the freshwater chronic criteria concentration of 13 ug/L for the protection of freshwater aquatic life (OWQC). Tetrachlorophenol was detected in SW-8, SW-9 and SW-10. The concentration of tetrachlorophenol in the samples was low compared to the PCP concentrations (eg. 2 to 7 ug/L).

##### **2.4.4.3 Volatile Aromatics (VOAs)**

Several volatile aromatic compounds were detected in the surface water samples. Toluene was detected in each of the surface water samples at concentrations varying from 0.3 ug/L to 0.6 ug/L. Ethylbenzene was detected in samples SW-8 and SW-9 at 0.5 and 0.2 ug/L, respectively, and xylenes were detected at SW-8 at 0.6 ug/L. The toluene and ethylbenzene concentrations are less than their respective freshwater acute criteria concentrations which are 17,500 ug/L and 32,000 ug/L (see Table 4-1).

**TABLE 2-10**  
**Surface Water Analytical Results**

|                               | SW-8    | SW-9    | SW-10   | SW-11   | DUP(SW-8) | FIELD |
|-------------------------------|---------|---------|---------|---------|-----------|-------|
| Date Sampled                  | 30/3/93 | 30/3/93 | 30/3/93 | 30/3/93 | 30/3/93   | BLANK |
| <b>PAHs EPA Method 610</b>    |         |         |         |         |           |       |
| Naphthalene                   | <4      | <2      | <4      | <4      | <4        | <4    |
| Acenaphthylene                | <4      | <2      | <4      | <4      | <4        | <4    |
| Acenaphthene                  | <4      | <2      | <4      | <4      | <4        | <4    |
| Fluorene                      | <.4     | <.2     | <.4     | <.4     | 0.481     | <.4   |
| Phenanthrene                  | <.2     | <.1     | <.2     | <.2     | <.2       | <.2   |
| Anthracene                    | <.2     | <.1     | <.2     | <.2     | <.2       | <.2   |
| Fluoranthene                  | <.4     | 0.322   | <.4     | <.4     | 0.416     | <.4   |
| Pyrene                        | 0.429   | 0.477   | <.4     | <.4     | 0.503     | <.4   |
| Benzo(a)anthracene            | 0.215   | 0.196   | 0.074   | <.04    | 0.251     | <.04  |
| Chrysene                      | <.3     | 0.273   | <.3     | <.3     | <.3       | <.3   |
| Benzo(b)fluoranthene          | 0.437   | 0.404   | 0.1     | 0.078   | 0.528     | <.04  |
| Benzo(k)fluoranthene          | 0.096   | 0.094   | <.04    | <.04    | 0.124     | <.04  |
| Benzo(a)pyrene                | 0.288   | 0.275   | 0.134   | 0.094   | 0.361     | <.04  |
| Dibenzo(a,h)anthracene        | 0.691   | 0.853   | 0.333   | <.06    | 1.12      | <.06  |
| Benzo(g,h,i)perylene          | 0.366   | 0.374   | 0.133   | <.1     | 0.394     | <.1   |
| Indeno(1,2,3-cd)pyrene        | 0.188   | 0.16    | 0.105   | <.1     | 0.221     | <.1   |
| <b>Phenols EPA Method 604</b> |         |         |         |         |           |       |
| Phenol                        | <1      | <.5     | <1      | <1      | NA        | <1    |
| 2-Chlorophenol                | <1      | <.5     | <1      | <1      | NA        | <1    |
| 2-Nitrophenol                 | <1      | <.5     | <1      | <1      | NA        | <1    |
| 2,4-Dimethylphenol            | <1      | <.5     | <1      | <1      | NA        | <1    |
| 2,4-Dichlorophenol            | <1      | <.5     | <1      | <1      | NA        | <1    |
| 4-Chloro-3-Methylphenol       | <1      | <.5     | <1      | <1      | NA        | <1    |
| 2,4,6-Trichlorophenol         | <2      | <1      | <2      | <2      | NA        | <2    |
| 2,4-Dinitrophenol             | <2      | <1      | <2      | <2      | NA        | <2    |
| 4-Nitrophenol                 | <2      | <1      | <2      | <2      | NA        | <2    |
| 2,3,5,6-Tetrachlorophenol     | 7.2     | 7       | 1.8     | <2      | NA        | <2    |
| 2-Methyl-4,6-Dinitrophenol    | <2      | <1      | <2      | <2      | NA        | <2    |
| Pentachlorophenol             | 266     | 187     | 75      | 26      | NA        | <2    |
| <b>Volatiles EPA No. 602</b>  |         |         |         |         |           |       |
| Benzene                       | <.2     | <.2     | <.2     | <.2     | <.2       | <.2   |
| Toluene                       | 0.5     | 0.6     | 0.3     | 0.3     | 0.6       | <.2   |
| Chlorobenzene                 | <.2     | <.2     | <.2     | <.2     | <.2       | <.2   |
| Ethylbenzene                  | 0.5     | 0.2     | <.2     | <.2     | 0.6       | <.2   |
| Xylenes                       | 0.6     | <.3     | <.3     | <.3     | 0.9       | <.3   |
| Styrene                       | <.3     | <.3     | <.3     | <.3     | <.3       | <.3   |
| 1,3-Dichlorobenzene           | <.4     | <.4     | <.4     | <.4     | <.4       | <.4   |
| 1,4-Dichlorobenzene           | <.4     | <.4     | <.4     | <.4     | <.4       | <.4   |
| 1,2-Dichlorobenzene           | <.4     | <.4     | <.4     | <.4     | <.4       | <.4   |
| <b>Metals</b>                 |         |         |         |         |           |       |
| Total Arsenic                 | 83.8    | 86.6    | 48      | 28.4    | 80.8      | <10   |
| Total Chromium                | <10     | <10     | <10     | <10     | <10       | <10   |
| Total Copper                  | 128     | 253     | 49      | 28      | 127       | <25   |
| Total Zinc                    | 67.7    | 140     | 100     | 70.5    | 72.8      | <20   |

"<" below quantitation limit given.

All values in ug/L

NA not available

DUP- duplicate sample.

#### **2.4.4.4 Total Arsenic, Chromium, Copper and Zinc**

Of the four metals of concern analyzed only chromium was not detected in any of the samples. Arsenic was present at each sampling location at concentrations ranging from approximately 87 ug/L at SW-9 to 28 ug/L at SW-11. There are two sets of freshwater chronic criteria for arsenic. If the arsenic is the trivalent then the criteria is 190 ug/L. If the arsenic is pentavalent then the criteria is 48 ug/L. However, the criteria for pentavalent arsenic is based on the lowest observed effect level since insufficient data is available.

The highest concentrations of copper and zinc were also at SW-9 and the lowest at SW-11. Copper concentrations varied from 253 ug/L at SW-9 to 28 ug/L at SW-11, which exceed the OWQC copper concentration for the protection of aquatic life (12 ug/L). Zinc concentrations ranged from 140 ug/L at SW-9 to approximately 68 ug/L at SW-8. The freshwater chronic concentration for the protection of aquatic life for zinc is 110 ug/L.

**TABLE 2-6  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-1<br>(0-1')<br>JAN 26/94 | B-1<br>(4-5')<br>JAN 26/94 | B-2<br>(3"-1.5')<br>JAN 26/94 | B-2<br>(3-4')<br>JAN 26/94 | B-2<br>DUP<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|----------------------------|----------------------------|-------------------------------|----------------------------|-------------------------|---------------------|
| PAHs EPA Method 8310                               |                            |                            |                               |                            |                         |                     |
| Carbazole                                          | <110                       | <150                       | <130                          | <130                       | <130                    | 100.0               |
| Naphthalene                                        | <76                        | <100                       | <88                           | <93.0                      | <93.0                   | 70.0                |
| Acenaphthylene                                     | <76                        | <100                       | <88                           | <93.0                      | <93.0                   | 70.0                |
| Acenaphthene                                       | <76                        | <100                       | <88                           | <93.0                      | <93.0                   | 70.0                |
| Fluorene                                           | <7.6                       | <10                        | <8.8                          | <9.3                       | <9.3                    | 7.0                 |
| Phenanthrene                                       | <3.8                       | <5.1                       | <4.4                          | 11.9                       | <4.7                    | 3.5                 |
| Anthracene                                         | <3.8                       | <5.1                       | <4.4                          | <4.7                       | <4.7                    | 3.5                 |
| Fluoranthene                                       | <7.6                       | <10                        | <8.8                          | <9.3                       | <9.3                    | 7.0                 |
| Pyrene                                             | <7.6                       | <10                        | <8.8                          | <9.3                       | <9.3                    | 7.0                 |
| Benzo(a)anthracene                                 | <.76                       | 3.81                       | <.88                          | <.93                       | <.93                    | 0.7                 |
| Chrysene                                           | <5.5                       | <7.3                       | <6.3                          | <6.7                       | <6.7                    | 5.0                 |
| Benzo(b)fluoranthene                               | 1.28                       | 4.25                       | 1.9                           | <.93                       | <.93                    | 0.7                 |
| Benzo(k)fluoranthene                               | 1.14                       | 2.66                       | <.88                          | <.93                       | <.93                    | 0.7                 |
| Benzo(a)pyrene                                     | <.76                       | 3.08                       | <.88                          | <.93                       | <.93                    | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.1                       | <1.5                       | <1.3                          | <1.3                       | <1.3                    | 1.0                 |
| Benzo(g,h,i)perylene                               | <1.9                       | 2.98                       | <2.1                          | <2.3                       | <2.3                    | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | <1.9                       | <2.5                       | <2.1                          | <2.3                       | <2.3                    | 1.7                 |
| Total PAH                                          | 2.4                        | 16.8                       | 1.9                           | 11.9                       | 0.0                     |                     |
| Phenols EPA Method 8040                            |                            |                            |                               |                            |                         |                     |
| Phenol                                             | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 2-Chlorophenol                                     | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 2-Nitrophenol                                      | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 2,4-Dimethylphenol                                 | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 2,4-Dichlorophenol                                 | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 4-Chloro-3-Methylphenol                            | <18.0                      | <25.0                      | <21.0                         | <23.0                      | <23.0                   | 17.0                |
| 2,4,6-Trichlorophenol                              | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| 2,4-Dinitrophenol                                  | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| 4-Nitrophenol                                      | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| Pentachlorophenol                                  | <36.0                      | <48.0                      | <42.0                         | <44.0                      | <44.0                   | 33.0                |
| Volatiles EPA No. 8020                             |                            |                            |                               |                            |                         |                     |
| Benzene                                            | <22.0                      | <29.0                      | 29                            | <27.0                      | <27.0                   | 20.0                |
| Toluene                                            | <22.0                      | <29.0                      | <25.0                         | <27.0                      | <27.0                   | 20.0                |
| Chlorobenzene                                      | <22.0                      | <29.0                      | <25.0                         | <27.0                      | <27.0                   | 20.0                |
| Ethylbenzene                                       | <22.0                      | <29.0                      | <25.0                         | <27.0                      | <27.0                   | 20.0                |
| Xylenes                                            | <33.0                      | <44.0                      | <38.0                         | <40.0                      | <40.0                   | 30.0                |
| Styrene                                            | <33.0                      | <44.0                      | <38.0                         | <40.0                      | <40.0                   | 30.0                |
| Metals                                             |                            |                            |                               |                            |                         |                     |
| Arsenic                                            | 2.24                       | 4.1                        | 4.3                           | 4                          | 4.6                     | 1.0                 |
| Chromium                                           | 15.5                       | 33.3                       | 36.6                          | 30.9                       | 29.8                    | 1.0                 |
| Copper                                             | 22.9                       | 34.6                       | 28.3                          | 20.7                       | 22.2                    | 2.5                 |
| Iron                                               | 23000                      | 42900                      | 33600                         | 25000                      | 24300                   | 10.0                |
| Manganese                                          | 267                        | 808                        | 1430                          | 497                        | 753                     | 1.5                 |
| Zinc                                               | 36.6                       | 75.3                       | 62.3                          | 43.4                       | 42                      | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-3<br>(0-1')<br>JAN 26/94 | B-3<br>(4-5.5')<br>JAN 26/94 | B-4<br>(3"-1.9')<br>JAN 26/94 | B-4<br>(4-5.5')<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|----------------------------|------------------------------|-------------------------------|------------------------------|---------------------|
| PAHs EPA Method 8310                               |                            |                              |                               |                              |                     |
| Carbazole                                          | <110                       | <140                         | <120                          | <140                         | 100.0               |
| Naphthalene                                        | <76                        | <98                          | <85                           | <95                          | 70.0                |
| Acenaphthylene                                     | <76                        | <98                          | <85                           | <95                          | 70.0                |
| Acenaphthene                                       | <76                        | <98                          | <85                           | <95                          | 70.0                |
| Fluorene                                           | <7.6                       | <9.8                         | <8.5                          | <9.5                         | 7.0                 |
| Phenanthrene                                       | 24.5                       | <4.9                         | <4.3                          | 5.39                         | 3.5                 |
| Anthracene                                         | 6.58                       | <4.9                         | <4.3                          | <4.8                         | 3.5                 |
| Fluoranthene                                       | 78.1                       | <9.8                         | <8.5                          | <9.5                         | 7.0                 |
| Pyrene                                             | 115                        | <9.8                         | <8.5                          | 25.6                         | 7.0                 |
| Benzo(a)anthracene                                 | 47.1                       | 0.985                        | 4.21                          | 2.59                         | 0.7                 |
| Chrysene                                           | 79.2                       | <7                           | <6.1                          | <6.8                         | 5.0                 |
| Benzo(b)fluoranthene                               | 74.2                       | <.98                         | 14.7                          | 6.6                          | 0.7                 |
| Benzo(k)fluoranthene                               | 23.6                       | <.98                         | 2.98                          | 1.82                         | 0.7                 |
| Benzo(a)pyrene                                     | 60.4                       | <.98                         | 11.2                          | 4.91                         | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.1                       | <1.4                         | <1.2                          | <1.4                         | 1.0                 |
| Benzo(g,h,i,)perylene                              | 81.4                       | <2.4                         | 12.6                          | 3.06                         | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 36.85                      | <2.4                         | <2.1                          | <2.3                         | 1.7                 |
| Total PAH                                          | 627                        | 1.0                          | 46                            | 50                           |                     |
| Phenols EPA Method 8040                            |                            |                              |                               |                              |                     |
| Phenol                                             | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 2-Chlorophenol                                     | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 2-Nitrophenol                                      | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 2,4-Dimethylphenol                                 | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 2,4-Dichlorophenol                                 | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 4-Chloro-3-Methylphenol                            | <18                        | <24.0                        | <21                           | <23.0                        | 17.0                |
| 2,4,6-Trichlorophenol                              | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| 2,4-Dinitrophenol                                  | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| 4-Nitrophenol                                      | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| Pentachlorophenol                                  | <36                        | <46.0                        | <40                           | <45.0                        | 33.0                |
| Volatiles EPA No. 8020                             |                            |                              |                               |                              |                     |
| Benzene                                            | <22                        | <28.0                        | <24.0                         | <27.0                        | 20.0                |
| Toluene                                            | 26                         | <28.0                        | 25                            | <27.0                        | 20.0                |
| Chlorobenzene                                      | <22                        | <28.0                        | <24.0                         | <27.0                        | 20.0                |
| Ethylbenzene                                       | <22                        | <28.0                        | <24.0                         | <27.0                        | 20.0                |
| Xylenes                                            | 46                         | <42.0                        | <37.0                         | <41.0                        | 30.0                |
| Styrene                                            | <33                        | <42.0                        | <37.0                         | <41.0                        | 30.0                |
| Metals                                             |                            |                              |                               |                              |                     |
| Arsenic                                            | 90.3                       | 3.9                          | 28.3                          | 7.9                          | 1.0                 |
| Chromium                                           | 16                         | 33.9                         | 32.7                          | 41.3                         | 1.0                 |
| Copper                                             | 80.8                       | 32.9                         | 30                            | 35.2                         | 2.5                 |
| Iron                                               | 15600                      | 40200                        | 36500                         | 45000                        | 10.0                |
| Manganese                                          | 242                        | 809                          | 585                           | 791                          | 1.5                 |
| Zinc                                               | 73.8                       | 73.9                         | 64.3                          | 77.6                         | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate



**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-5<br>(1-2.5')<br>JAN 26/94 | B-5<br>(5-6.5')<br>JAN 26/94 | B-6<br>(0-1.5')<br>JAN 26/94 | B-6<br>(2.5-4')<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|---------------------|
| PAHs EPA Method 8310                               |                              |                              |                              |                              |                     |
| Carbazole                                          | <130                         | <140                         | <520                         | <130                         | 100.0               |
| Naphthalene                                        | <89                          | <97                          | <360                         | <93                          | 70.0                |
| Acenaphthylene                                     | <89                          | <97                          | <360                         | <93                          | 70.0                |
| Acenaphthene                                       | <89                          | <97                          | <360                         | <93                          | 70.0                |
| Fluorene                                           | <8.9                         | <9.7                         | 54                           | <9.3                         | 7.0                 |
| Phenanthrene                                       | <4.4                         | 7.2                          | 108                          | <4.7                         | 3.5                 |
| Anthracene                                         | <4.4                         | <4.8                         | <18                          | <4.7                         | 3.5                 |
| Fluoranthene                                       | <8.9                         | 14.7                         | 181                          | <9.3                         | 7.0                 |
| Pyrene                                             | <8.9                         | 17.5                         | 505                          | <9.3                         | 7.0                 |
| Benzo(a)anthracene                                 | 1.04                         | 5.13                         | 71.2                         | <.93                         | 0.7                 |
| Chrysene                                           | <6.4                         | 7.03                         | 247                          | <6.7                         | 5.0                 |
| Benzo(b)fluoranthene                               | 2.54                         | 10.8                         | 276.0                        | <.93                         | 0.7                 |
| Benzo(k)fluoranthene                               | <.89                         | 4.64                         | 46.6                         | <.93                         | 0.7                 |
| Benzo(a)pyrene                                     | 2.43                         | 5.91                         | 151                          | <.93                         | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.3                         | <1.4                         | <5.2                         | <1.3                         | 1.0                 |
| Benzo(g,h,i,)perylene                              | <2.2                         | 8.2                          | 596                          | <2.3                         | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | <2.2                         | 5.21                         | <8.8                         | <2.3                         | 1.7                 |
| Total PAH                                          | 6.0                          | 86.3                         | 2235.8                       | 0.0                          |                     |
| Phenols EPA Method 8040                            |                              |                              |                              |                              |                     |
| Phenol                                             | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 2-Chlorophenol                                     | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 2-Nitrophenol                                      | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 2,4-Dimethylphenol                                 | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 2,4-Dichlorophenol                                 | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 4-Chloro-3-Methylphenol                            | <22                          | <23                          | <71                          | <23.0                        | 17.0                |
| 2,4,6-Trichlorophenol                              | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| 2,4-Dinitrophenol                                  | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| 4-Nitrophenol                                      | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| Pentachlorophenol                                  | <42                          | <46.0                        | <137                         | <44.0                        | 33.0                |
| Volatiles EPA No. 8020                             |                              |                              |                              |                              |                     |
| Benzene                                            | <25                          | <28.0                        | <21.0                        | <27.0                        | 20.0                |
| Toluene                                            | <25                          | <28.0                        | 28                           | <27.0                        | 20.0                |
| Chlorobenzene                                      | <25                          | <28.0                        | <21.0                        | <27.0                        | 20.0                |
| Ethylbenzene                                       | <25                          | <28.0                        | 35                           | <27.0                        | 20.0                |
| Xylenes                                            | <38                          | <41.0                        | 77                           | <40.0                        | 30.0                |
| Styrene                                            | <38                          | <41.0                        | <31.0                        | <40.0                        | 30.0                |
| Metals                                             |                              |                              |                              |                              |                     |
| Arsenic                                            | 6                            | 8.6                          | 84.4                         | 3.5                          | 1.0                 |
| Chromium                                           | 34.3                         | 41                           | 35.8                         | 44.1                         | 1.0                 |
| Copper                                             | 33.6                         | 40.1                         | 103                          | 34                           | 2.5                 |
| Iron                                               | 33800                        | 41500                        | 16900                        | 37700                        | 10.0                |
| Manganese                                          | 776                          | 1160                         | 259                          | 547                          | 1.5                 |
| Zinc                                               | 71.2                         | 77.4                         | 73.2                         | 72.8                         | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP= duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-7<br>(0-1.5')<br>JAN 26/94 | B-7<br>(4-5.5')<br>JAN 26/94 | B-8<br>(0-1')<br>JAN 26/94 | B-8<br>(4-5.5')<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|---------------------|
| PAHs EPA Method 8310                               |                              |                              |                            |                              |                     |
| Carbazole                                          | <1100                        | <140                         | <3300                      | <1300                        | 100.0               |
| Naphthalene                                        | <770                         | <100                         | <2300                      | 11200                        | 70.0                |
| Acenaphthylene                                     | <770                         | <100                         | <2300                      | 1470                         | 70.0                |
| Acenaphthene                                       | 1960                         | <100                         | <2300                      | 10100                        | 70.0                |
| Fluorene                                           | 1240                         | 47.5                         | <230                       | 7080                         | 7.0                 |
| Phenanthrene                                       | 5230                         | 81.8                         | 140                        | 17400                        | 3.5                 |
| Anthracene                                         | 2420                         | 30.3                         | <120                       | <4700                        | 3.5                 |
| Fluoranthene                                       | 13200                        | 97.5                         | 914                        | 14100                        | 7.0                 |
| Pyrene                                             | 15000                        | 81.2                         | 1110                       | 11400                        | 7.0                 |
| Benzo(a)anthracene                                 | 5230                         | 24.2                         | 114                        | 4070                         | 0.7                 |
| Chrysene                                           | 12000                        | 46.5                         | 835                        | 6090                         | 5.0                 |
| Benzo(b)fluoranthene                               | 4220                         | 15.2                         | 2420.0                     | 2170                         | 0.7                 |
| Benzo(k)fluoranthene                               | 1670                         | 4.02                         | 405                        | 928                          | 0.7                 |
| Benzo(a)pyrene                                     | 3850                         | 9.73                         | 2030                       | 2040                         | 0.7                 |
| Dibenzo(a,h)anthracene                             | 6470                         | <1.4                         | <33                        | <13                          | 1.0                 |
| Benzo(g,h,i,)perylene                              | 1700                         | 12.7                         | 2480                       | 1570                         | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 2210                         | 10.5                         | 1990                       | 977                          | 1.7                 |
| Total PAH                                          | 76400                        | 461.2                        | 12438                      | 90595                        |                     |
| Phenols EPA Method 8040                            |                              |                              |                            |                              |                     |
| Phenol                                             | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 2-Chlorophenol                                     | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 2-Nitrophenol                                      | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 2,4-Dimethylphenol                                 | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 2,4-Dichlorophenol                                 | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 4-Chloro-3-Methylphenol                            | <187                         | <24.0                        | <56                        | <23.0                        | 17.0                |
| 2,4,6-Trichlorophenol                              | <362                         | <48.0                        | <109                       | 576                          | 33.0                |
| 2,4-Dinitrophenol                                  | <362                         | <48.0                        | <109                       | <44.0                        | 33.0                |
| 4-Nitrophenol                                      | <362                         | <48.0                        | <109                       | <44.0                        | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | 21500                        | <48.0                        | 8110                       | <44.0                        | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <362                         | <48.0                        | <109                       | <44.0                        | 33.0                |
| Pentachlorophenol                                  | 66400                        | <48.0                        | <109                       | <44.0                        | 33.0                |
| Volatiles EPA No. 8020                             |                              |                              |                            |                              |                     |
| Benzene                                            | 25                           | <29.0                        | <27.0                      | <27.0                        | 20.0                |
| Toluene                                            | 59                           | <29.0                        | <27.0                      | <27.0                        | 20.0                |
| Chlorobenzene                                      | <22                          | <29.0                        | <27.0                      | <27.0                        | 20.0                |
| Ethylbenzene                                       | <22                          | <29.0                        | <27.0                      | 72                           | 20.0                |
| Xylenes                                            | 49                           | <43.0                        | <40.0                      | 315                          | 30.0                |
| Styrene                                            | <33                          | <43.0                        | <40.0                      | <40.0                        | 30.0                |
| Metals                                             |                              |                              |                            |                              |                     |
| Arsenic                                            | 167                          | 21.3                         | 234                        | 6.5                          | 1.0                 |
| Chromium                                           | 17.3                         | 27.5                         | 47.5                       | 34                           | 1.0                 |
| Copper                                             | 153                          | 37.4                         | 440                        | 26.5                         | 2.5                 |
| Iron                                               | 20700                        | 35800                        | 16700                      | 30000                        | 10.0                |
| Manganese                                          | 281                          | 647                          | 166                        | 1290                         | 1.5                 |
| Zinc                                               | 575                          | 63.7                         | 175                        | 44.6                         | 2.0                 |

"<" below quantitation limit given.  
PAH, Volatiles and Phenol values in ug/kg  
Metal values in ug/g.  
DUP- duplicate



**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-9<br>(1-2.5')<br>JAN 26/94 | B-9<br>(5-6.5')<br>JAN 26/94 | B-10<br>(0-1.5')<br>JAN 26/94 | B-10<br>(4-5.5')<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                              |                              |                               |                               |                     |
| Carbazole                                          | <120                         | <110                         | <110                          | 367                           | 100.0               |
| Naphthalene                                        | 321                          | 826                          | 114                           | 320                           | 70.0                |
| Acenaphthylene                                     | <86                          | <80                          | <75                           | 118                           | 70.0                |
| Acenaphthene                                       | <86                          | 689                          | <75                           | 532                           | 70.0                |
| Fluorene                                           | <8.6                         | 401                          | 27.8                          | 594                           | 7.0                 |
| Phenanthrene                                       | 22.9                         | 979                          | 120                           | 1680                          | 3.5                 |
| Anthracene                                         | 44.1                         | 772                          | <37                           | 87.4                          | 3.5                 |
| Fluoranthene                                       | 371                          | 1700                         | 388                           | 820                           | 7.0                 |
| Pyrene                                             | 402                          | 1670                         | 594                           | 479                           | 7.0                 |
| Benzo(a)anthracene                                 | 195                          | 597                          | 517                           | 143                           | 0.7                 |
| Chrysene                                           | 210                          | 851                          | 1540                          | 207                           | 5.0                 |
| Benzo(b)fluoranthene                               | 120                          | 359                          | 719                           | 44.7                          | 0.7                 |
| Benzo(k)fluoranthene                               | 52.2                         | 164                          | 170                           | 16.6                          | 0.7                 |
| Benzo(a)pyrene                                     | 65.7                         | 251                          | 966                           | 20.4                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.2                         | <1.1                         | 686                           | <1.5                          | 1.0                 |
| Benzo(g,h,i,)perylene                              | 54.5                         | 205                          | 646                           | 10.4                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 34.3                         | 130                          | 1130                          | 16                            | 1.7                 |
| Total PAH                                          | 1893                         | 9594                         | 7618                          | 5456                          |                     |
| Phenols EPA Method 8040                            |                              |                              |                               |                               |                     |
| Phenol                                             | <21                          | <19.0                        | <18                           | <26                           | 17.0                |
| 2-Chlorophenol                                     | <21                          | <19.0                        | <18                           | <26                           | 17.0                |
| 2-Nitrophenol                                      | <21                          | <19.0                        | <18                           | <26                           | 17.0                |
| 2,4-Dimethylphenol                                 | <21                          | <19.0                        | <18                           | <26                           | 17.0                |
| 2,4-Dichlorophenol                                 | <21                          | <19.0                        | <18                           | <26                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <21                          | <19.0                        | 56                            | 102                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <41                          | <38.0                        | <35                           | <50                           | 33.0                |
| 2,4-Dinitrophenol                                  | <41                          | <38.0                        | <35                           | <50                           | 33.0                |
| 4-Nitrophenol                                      | <41                          | 114                          | <35                           | <50                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <41                          | <38.0                        | <35                           | <50                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <41                          | <38.0                        | <35                           | <50                           | 33.0                |
| Pentachlorophenol                                  | <41                          | <38.0                        | <35                           | <50                           | 33.0                |
| Volatiles EPA No. 8020                             |                              |                              |                               |                               |                     |
| Benzene                                            | <25                          | <23.0                        | <21                           | 32                            | 20.0                |
| Toluene                                            | <25                          | <23.0                        | 29                            | <30                           | 20.0                |
| Chlorobenzene                                      | <25                          | <23.0                        | <21                           | <30                           | 20.0                |
| Ethylbenzene                                       | <25                          | <23.0                        | 29                            | 42                            | 20.0                |
| Xylenes                                            | <37                          | <34.0                        | 79                            | 88                            | 30.0                |
| Styrene                                            | <37                          | <34.0                        | <32                           | <45                           | 30.0                |
| Metals                                             |                              |                              |                               |                               |                     |
| Arsenic                                            | 227                          | 6.1                          | 16                            | 4.99                          | 1.0                 |
| Chromium                                           | 39.4                         | 10                           | 27.3                          | 35.1                          | 1.0                 |
| Copper                                             | 41.4                         | 16.1                         | 48.8                          | 39.8                          | 2.5                 |
| Iron                                               | 37900                        | 19000                        | 21300                         | 50500                         | 10.0                |
| Manganese                                          | 1370                         | 365                          | 171                           | 1420                          | 1.5                 |
| Zinc                                               | 720                          | 74.3                         | 68.6                          | 77.5                          | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-11<br>(0-1')<br>JAN 27/94 | B-11<br>(2.5-4')<br>JAN 27/94 | B-11<br>DUP<br>JAN 27/94 | B-12<br>(4-5.5')<br>JAN 27/94 | B-12<br>DUP<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-----------------------------|-------------------------------|--------------------------|-------------------------------|--------------------------|---------------------|
| PAHs EPA Method 8310                               |                             |                               |                          |                               |                          |                     |
| Carbazole                                          | <6500                       | 2670                          | 4110                     | <1400                         | <1400                    | 100.0               |
| Naphthalene                                        | <4600                       | <48300                        | 53900                    | 12100                         | 7850                     | 70.0                |
| Acenaphthylene                                     | <4600                       | 6620                          | 9980                     | <1000                         | 1190                     | 70.0                |
| Acenaphthene                                       | 7310                        | <48300                        | 23500                    | 3050                          | 2720                     | 70.0                |
| Fluorene                                           | 5440                        | 19100                         | 19300                    | 2220                          | 2060                     | 7.0                 |
| Phenanthrene                                       | 19700                       | 51700                         | 56600                    | 7340                          | 6460                     | 3.5                 |
| Anthracene                                         | 1550                        | 8810                          | 9700                     | 1200                          | 1080                     | 3.5                 |
| Fluoranthene                                       | 11600                       | 30500                         | 25200                    | 2860                          | 2340                     | 7.0                 |
| Pyrene                                             | 15900                       | 20800                         | 19200                    | 2290                          | 3320                     | 7.0                 |
| Benzo(a)anthracene                                 | 14300                       | 4790                          | 6070                     | 958                           | 806                      | 0.7                 |
| Chrysene                                           | 30700                       | 9960                          | 22700                    | 4240                          | 3810                     | 5.0                 |
| Benzo(b)fluoranthene                               | 13100                       | 1700                          | 2580                     | 595                           | 476                      | 0.7                 |
| Benzo(k)fluoranthene                               | 3960                        | 798                           | 944                      | 234                           | 188                      | 0.7                 |
| Benzo(a)pyrene                                     | 4440                        | 1390                          | 1240                     | 703                           | 600                      | 0.7                 |
| Dibenzo(a,h)anthracene                             | 15200                       | <690                          | <140                     | 1110                          | 887                      | 1.0                 |
| Benzo(g,h,i,)perylene                              | 3490                        | 369                           | 478                      | 180                           | 136                      | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 4520                        | 467                           | 532                      | 258                           | 193                      | 1.7                 |
| Total PAH                                          | 151210                      | 159674                        | 256034                   | 39338                         | 34116                    |                     |
| Phenols EPA Method 8040                            |                             |                               |                          |                               |                          |                     |
| Phenol                                             | <110                        | <235                          | <234                     | <243                          | <239                     | 17.0                |
| 2-Chlorophenol                                     | <110                        | <235                          | <234                     | <243                          | <239                     | 17.0                |
| 2-Nitrophenol                                      | <110                        | <235                          | <234                     | <243                          | <239                     | 17.0                |
| 2,4-Dimethylphenol                                 | <110                        | <235                          | <234                     | <243                          | <239                     | 17.0                |
| 2,4-Dichlorophenol                                 | <110                        | 1700                          | 2410                     | 4780                          | 3080                     | 17.0                |
| 4-Chloro-3-Methylphenol                            | <110                        | <235                          | <234                     | <243                          | <239                     | 17.0                |
| 2,4,6-Trichlorophenol                              | <213                        | 1040                          | <455                     | 3260                          | <464                     | 33.0                |
| 2,4-Dinitrophenol                                  | <2130                       | 4790                          | <455                     | <471                          | <464                     | 33.0                |
| 4-Nitrophenol                                      | <213                        | <456                          | <455                     | <471                          | <464                     | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <213                        | <456                          | <455                     | <471                          | <464                     | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <2130                       | <456                          | <455                     | <471                          | <464                     | 33.0                |
| Pentachlorophenol                                  | 182000                      | <456                          | <455                     | 46700                         | 38500                    | 33.0                |
| Volatiles EPA No. 8020                             |                             |                               |                          |                               |                          |                     |
| Benzene                                            | <22                         | 48                            | <28                      | <29                           | <28                      | 20.0                |
| Toluene                                            | 31                          | <28                           | <28                      | <29                           | <28                      | 20.0                |
| Chlorobenzene                                      | 37                          | 203                           | 224                      | <29                           | <28                      | 20.0                |
| Ethylbenzene                                       | <22                         | 48                            | 62                       | <29                           | <28                      | 20.0                |
| Xylenes                                            | <32                         | 411                           | 410                      | 45                            | 114                      | 30.0                |
| Styrene                                            | 96                          | 362                           | 473                      | 380                           | 111                      | 30.0                |
| Metals                                             |                             |                               |                          |                               |                          |                     |
| Arsenic                                            | 1710                        | 7.1                           | 10                       | 7.9                           | 12                       | 1.0                 |
| Chromium                                           | 64.4                        | 45                            | 43.3                     | 28.7                          | 35.3                     | 1.0                 |
| Copper                                             | 288                         | 41.9                          | 40.4                     | 33.5                          | 37.8                     | 2.5                 |
| Iron                                               | 16700                       | 44800                         | 43400                    | 40400                         | 41900                    | 10.0                |
| Manganese                                          | 195                         | 970                           | 912                      | 1120                          | 934                      | 1.5                 |
| Zinc                                               | 261                         | 91.7                          | 103                      | 75.9                          | 145                      | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-13<br>(8"-1.5')<br>JAN 27/94 | B-13<br>(4-5.5')<br>JAN 27/94 | B-14<br>(0-1')<br>JAN 27/94 | B-14<br>(4-5.5')<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|--------------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                                |                               |                             |                               |                     |
| Carbazole                                          | <640                           | <140                          | <3100                       | <130                          | 100.0               |
| Naphthalene                                        | <450                           | <100                          | <2200                       | <93                           | 70.0                |
| Acenaphthylene                                     | <450                           | <100                          | <2200                       | <93                           | 70.0                |
| Acenaphthene                                       | 1020                           | <100                          | <2200                       | <93                           | 70.0                |
| Fluorene                                           | 248                            | <10                           | <220                        | <9.3                          | 7.0                 |
| Phenanthrene                                       | 845                            | <5                            | 502                         | 7.24                          | 3.5                 |
| Anthracene                                         | 128                            | <5                            | <110                        | <4.7                          | 3.5                 |
| Fluoranthene                                       | 1310                           | 12.2                          | 414                         | 9.65                          | 7.0                 |
| Pyrene                                             | 3570                           | <10                           | 619                         | <9.3                          | 7.0                 |
| Benzo(a)anthracene                                 | 343                            | <1                            | 266                         | 4.08                          | 0.7                 |
| Chrysene                                           | 2090                           | <7.2                          | 823                         | <6.7                          | 5.0                 |
| Benzo(b)fluoranthene                               | 398                            | <1                            | 537                         | 9.49                          | 0.7                 |
| Benzo(k)fluoranthene                               | 123                            | <1                            | 64.8                        | <.93                          | 0.7                 |
| Benzo(a)pyrene                                     | 377                            | <1                            | 317                         | <.93                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | 1820                           | <1.4                          | 2570                        | <1.3                          | 1.0                 |
| Benzo(g,h,i,)perylene                              | 303                            | <2.4                          | 403                         | 3.28                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 251                            | <2.4                          | 718                         | 10.9                          | 1.7                 |
| Total PAH                                          | 12826                          | 12                            | 7234                        | 45                            |                     |
| Phenols EPA Method 8040                            |                                |                               |                             |                               |                     |
| Phenol                                             | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 2-Chlorophenol                                     | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 2-Nitrophenol                                      | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 2,4-Dimethylphenol                                 | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 2,4-Dichlorophenol                                 | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <107                           | <24                           | <106                        | <23                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <207                           | <48                           | <206                        | <44                           | 33.0                |
| 2,4-Dinitrophenol                                  | 362                            | <48                           | <206                        | <44                           | 33.0                |
| 4-Nitrophenol                                      | <207                           | <48                           | <206                        | <44                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <207                           | <48                           | <206                        | <44                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <207                           | <48                           | <206                        | <44                           | 33.0                |
| Pentachlorophenol                                  | <207                           | 1880                          | <206                        | <44                           | 33.0                |
| Volatiles EPA No. 8020                             |                                |                               |                             |                               |                     |
| Benzene                                            | <21                            | <29                           | <21                         | <27                           | 20.0                |
| Toluene                                            | 250                            | <29                           | 69                          | <27                           | 20.0                |
| Chlorobenzene                                      | <21                            | <29                           | <21                         | <27                           | 20.0                |
| Ethylbenzene                                       | <21                            | <29                           | 36                          | <27                           | 20.0                |
| Xylenes                                            | 42                             | <43                           | 123                         | <40                           | 30.0                |
| Styrene                                            | <32                            | <43                           | <31                         | <40                           | 30.0                |
| Metals                                             |                                |                               |                             |                               |                     |
| Arsenic                                            | 13                             | 103                           | 20.5                        | 7.6                           | 1.0                 |
| Chromium                                           | 34.9                           | 38.1                          | 23.7                        | 44.5                          | 1.0                 |
| Copper                                             | 35.6                           | 34.8                          | 56.4                        | 40.8                          | 2.5                 |
| Iron                                               | 15700                          | 47500                         | 18100                       | 48400                         | 10.0                |
| Manganese                                          | 212                            | 1340                          | 242                         | 1430                          | 1.5                 |
| Zinc                                               | 219                            | 82.3                          | 95.3                        | 84                            | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-15<br>(0-1')<br>JAN 26/94 | B-15<br>(3-4')<br>JAN 26/94 | B-16<br>(0-1')<br>JAN 27/94 | B-16<br>(2.5-4')<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                             |                             |                             |                               |                     |
| Carbazole                                          | <320                        | <130                        | <1050                       | <130                          | 100.0               |
| Naphthalene                                        | <230                        | <91                         | <740                        | <92                           | 70.0                |
| Acenaphthylene                                     | <230                        | <91                         | <740                        | <92                           | 70.0                |
| Acenaphthene                                       | <230                        | <91                         | <740                        | <92                           | 70.0                |
| Fluorene                                           | <23                         | <91                         | 102                         | <9.2                          | 7.0                 |
| Phenanthrene                                       | 32.3                        | <4.6                        | 399                         | <4.6                          | 3.5                 |
| Anthracene                                         | <11.3                       | <4.6                        | 44                          | <4.6                          | 3.5                 |
| Fluoranthene                                       | 64.1                        | <9.1                        | 561                         | <9.2                          | 7.0                 |
| Pyrene                                             | 181                         | <9.1                        | 789                         | <9.2                          | 7.0                 |
| Benzo(a)anthracene                                 | 102                         | <.91                        | 437                         | <.92                          | 0.7                 |
| Chrysene                                           | 260                         | <6.5                        | 789                         | <6.6                          | 5.0                 |
| Benzo(b)fluoranthene                               | 140                         | <.91                        | 503                         | <.92                          | 0.7                 |
| Benzo(k)fluoranthene                               | 48.2                        | <.91                        | 195                         | <.92                          | 0.7                 |
| Benzo(a)pyrene                                     | 110                         | <.91                        | 410                         | <.92                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | 184                         | <1.3                        | <10.5                       | <1.3                          | 1.0                 |
| Benzo(g,h,i)perylene                               | 68.7                        | <2.2                        | 246                         | <2.2                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 57                          | <2.2                        | 278                         | <2.2                          | 1.7                 |
| Total PAH                                          | 1247                        | 0                           | 4753                        | 0                             |                     |
| Phenols EPA Method 8040                            |                             |                             |                             |                               |                     |
| Phenol                                             | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 2-Chlorophenol                                     | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 2-Nitrophenol                                      | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 2,4-Dimethylphenol                                 | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 2,4-Dichlorophenol                                 | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <55                         | <22                         | <18                         | <22                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <106                        | <43                         | <34                         | <43                           | 33.0                |
| 2,4-Dinitrophenol                                  | <106                        | <43                         | <34                         | <43                           | 33.0                |
| 4-Nitrophenol                                      | <106                        | <43                         | <34                         | <43                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <106                        | <43                         | <34                         | <43                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <106                        | <43                         | <34                         | <43                           | 33.0                |
| Pentachlorophenol                                  | <106                        | <43                         | <34                         | <43                           | 33.0                |
| Volatiles EPA No. 8020                             |                             |                             |                             |                               |                     |
| Benzene                                            | <21                         | <26                         | <21                         | <26                           | 20.0                |
| Toluene                                            | 24                          | <26                         | <21                         | <26                           | 20.0                |
| Chlorobenzene                                      | <21                         | <26                         | <21                         | <26                           | 20.0                |
| Ethylbenzene                                       | <21                         | <26                         | 24                          | <26                           | 20.0                |
| Xylenes                                            | <32                         | <39                         | 81                          | <39                           | 30.0                |
| Styrene                                            | <32                         | <39                         | <31                         | <39                           | 30.0                |
| Metals                                             |                             |                             |                             |                               |                     |
| Arsenic                                            | 6.99                        | 5.49                        | 7.6                         | 2.5                           | 1.0                 |
| Chromium                                           | 16.4                        | 42.1                        | 44.5                        | 41.5                          | 1.0                 |
| Copper                                             | 23.8                        | 36.6                        | 40.8                        | 28.2                          | 2.5                 |
| Iron                                               | 23800                       | 48000                       | 48400                       | 35500                         | 10.0                |
| Manganese                                          | 212                         | 1030                        | 1430                        | 1830                          | 1.5                 |
| Zinc                                               | 49.7                        | 78.6                        | 84                          | 57.8                          | 2.0                 |

"<" below quantitation limit given.  
PAH, Volatiles and Phenol values in ug/kg  
Metal values in ug/g.  
DUP- duplicate

**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-17<br>(0.5-2')<br>JAN 27/94 | B-17<br>(4-5.5')<br>JAN 27/94 | B-18<br>(0-1')<br>JAN 27/94 | B-18<br>(2.5-4')<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                               |                               |                             |                               |                     |
| Carbazole                                          | <1300                         | <140                          | <110                        | <140                          | 100.0               |
| Naphthalene                                        | <870                          | <98                           | <78                         | <95                           | 70.0                |
| Acenaphthylene                                     | <870                          | <98                           | <78                         | <95                           | 70.0                |
| Acenaphthene                                       | <870                          | <98                           | <78                         | <95                           | 70.0                |
| Fluorene                                           | <87                           | <9.8                          | <7.8                        | <9.5                          | 7.0                 |
| Phenanthrene                                       | 291                           | <4.9                          | 17.9                        | 5.03                          | 3.5                 |
| Anthracene                                         | <44                           | <4.9                          | <3.9                        | <4.7                          | 3.5                 |
| Fluoranthene                                       | 115                           | 34.2                          | 49.5                        | <9.5                          | 7.0                 |
| Pyrene                                             | <87                           | 20.7                          | 91.6                        | <9.5                          | 7.0                 |
| Benzo(a)anthracene                                 | <8.7                          | <.98                          | 57.4                        | <.95                          | 0.7                 |
| Chrysene                                           | <62                           | <7                            | 93.5                        | <6.8                          | 5.0                 |
| Benzo(b)fluoranthene                               | 459                           | <.98                          | 86                          | <.95                          | 0.7                 |
| Benzo(k)fluoranthene                               | <8.7                          | <.98                          | 26.2                        | <.95                          | 0.7                 |
| Benzo(a)pyrene                                     | <8.7                          | <.98                          | 70                          | <.95                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | <13                           | <1.4                          | 232                         | <1.4                          | 1.0                 |
| Benzo(g,h,i)perylene                               | 436                           | <2.4                          | 44.6                        | <2.3                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | <21                           | <2.4                          | 82.6                        | <2.3                          | 1.7                 |
| Total PAH                                          | 1301                          | 55                            | 851                         | 5                             |                     |
| Phenols EPA Method 8040                            |                               |                               |                             |                               |                     |
| Phenol                                             | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 2-Chlorophenol                                     | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 2-Nitrophenol                                      | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 2,4-Dimethylphenol                                 | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 2,4-Dichlorophenol                                 | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <107                          | <24                           | <19                         | <23                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <207                          | <46                           | <37                         | <44                           | 33.0                |
| 2,4-Dinitrophenol                                  | <207                          | <46                           | <37                         | <44                           | 33.0                |
| 4-Nitrophenol                                      | <207                          | <46                           | <37                         | <44                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <207                          | <46                           | <37                         | <44                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <207                          | <46                           | <37                         | <44                           | 33.0                |
| Pentachlorophenol                                  | <207                          | <46                           | <37                         | <44                           | 33.0                |
| Volatiles EPA No. 8020                             |                               |                               |                             |                               |                     |
| Benzene                                            | <21                           | <28                           | <22                         | <27                           | 20.0                |
| Toluene                                            | <21                           | <28                           | <22                         | <27                           | 20.0                |
| Chlorobenzene                                      | <21                           | <28                           | <22                         | <27                           | 20.0                |
| Ethylbenzene                                       | <21                           | <28                           | <22                         | <27                           | 20.0                |
| Xylenes                                            | <31                           | <42                           | <33                         | <40                           | 30.0                |
| Styrene                                            | <31                           | <42                           | <33                         | <40                           | 30.0                |
| Metals                                             |                               |                               |                             |                               |                     |
| Arsenic                                            | 2.4                           | 3.8                           | 29.9                        | 1650                          | 1.0                 |
| Chromium                                           | 11                            | 29.7                          | 27.5                        | 53.6                          | 1.0                 |
| Copper                                             | 24.4                          | 30.2                          | 152                         | 154                           | 2.5                 |
| Iron                                               | 13600                         | 39600                         | 20600                       | 41200                         | 10.0                |
| Manganese                                          | 173                           | 946                           | 280                         | 727                           | 1.5                 |
| Zinc                                               | 25.9                          | 70.8                          | 113                         | 426                           | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-19<br>(0-1')<br>JAN 27/94 | B-19<br>(4-5.5')<br>JAN 27/94 | B-20<br>(0-1.5')<br>JAN 27/94 | B-20<br>(2.5-4')<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-----------------------------|-------------------------------|-------------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                             |                               |                               |                               |                     |
| Carbazole                                          | <110                        | <140                          | <1100                         | <130                          | 100.0               |
| Naphthalene                                        | <74                         | <95                           | <760                          | <94                           | 70.0                |
| Acenaphthylene                                     | <74                         | <95                           | <760                          | <94                           | 70.0                |
| Acenaphthene                                       | <74                         | <95                           | <760                          | <94                           | 70.0                |
| Fluorene                                           | <7.4                        | 12                            | <76                           | <9.4                          | 7.0                 |
| Phenanthrene                                       | 5.54                        | 4.81                          | 180                           | <4.7                          | 3.5                 |
| Anthracene                                         | <3.7                        | <4.7                          | 42.6                          | <4.7                          | 3.5                 |
| Fluoranthene                                       | <7.4                        | <9.5                          | 751                           | 12.6                          | 7.0                 |
| Pyrene                                             | <7.4                        | <9.5                          | 1590                          | 17                            | 7.0                 |
| Benzo(a)anthracene                                 | 4.19                        | 2.71                          | 553                           | 5.13                          | 0.7                 |
| Chrysene                                           | 24.1                        | <6.8                          | 992                           | 10.2                          | 5.0                 |
| Benzo(b)fluoranthene                               | 15.1                        | 3.92                          | 647                           | 7.92                          | 0.7                 |
| Benzo(k)fluoranthene                               | <.74                        | <.95                          | 256                           | <.94                          | 0.7                 |
| Benzo(a)pyrene                                     | 12.4                        | <.95                          | 225                           | 3.94                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | 12.8                        | <1.4                          | 1300                          | <1.3                          | 1.0                 |
| Benzo(g,h,i,)perylene                              | 3.37                        | <2.3                          | 275                           | <2.3                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 3.97                        | <2.3                          | 455                           | 6                             | 1.7                 |
| Total PAH                                          | 81                          | 23                            | 7267                          | 63                            |                     |
| Phenols EPA Method 8040                            |                             |                               |                               |                               |                     |
| Phenol                                             | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 2-Chlorophenol                                     | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 2-Nitrophenol                                      | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 2,4-Dimethylphenol                                 | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 2,4-Dichlorophenol                                 | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <108                        | <23                           | <18                           | <23                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <210                        | <45                           | <36                           | <44                           | 33.0                |
| 2,4-Dinitrophenol                                  | <210                        | <45                           | <36                           | <44                           | 33.0                |
| 4-Nitrophenol                                      | <210                        | <45                           | <36                           | <44                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <210                        | <45                           | <36                           | <44                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <210                        | <45                           | 173                           | <44                           | 33.0                |
| Pentachlorophenol                                  | <210                        | <45                           | <36                           | <44                           | 33.0                |
| Volatiles EPA No. 8020                             |                             |                               |                               |                               |                     |
| Benzene                                            | <21                         | <27                           | 25                            | <27                           | 20.0                |
| Toluene                                            | <21                         | <27                           | 54                            | <27                           | 20.0                |
| Chlorobenzene                                      | <21                         | <27                           | <22                           | <27                           | 20.0                |
| Ethylbenzene                                       | <21                         | <27                           | <22                           | <27                           | 20.0                |
| Xylenes                                            | 51                          | <41                           | 60                            | <40                           | 30.0                |
| Styrene                                            | <32                         | <41                           | <33                           | <40                           | 30.0                |
| Metals                                             |                             |                               |                               |                               |                     |
| Arsenic                                            | 4.14                        | 2.44                          | 2390                          | 5.3                           | 1.0                 |
| Chromium                                           | 26.1                        | 43.3                          | 468                           | 40                            | 1.0                 |
| Copper                                             | 28.9                        | 35                            | 4090                          | 45.2                          | 2.5                 |
| Iron                                               | 26100                       | 46700                         | 26800                         | 42300                         | 10.0                |
| Manganese                                          | 288                         | 927                           | 245                           | 1020                          | 1.5                 |
| Zinc                                               | 217                         | 1180                          | 1790                          | 360                           | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate



**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-21<br>(0-1')<br>JAN 27/94 | B-21<br>(4-5.5')<br>JAN 27/94 | B-22<br>(0-1')<br>JAN 26/94 | B-22<br>(4-5.5')<br>JAN 26/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------|
| <b>PAHs EPA Method 8310</b>                        |                             |                               |                             |                               |                     |
| Carbazole                                          | <100                        | 150                           | <110                        | <140                          | 100.0               |
| Naphthalene                                        | <73                         | <100                          | <76                         | <99                           | 70.0                |
| Acenaphthylene                                     | <73                         | <100                          | <76                         | <99                           | 70.0                |
| Acenaphthene                                       | <73                         | <100                          | <76                         | <99                           | 70.0                |
| Fluorene                                           | <7.3                        | <10                           | <7.6                        | <9.9                          | 7.0                 |
| Phenanthrene                                       | 8.32                        | 14.9                          | 11.2                        | <4.9                          | 3.5                 |
| Anthracene                                         | <3.6                        | 7.83                          | <3.8                        | <4.9                          | 3.5                 |
| Fluoranthene                                       | 24.7                        | 133                           | 25.5                        | <9.9                          | 7.0                 |
| Pyrene                                             | 32.6                        | 101                           | 50.6                        | <9.9                          | 7.0                 |
| Benzo(a)anthracene                                 | 40.2                        | 23.9                          | 13.5                        | 5.41                          | 0.7                 |
| Chrysene                                           | 39.9                        | 41.5                          | 87.9                        | <7.1                          | 5.0                 |
| Benzo(b)fluoranthene                               | 22.7                        | 13.3                          | 25.3                        | <5.91                         | 0.7                 |
| Benzo(k)fluoranthene                               | 6.24                        | 2.83                          | 6.37                        | <.99                          | 0.7                 |
| Benzo(a)pyrene                                     | 14.8                        | 6.05                          | 22.8                        | <.99                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | 119                         | <1.5                          | 105                         | <1.4                          | 1.0                 |
| Benzo(g,h,i)perylene                               | 29.4                        | 3.37                          | 26.1                        | <2.4                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 40.2                        | 6.46                          | 15.1                        | <2.4                          | 1.7                 |
| <b>Total PAH</b>                                   | <b>378</b>                  | <b>504</b>                    | <b>389</b>                  | <b>5</b>                      |                     |
| <b>Phenols EPA Method 8040</b>                     |                             |                               |                             |                               |                     |
| Phenol                                             | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 2-Chlorophenol                                     | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 2-Nitrophenol                                      | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 2,4-Dimethylphenol                                 | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 2,4-Dichlorophenol                                 | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <18                         | <25                           | <18                         | <24                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <34                         | <48                           | <36                         | <46                           | 33.0                |
| 2,4-Dinitrophenol                                  | <34                         | <48                           | <36                         | <46                           | 33.0                |
| 4-Nitrophenol                                      | <34                         | <48                           | <36                         | <46                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <34                         | <48                           | <36                         | <46                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <34                         | <48                           | <36                         | <46                           | 33.0                |
| Pentachlorophenol                                  | <34                         | <48                           | <36                         | <46                           | 33.0                |
| <b>Volatiles EPA No. 8020</b>                      |                             |                               |                             |                               |                     |
| Benzene                                            | <21                         | <29                           | <22                         | <28                           | 20.0                |
| Toluene                                            | <21                         | <29                           | <22                         | 48                            | 20.0                |
| Chlorobenzene                                      | <21                         | <29                           | <22                         | <28                           | 20.0                |
| Ethylbenzene                                       | <21                         | <29                           | <22                         | <28                           | 20.0                |
| Xylenes                                            | <31                         | <44                           | <33                         | <42                           | 30.0                |
| Styrene                                            | <31                         | <44                           | <33                         | <42                           | 30.0                |
| <b>Metals</b>                                      |                             |                               |                             |                               |                     |
| Arsenic                                            | 5.36                        | 7.98                          | 5.49                        | 5.99                          | 1.0                 |
| Chromium                                           | 20.2                        | 44.8                          | 26.9                        | 36.5                          | 1.0                 |
| Copper                                             | 30.1                        | 35.1                          | 33.9                        | 33.8                          | 2.5                 |
| Iron                                               | 24500                       | 49300                         | 26600                       | 47700                         | 10.0                |
| Manganese                                          | 273                         | 1150                          | 291                         | 1050                          | 1.5                 |
| Zinc                                               | 46.7                        | 274                           | 51.3                        | 72.8                          | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate



TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-23<br>(0-1')<br>JAN 26/94 | B-23<br>(4-5.5')<br>JAN 26/94 | B-24<br>(0-1')<br>JAN 25/94 | B-24<br>(4-5.5')<br>JAN 25/94 | B-24<br>DUP<br>JAN 25/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|--------------------------|---------------------|
| PAHs EPA Method 8310                               |                             |                               |                             |                               |                          |                     |
| Carbazole                                          | <1100                       | <140                          | <110                        | <140                          | <140                     | 100.0               |
| Naphthalene                                        | <760                        | <97                           | 94.8                        | <97                           | <95                      | 70.0                |
| Acenaphthylene                                     | <760                        | <97                           | <76                         | <97                           | <95                      | 70.0                |
| Acenaphthene                                       | <760                        | <97                           | <76                         | <97                           | <95                      | 70.0                |
| Fluorene                                           | 257                         | <9.7                          | 35.7                        | <9.7                          | 14.6                     | 7.0                 |
| Phenanthrene                                       | 631                         | <4.8                          | 119                         | <4.8                          | 27.2                     | 3.5                 |
| Anthracene                                         | 1780                        | <4.8                          | 112                         | <4.8                          | 25.9                     | 3.5                 |
| Fluoranthene                                       | 2210                        | <9.7                          | 443                         | <9.7                          | 115                      | 7.0                 |
| Pyrene                                             | 2880                        | <9.7                          | 526                         | <9.7                          | 126                      | 7.0                 |
| Benzo(a)anthracene                                 | 1630                        | 2.94                          | 125                         | 4.5                           | 109                      | 0.7                 |
| Chrysene                                           | 2920                        | <6.9                          | 873                         | <6.9                          | 158                      | 5.0                 |
| Benzo(b)fluoranthene                               | 1040                        | 8.14                          | 395                         | 4.97                          | 61.9                     | 0.7                 |
| Benzo(k)fluoranthene                               | 475                         | <.97                          | 144                         | <.97                          | 23.9                     | 0.7                 |
| Benzo(a)pyrene                                     | 721                         | 6.14                          | 248                         | <.97                          | 30.7                     | 0.7                 |
| Dibenzo(a,h)anthracene                             | <10.9                       | <1.4                          | 650                         | <1.4                          | 34.5                     | 1.0                 |
| Benzo(g,h,i)perylene                               | 765                         | <2.3                          | 454                         | <2.3                          | 23.1                     | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 693                         | <2.3                          | 417                         | <2.3                          | 39.1                     | 1.7                 |
| Total PAH                                          | 16002                       | 17.22                         | 4636.5                      | 9.47                          | 788.9                    |                     |
| Phenols EPA Method 8040                            |                             |                               |                             |                               |                          |                     |
| Phenol                                             | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 2-Chlorophenol                                     | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 2-Nitrophenol                                      | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 2,4-Dimethylphenol                                 | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 2,4-Dichlorophenol                                 | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 4-Chloro-3-Methylphenol                            | <18                         | <23                           | <18                         | <24                           | <23                      | 17.0                |
| 2,4,6-Trichlorophenol                              | <36                         | <45                           | <35                         | <46                           | <45                      | 33.0                |
| 2,4-Dinitrophenol                                  | <36                         | <45                           | <35                         | <46                           | <45                      | 33.0                |
| 4-Nitrophenol                                      | <36                         | <45                           | <35                         | <46                           | <45                      | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <36                         | <45                           | <35                         | <46                           | <45                      | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <36                         | <45                           | <35                         | <46                           | <45                      | 33.0                |
| Pentachlorophenol                                  | 1930                        | <45                           | <35                         | <46                           | <45                      | 33.0                |
| Volatiles EPA No. 8020                             |                             |                               |                             |                               |                          |                     |
| Benzene                                            | 26                          | 28                            | <21                         | <28                           | <27                      | 20.0                |
| Toluene                                            | <22                         | <27                           | <21                         | <28                           | <27                      | 20.0                |
| Chlorobenzene                                      | <22                         | <27                           | <21                         | <28                           | <27                      | 20.0                |
| Ethylbenzene                                       | <22                         | <27                           | <21                         | <28                           | <27                      | 20.0                |
| Xylenes                                            | <33                         | <41                           | <32                         | <42                           | <41                      | 30.0                |
| Styrene                                            | <33                         | <41                           | <32                         | <42                           | <41                      | 30.0                |
| Metals                                             |                             |                               |                             |                               |                          |                     |
| Arsenic                                            | 48.1                        | 5.7                           | 8.45                        | 4.64                          | 4.65                     | 1.0                 |
| Chromium                                           | 31.1                        | 34.2                          | 13.9                        | 37.3                          | 33.8                     | 1.0                 |
| Copper                                             | 82.8                        | 35.6                          | 27                          | 32.1                          | 28.1                     | 2.5                 |
| Iron                                               | 16300                       | 41600                         | 19000                       | 47400                         | 43800                    | 10.0                |
| Manganese                                          | 219                         | 1020                          | 2330                        | 1000                          | 726                      | 1.5                 |
| Zinc                                               | 89.2                        | 71.8                          | 38.3                        | 77.6                          | 75.2                     | 2.0                 |

"<" below quantitation limit given.  
PAH, Volatiles and Phenol values in ug/kg  
Metal values in ug/g.  
DUP- duplicate



**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-25<br>(0.5-2')<br>JAN 27/94 | B-25<br>(2.5-4')<br>JAN 27/94 | B-26<br>(0-1')<br>JAN 27/94 | B-26<br>(4-5.5')<br>JAN 27/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|---------------------|
| PAHs EPA Method 8310                               |                               |                               |                             |                               |                     |
| Carbazole                                          | <110                          | <140                          | <110                        | <140                          | 100.0               |
| Naphthalene                                        | 87.2                          | <95                           | 421                         | <97                           | 70.0                |
| Acenaphthylene                                     | <74                           | <95                           | <76                         | <97                           | 70.0                |
| Acenaphthene                                       | 196                           | <95                           | <76                         | <97                           | 70.0                |
| Fluorene                                           | 77.4                          | 11.7                          | 141                         | <9.7                          | 7.0                 |
| Phenanthrene                                       | 496                           | 58.6                          | 253                         | <4.8                          | 3.5                 |
| Anthracene                                         | 65                            | 8.73                          | 139                         | <4.8                          | 3.5                 |
| Fluoranthene                                       | 185                           | 28.3                          | 902                         | <9.7                          | 7.0                 |
| Pyrene                                             | 241                           | 39.6                          | 1380                        | <9.7                          | 7.0                 |
| Benzo(a)anthracene                                 | 35                            | 5.9                           | 3060                        | 7.67                          | 0.7                 |
| Chrysene                                           | 51.8                          | 8.35                          | 237                         | <6.9                          | 5.0                 |
| Benzo(b)fluoranthene                               | 51.3                          | 10.1                          | 1700                        | 6                             | 0.7                 |
| Benzo(k)fluoranthene                               | 8.21                          | 2.38                          | 464                         | <.97                          | 0.7                 |
| Benzo(a)pyrene                                     | 13.6                          | 3.69                          | 1510                        | 3.13                          | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.1                          | <1.4                          | 514                         | <1.4                          | 1.0                 |
| Benzo(g,h,i)perylene                               | 24.8                          | 2.55                          | 876                         | <2.3                          | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | 11.2                          | <2.3                          | 1250                        | <2.3                          | 1.7                 |
| Total PAH                                          | 1544                          | 179.9                         | 12847                       | 16.8                          |                     |
| Phenols EPA Method 8040                            |                               |                               |                             |                               |                     |
| Phenol                                             | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 2-Chlorophenol                                     | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 2-Nitrophenol                                      | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 2,4-Dimethylphenol                                 | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 2,4-Dichlorophenol                                 | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 4-Chloro-3-Methylphenol                            | <18                           | <23                           | <18                         | <23                           | 17.0                |
| 2,4,6-Trichlorophenol                              | <34                           | <45                           | <36                         | <46                           | 33.0                |
| 2,4-Dinitrophenol                                  | <34                           | <45                           | <36                         | <46                           | 33.0                |
| 4-Nitrophenol                                      | <34                           | <45                           | <36                         | <46                           | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <34                           | <45                           | <36                         | <46                           | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <34                           | <45                           | <36                         | <46                           | 33.0                |
| Pentachlorophenol                                  | <34                           | <45                           | <36                         | <46                           | 33.0                |
| Volatiles EPA No. 8020                             |                               |                               |                             |                               |                     |
| Benzene                                            | <21                           | <27                           | 37                          | <28                           | 20.0                |
| Toluene                                            | <21                           | <27                           | <22                         | <28                           | 20.0                |
| Chlorobenzene                                      | <21                           | <27                           | 31                          | <28                           | 20.0                |
| Ethylbenzene                                       | <21                           | <27                           | 26                          | <28                           | 20.0                |
| Xylenes                                            | <31                           | <41                           | 63                          | <41                           | 30.0                |
| Styrene                                            | <31                           | <41                           | <32                         | <41                           | 30.0                |
| Metals                                             |                               |                               |                             |                               |                     |
| Arsenic                                            | 29.4                          | 3.04                          | 62.2                        | 2.84                          | 1.0                 |
| Chromium                                           | 10.2                          | 47.2                          | 27.7                        | 36.8                          | 1.0                 |
| Copper                                             | 31.2                          | 31                            | 100                         | 32.8                          | 2.5                 |
| Iron                                               | 14300                         | 38100                         | 28                          | 46500                         | 10.0                |
| Manganese                                          | 231                           | 768                           | 426                         | 1030                          | 1.5                 |
| Zinc                                               | 86.9                          | 73.6                          | 80.2                        | 75.7                          | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-27<br>(0-1')<br>JAN 25/94 | B-27<br>(4-5.5')<br>JAN 25/94 | B-28<br>(0-1')<br>JAN 25/94 | B-28<br>(4-5.5')<br>JAN 25/94 | B-29<br>(0-1')<br>JAN 25/94 | B-29<br>(4-5.5')<br>JAN 25/94 | DETECTIC<br>LIMITS |
|----------------------------------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|-------------------------------|--------------------|
| PAHs EPA Method 8310                               |                             |                               |                             |                               |                             |                               |                    |
| Carbazole                                          | <130                        | <140                          | <110                        | <140                          | <110                        | <130                          | 100.0              |
| Naphthalene                                        | <90                         | <95                           | 156                         | <99                           | <74                         | <90                           | 70.0               |
| Acenaphthylene                                     | <90                         | <95                           | <76                         | <99                           | <74                         | <90                           | 70.0               |
| Acenaphthene                                       | <90                         | <95                           | 112                         | <99                           | <74                         | <90                           | 70.0               |
| Fluorene                                           | 12                          | <9.5                          | <7.6                        | <9.9                          | <7.4                        | <9                            | 7.0                |
| Phenanthrene                                       | 56.5                        | 5.66                          | 32                          | 10                            | <3.7                        | <4.5                          | 3.5                |
| Anthracene                                         | 12.5                        | <4.7                          | 4.6                         | <5                            | <3.7                        | <4.5                          | 3.5                |
| Fluoranthene                                       | 222                         | <9.5                          | 95.4                        | <9.9                          | <7.4                        | <9                            | 7.0                |
| Pyrene                                             | 307                         | <9.5                          | 108                         | <9.9                          | 12                          | <9                            | 7.0                |
| Benzo(a)anthracene                                 | 249                         | 2.97                          | 135                         | 4.15                          | 3.65                        | <9                            | 0.7                |
| Chrysene                                           | 456                         | <6.8                          | 146                         | <7.1                          | 13.5                        | <6.5                          | 5.0                |
| Benzo(b)fluoranthene                               | 276                         | 4.18                          | 84.8                        | 4.4                           | 4.42                        | <9                            | 0.7                |
| Benzo(k)fluoranthene                               | 123                         | <9.5                          | 34.1                        | <9.9                          | <7.4                        | <9                            | 0.7                |
| Benzo(a)pyrene                                     | 170                         | <9.5                          | 51.4                        | <9.9                          | 2.64                        | <9                            | 0.7                |
| Dibenzo(a,h)anthracene                             | 779                         | <1.4                          | 230                         | <1.4                          | <1.1                        | <1.3                          | 1.0                |
| Benzo(g,h,i)perylene                               | 142                         | <2.3                          | 36.4                        | <2.4                          | 2.08                        | <2.4                          | 1.7                |
| Indeno(1,2,3-cd)pyrene                             | 197                         | <2.3                          | 59.3                        | <2.4                          | 2.78                        | <2.4                          | 1.7                |
| Total PAH                                          | 3002                        | 12.81                         | 1285                        | 18.55                         | 41.07                       | 0                             |                    |
| Phenols EPA Method 8040                            |                             |                               |                             |                               |                             |                               |                    |
| Phenol                                             | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.0               |
| 2-Chlorophenol                                     | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.0               |
| 2-Nitrophenol                                      | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.                |
| 2,4-Dimethylphenol                                 | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.6               |
| 2,4-Dichlorophenol                                 | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.0               |
| 4-Chloro-3-Methylphenol                            | <22                         | <23                           | <18                         | <24                           | <18                         | <22                           | 17.0               |
| 2,4,6-Trichlorophenol                              | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| 2,4-Dinitrophenol                                  | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| 4-Nitrophenol                                      | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| 2,3,5,6-Tetrachlorophenol                          | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| 2-Methyl-4,6-Dinitrophenol                         | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| Pentachlorophenol                                  | <42                         | <44                           | <36                         | <47                           | <35                         | <43                           | 33.0               |
| Volatiles EPA No. 8020                             |                             |                               |                             |                               |                             |                               |                    |
| Benzene                                            | <26                         | <27                           | 73                          | <28                           | <21                         | 36                            | 20.0               |
| Toluene                                            | <26                         | <27                           | <22                         | <28                           | <21                         | <26                           | 20.0               |
| Chlorobenzene                                      | <26                         | <27                           | <22                         | <28                           | <21                         | <26                           | 20.0               |
| Ethylbenzene                                       | <26                         | <27                           | <22                         | <28                           | <21                         | <26                           | 20.0               |
| Xylenes                                            | <39                         | <40                           | <33                         | <43                           | 32                          | <39                           | 30.0               |
| Styrene                                            | <39                         | <40                           | <33                         | <43                           | <31                         | <39                           | 30.0               |
| Metals                                             |                             |                               |                             |                               |                             |                               |                    |
| Arsenic                                            | 8.15                        | 1.55                          | 22.5                        | 2.58                          | 29.4                        | 4.6                           | 1.0                |
| Chromium                                           | 17.5                        | 30.2                          | 26.5                        | 38.4                          | 29.4                        | 16.3                          | 1.0                |
| Copper                                             | 27                          | 28.2                          | 41.1                        | 33.3                          | 91.4                        | 19.6                          | 2.5                |
| Iron                                               | 27700                       | 41800                         | 27700                       | 47400                         | 30500                       | 27300                         | 10.0               |
| Manganese                                          | 313                         | 788                           | 675                         | 898                           | 935                         | 551                           | 1.5                |
| Zinc                                               | 55.8                        | 71.4                          | 65.6                        | 80.4                          | 132                         | 49.7                          | 2.0                |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

**TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY**

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | B-30<br>(1.5-2.5')<br>JAN 25/94 | B-30<br>(3-4.5')<br>JAN 25/94 | B-31<br>(1.5-2.5')<br>JAN 25/94 | B-31<br>(4.5-5.5')<br>JAN 25/94 | B-32<br>(0-1')<br>JAN 25/94 | B-32<br>(3-4')<br>JAN 25/94 | DETECTION<br>LIMITS |
|----------------------------------------------------|---------------------------------|-------------------------------|---------------------------------|---------------------------------|-----------------------------|-----------------------------|---------------------|
| PAHs EPA Method 8310                               |                                 |                               |                                 |                                 |                             |                             |                     |
| Carbazole                                          | <130                            | <140                          | <130                            | <140                            | <110                        | <130                        | 100.0               |
| Naphthalene                                        | <91                             | <97                           | <91                             | <98                             | <76                         | <90                         | 70.0                |
| Acenaphthylene                                     | <91                             | <97                           | <91                             | <98                             | <76                         | <90                         | 70.0                |
| Acenaphthene                                       | <91                             | <97                           | <91                             | <98                             | <76                         | <90                         | 70.0                |
| Fluorene                                           | <9.1                            | <9.7                          | <9.1                            | <9.8                            | 11.1                        | <9                          | 7.0                 |
| Phenanthrene                                       | <4.6                            | <4.8                          | <4.6                            | 6.61                            | 17.8                        | <4.5                        | 3.5                 |
| Anthracene                                         | <4.6                            | <4.8                          | <4.6                            | <4.9                            | 5.48                        | <4.5                        | 3.5                 |
| Fluoranthene                                       | <9.1                            | <9.7                          | <9.1                            | <9.8                            | 102                         | <9                          | 7.0                 |
| Pyrene                                             | <9.1                            | <9.7                          | <9.1                            | <9.8                            | 150                         | <9                          | 7.0                 |
| Benzo(a)anthracene                                 | <.91                            | <.97                          | <.91                            | <.98                            | 41.6                        | <.9                         | 0.7                 |
| Chrysene                                           | <6.5                            | <6.9                          | <6.5                            | <.7                             | 73.1                        | <6.5                        | 5.0                 |
| Benzo(b)fluoranthene                               | <.91                            | <.97                          | <.91                            | <.98                            | 122                         | <.9                         | 0.7                 |
| Benzo(k)fluoranthene                               | 2.14                            | <.97                          | <.91                            | <.98                            | 33.8                        | <.9                         | 0.7                 |
| Benzo(a)pyrene                                     | <.91                            | <.97                          | <.91                            | <.98                            | 70.5                        | <.9                         | 0.7                 |
| Dibenzo(a,h)anthracene                             | <1.3                            | <1.4                          | <1.3                            | <1.4                            | <1.1                        | <1.3                        | 1.0                 |
| Benzo(g,h,i,)perylene                              | <2.2                            | <2.3                          | <2.2                            | <2.4                            | 108                         | <2.2                        | 1.7                 |
| Indeno(1,2,3-cd)pyrene                             | <2.2                            | <2.3                          | <2.2                            | <2.4                            | 81                          | <2.2                        | 1.7                 |
| Total PAH                                          | 2                               | 0                             | 0                               | 6.61                            | 816.4                       | 0                           |                     |
| Phenols EPA Method 8040                            |                                 |                               |                                 |                                 |                             |                             |                     |
| Phenol                                             | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 2-Chlorophenol                                     | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 2-Nitrophenol                                      | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 2,4-Dimethylphenol                                 | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 2,4-Dichlorophenol                                 | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 4-Chloro-3-Methylphenol                            | <22                             | <23                           | <22                             | <24                             | <18                         | <22                         | 17.0                |
| 2,4,6-Trichlorophenol                              | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| 2,4-Dinitrophenol                                  | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| 4-Nitrophenol                                      | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| 2,3,5,6-Tetrachlorophenol                          | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| Pentachlorophenol                                  | <43                             | <45                           | <43                             | <46                             | <36                         | <42                         | 33.0                |
| Volatiles EPA No. 8020                             |                                 |                               |                                 |                                 |                             |                             |                     |
| Benzene                                            | <26                             | <28                           | <26                             | <28                             | <22                         | <26                         | 20.0                |
| Toluene                                            | <26                             | <28                           | <26                             | <28                             | <22                         | <26                         | 20.0                |
| Chlorobenzene                                      | <26                             | <28                           | <26                             | <28                             | <22                         | <26                         | 20.0                |
| Ethylbenzene                                       | <26                             | <28                           | <26                             | <28                             | <22                         | <26                         | 20.0                |
| Xylenes                                            | <39                             | <41                           | <39                             | <42                             | <32                         | <39                         | 30.0                |
| Styrene                                            | <39                             | <41                           | <39                             | <42                             | <32                         | <39                         | 30.0                |
| Metals                                             |                                 |                               |                                 |                                 |                             |                             |                     |
| Arsenic                                            | 4.8                             | 5.1                           | 15.9                            | 5.4                             | 123                         | 5                           | 1.0                 |
| Chromium                                           | 45.4                            | 49                            | 36.6                            | 24.1                            | 17.5                        | 38.8                        | 1.0                 |
| Copper                                             | 32.2                            | 29                            | 28.2                            | 26.7                            | 54.1                        | 27.4                        | 2.5                 |
| Iron                                               | 41800                           | 42600                         | 40700                           | 36400                           | 20800                       | 36100                       | 10.0                |
| Manganese                                          | 1130                            | 1120                          | 950                             | 870                             | 314                         | 907                         | 1.5                 |
| Zinc                                               | 77.3                            | 69.3                          | 68.8                            | 65.7                            | 66.6                        | 80.8                        | 2.0                 |

"<" below quantitation limit given.

PAH, Volatiles and Phenol values in ug/kg

Metal values in ug/g.

DUP- duplicate

TABLE 2-6 (CONT.)  
ONSITE SOIL QUALITY

| SOIL BORING NO.<br>DEPTH OF SAMPLE<br>DATE SAMPLED | FIELD<br>BLANK #1<br>1/26/94 | FIELD<br>BLANK #2<br>1/27/94 | FIELD<br>BLANK #3<br>1/27/94 | TRIP<br>BLANK | DETECTION<br>LIMITS |
|----------------------------------------------------|------------------------------|------------------------------|------------------------------|---------------|---------------------|
| PAHs EPA Method 8310                               |                              |                              |                              |               |                     |
| Carbazole                                          | <3.0                         | <3.0                         | <3.0                         | NA            | <3.0                |
| Naphthalene                                        | <2.0                         | <2.0                         | <2.0                         | NA            | <2.0                |
| Acenaphthylene                                     | <2.0                         | <2.0                         | <2.0                         | NA            | <2.0                |
| Acenaphthene                                       | <2.0                         | <2.0                         | <2.0                         | NA            | <2.0                |
| Fluorene                                           | <.2                          | <.2                          | <.2                          | NA            | <.2                 |
| Phenanthrene                                       | <.1                          | <.1                          | <.1                          | NA            | <.1                 |
| Anthracene                                         | <.1                          | <.1                          | <.1                          | NA            | <.1                 |
| Fluoranthene                                       | <.2                          | <.2                          | <.2                          | NA            | <.2                 |
| Pyrene                                             | <.2                          | <.2                          | <.2                          | NA            | <.2                 |
| Benzo(a)anthracene                                 | <.02                         | <.02                         | <.02                         | NA            | <.02                |
| Chrysene                                           | <.15                         | <.15                         | <.15                         | NA            | <.15                |
| Benzo(b)fluoranthene                               | <.02                         | <.02                         | <.02                         | NA            | <.02                |
| Benzo(k)fluoranthene                               | <.02                         | <.02                         | <.02                         | NA            | <.02                |
| Benzo(a)pyrene                                     | <.02                         | <.02                         | <.02                         | NA            | <.02                |
| Dibenzo(a,h)anthracene                             | <.03                         | <.03                         | <.03                         | NA            | <.03                |
| Benzo(g,h,i)perylene                               | <.05                         | <.05                         | <.05                         | NA            | <.05                |
| Indeno(1,2,3-cd)pyrene                             | <.05                         | <.05                         | <.05                         | NA            | <.05                |
| Total PAH                                          | 0                            | 0                            | 0                            |               |                     |
| Phenols EPA Method 8040                            |                              |                              |                              |               |                     |
| Phenol                                             | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 2-Chlorophenol                                     | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 2-Nitrophenol                                      | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 2,4-Dimethylphenol                                 | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 2,4-Dichlorophenol                                 | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 4-Chloro-3-Methylphenol                            | <.5                          | <.5                          | <.5                          | NA            | <.5                 |
| 2,4,6-Trichlorophenol                              | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| 2,4-Dinitrophenol                                  | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| 4-Nitrophenol                                      | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| 2,3,5,6-Tetrachlorophenol                          | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| 2-Methyl-4,6-Dinitrophenol                         | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| Pentachlorophenol                                  | <1.0                         | <1.0                         | <1.0                         | NA            | <1.0                |
| Volatiles EPA No. 8020                             |                              |                              |                              |               |                     |
| Benzene                                            | <.2                          | <.2                          | <.2                          | <.2           | <.2                 |
| Toluene                                            | <.2                          | <.2                          | <.2                          | <.2           | <.2                 |
| Chlorobenzene                                      | <.2                          | <.2                          | <.2                          | <.2           | <.2                 |
| Ethylbenzene                                       | <.2                          | <.2                          | <.2                          | <.2           | <.2                 |
| Xylenes                                            | <.3                          | <.3                          | <.3                          | <.3           | <.3                 |
| Styrene                                            | <.3                          | <.3                          | <.3                          | <.3           | <.3                 |
| Metals                                             |                              |                              |                              |               |                     |
| Arsenic                                            | <.01                         | <.01                         | <.01                         | NA            | 0.01                |
| Chromium                                           | <.01                         | <.01                         | <.01                         | NA            | 0.01                |
| Copper                                             | <.03                         | <.03                         | <.03                         | NA            | 0.03                |
| Iron                                               | <.1                          | <.1                          | 0.2                          | NA            | 0.10                |
| Manganese                                          | <.02                         | <.02                         | <.02                         | NA            | 0.02                |
| Zinc                                               | <.02                         | <.02                         | <.02                         | NA            | 0.02                |

"<" Value below quantitation limit given.  
PAH, Volatiles and Phenol values in ug/L  
Metal values in mg/L.

### **3.0 NATURE AND EXTENT OF CONTAMINATION**

This section of the report provides an evaluation on the nature and extent of contamination onsite and offsite at the J.H. Baxter site, based on the investigative results from the Phase I and Phase II RI programs. Descriptions and interpretations are presented regarding the known and potential horizontal and vertical extent of contamination.

These characteristics of the detected contamination are discussed for each of the five media sampled including; onsite and offsite soils, onsite and offsite groundwater, onsite and offsite sediment and surface waters.

Constituents of concern related to the wood treating operations of J.H. Baxter have been detected in the site soils, groundwater, sediment and surface waters. The extent of these constituents in onsite soils and offsite media such as groundwater, sediments, surface waters and surface soils has been evaluated.

#### **3.1 Soils**

##### **Onsite Soil**

The extent and nature of contaminants in onsite soils has been evaluated from the collection and analysis of 67 soil samples. The constituents analyzed in the onsite soils were PAH, phenols, VOAs, arsenic, chromium, copper, zinc, manganese and iron. Dioxins and furans were also analyzed in three of the near surface soil samples. Figure 2-10 through 2-25 display PCOC concentrations on the site for total PAH, total chlorophenols, pentachlorophenol, arsenic, copper, chromium and zinc for both the shallow soil zone (0 to 2.5 feet below grade) and the deeper soil zone analyzed (2.5 to 6.5 feet below grade).

## **PAH**

Figures 2-10 and 2-11 in Section 2 show the extent of PAH in the shallow onsite soils. PAH extends over approximately one-half the site in the near surface soils (0 to 2.5 feet below grade) at concentrations greater than 100 ug/g (total PAH). The highest concentration detected was in the vicinity of the southern portion of the chemical storage tank farm. In general, the PAH contamination is centered around the treatment plant and tank farm. Several small areas with total PAH concentrations exceeding 1,000 ug/g are located east of the treatment plant area. The source of these PAHs are likely creosote treated wood which was stored in this area.

The extent of PAH in deeper soils is much less than the near surface soils. Total PAH concentrations greater than 100 ug/g are limited to the vicinity of the treatment plant and area south of the treatment plant including the area of the former burn pit.

## **Phenols**

Chlorinated phenolics were detected sporadically in the onsite soils. PCP was only detected at five borehole locations. These boreholes were located near the former burn pit (B-7), on the west side of the tank farm (B-11, B-12 and B-13) and at one location in the treated wood storage yard (B-23). Figure 2-12 through 2-15 provide contoured isopleths for total chlorophenols and PCP.

At one location in the southwest portion of the site near the onsite railway tracks, east of the retention pond, trichlorophenol and tetrachlorophenol were detected in the soil. Overall, the extent of chlorinated phenolics on the site is generally limited to near the tank farm, in the vicinity of the former underground PCP line which was located immediately to the east of B-13 and ran north south past B-13, and near the former burn pit.

The vertical extent of chlorophenols in the soil depends on the location which reflects different potential sources of contamination. Near the former burn (B-7) pit, chlorophenols were present in the surface soil but not at depth. Near the tank farm



(B-11 and B-12) chlorophenols were detected in both the shallow and deeper soil samples. In the vicinity of the former underground penta line (B-13) the deeper sample was contaminated and the shallow sample was not.

Overall, as can be seen in Figures 2-12 to 2-15 in Section 2, the extent of chlorophenols in the shallow surface soil is similar to the extent in the deeper soil horizon. The extent of chlorophenols in the soils is also not as widespread as was observed for PAH.

### **VOAs**

Volatile aromatic compounds were detected at various locations over the site (Figures 2-16 and 2-17). Benzene, toluene, ethylbenzene or xylenes (BTEX) were the predominant VOAs detected on the site. Samples analyzed from boreholes in the vicinity of the tank farm (B-11 and B-12) also contain styrene and chlorobenzenes in addition to BTEX.

BTEX was found in the surface soils at sporadic locations in the in the eastern part of the site and on the western part of the site not in the immediate vicinity of the treatment plant. A potential source of the BTEX is minor leakage of gasoline type constituents by vehicles on the site. BTEX is a major component of gasoline and is generally used to identify gasoline, if present in soils or groundwater.

### **Metals**

The four metals of concern, arsenic, chromium, copper and zinc analyzed in the onsite soils were detected at all sampling locations. This is expected since these metals are naturally present in the soil. Arsenic was detected at concentrations above background levels (previously defined at between 5 to 10 ug/g) at various locations on the site. Figures 2-18 and 2-19 in Section 2 display isopleths of arsenic concentrations in the surface soils and a deeper soil zone. The figures reveal that arsenic contamination is more widespread in the surface soils than at depth.

Of the four metals, chromium, was detected over the smallest area at concentrations above background levels estimated in section 2.4.2.1.4 (see Figures 2-20 and 2-21). This is predominantly the result of one soil sample collected at borehole B-20 which had a chromium concentration of 468 ug/g.

Copper in the surface soils is above background levels (approximately 50 ug/g) over the central area of the site and in pockets to the east and west of the general treating area. The area with copper above background levels at depth decreases substantially from the area observed in the surface soils.

Soils with zinc concentrations in excess of estimated background levels (approximately 100 ug/g) are restricted to the central area of the site (see Figure 2-24 and 2-25). Unlike the other three metals, the area of soils at depth with zinc concentrations in excess of background levels is similar to the area above background in the surficial soils.

#### **Offsite Soil**

Several of the PCOCs identified at the site were detected in the offsite surface soils both north and south of the J.H. Baxter property. PAH was detected in all the offsite soil samples, but only at sample location SS-2 was the total PAH concentration greater than 1 ppm (1.23 ppm). SS-2 is located directly south of the site on 1st Avenue. Similarly, several chlorinated phenolics including PCP were detected in the offsite soils. The SS-2 location described previously, had PCP in the soil at approximately 0.5 ppm. PCP was also present at sample location SS-6 (0.1 ppm). The origin of the PCOCs at SS-2 and SS-6 may be the site since these locations are downwind of the treatment area in the summer (SS-2) and fall to spring (SS-6).

Metal concentrations in the offsite samples were significantly less than the concentrations observed in the onsite soil samples. For example, the mean arsenic concentration in the offsite surface samples is approximately 3.3 ppm whereas it is 25.5 ppm for the onsite surface soils. VOAs were not detected in any of the offsite samples.



### 3.2 Groundwater

Nine wells were installed as part of Phase II to assess the extent of PCOCs in the groundwater offsite to the north and northwest of the J.H. Baxter property. The findings of the Phase I RI indicated that some PCOCs detected onsite may have migrated offsite. These PCOCs included PAHs and PCP. The extent of PCOCs in groundwater at the site is discussed below.

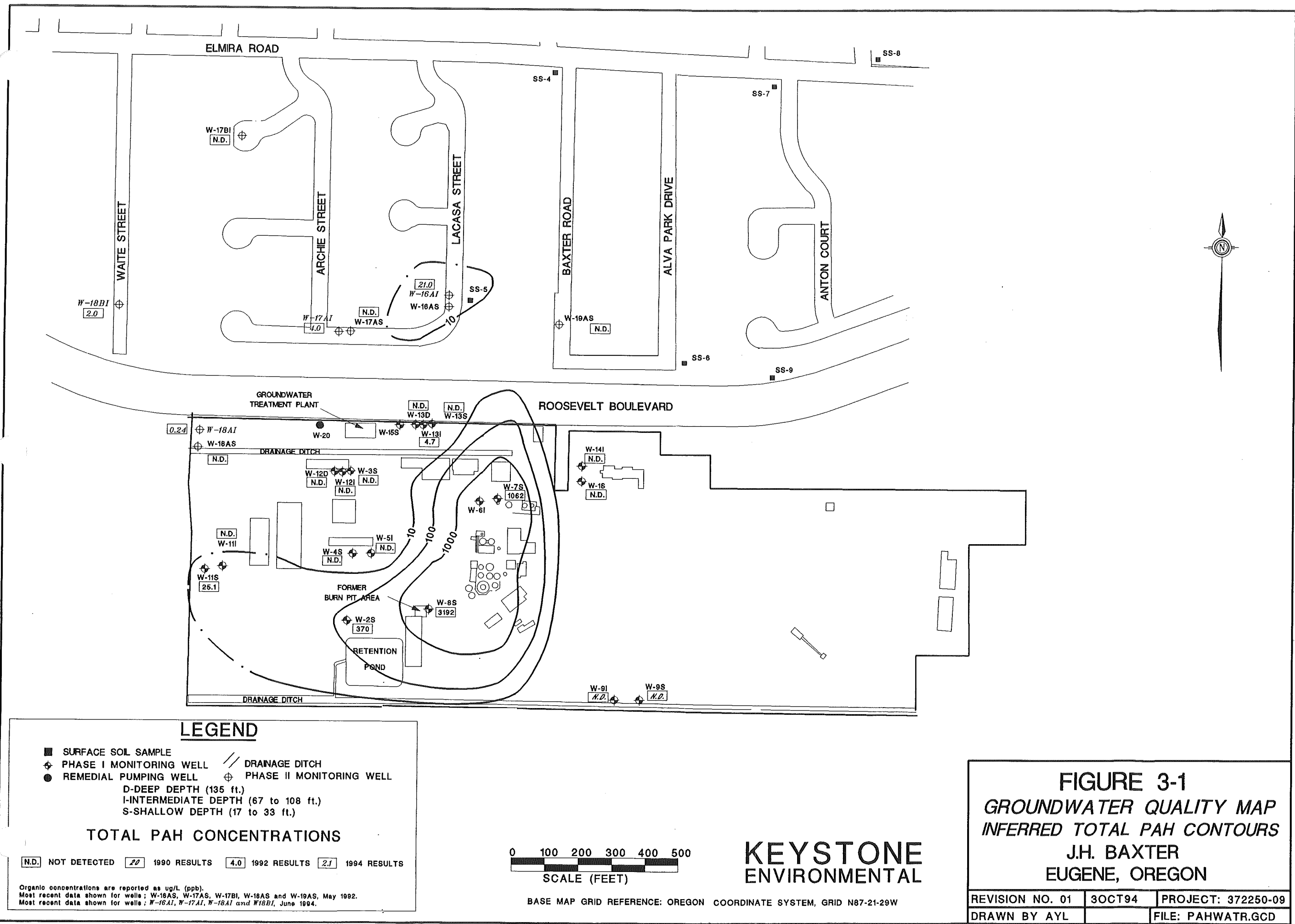
#### **PAHs**

Low concentrations of several PAHs have been detected in offsite wells (W-16AI, W-17AI, W-17BI, W-18AI and W-18BI). The highest offsite PAH concentrations have been observed in the Phase II wells which are the furthest offsite (W-17BI and W-18BI). This may indicate that the source of the PAH is not the J.H. Baxter site. Three other intermediate depth wells also had PAHs detected in January 1992. However, the May 1992 sampling session did not detect any PAHs in the Phase II wells. Recent results from February and June of 1994 detected low concentrations of PAHs in some of the offsite wells. Detections have been inconsistent and sporadic.

Figure 3-1, displays the inferred extent of total PAH in the groundwater at the site. The figure uses the most recent data available from each well. For most of the onsite wells the latest results are from May of 1992. Four offsite wells have data from June 1994. At well nest locations the highest PAH from either the shallow or intermediate well was plotted and used to generate isopleths. The figure indicates that PAH groundwater contamination is generally restricted to onsite locations. PAHs have been detected offsite but at low concentrations and inconsistently which may suggest a source other than J.H. Baxter.

#### **Phenols**

The groundwater data from the first phase of the RI indicated that PCP had contaminated onsite groundwater and had potentially migrated offsite to the north. The results of the Phase II well sampling in January and May 1992, prior to pumping and treating groundwater onsite, detected PCP in only one sample. PCP was



detected in a duplicate sample collected in January 1992 from well W-17AI. The May 1992 analysis for PCP in well W-17AI did not detect PCP. Subsequently in February 1994 and June 1994 PCP was also not detected offsite, although groundwater was being pumped from the site at this time. The detection of PCP in well W-17AI is an anomaly. If it was present in the well in January 1992, it no longer is, and PCP in the groundwater north of the site does not extend to the first set of Phase II wells (eg. W-16AI, W-17AI, W-18AI).

Other chlorinated phenols have been detected offsite. Dichlorophenol and trichlorophenol were detected in well W-18AI (2 ug/L and 2.5 ug/L, respectively) and W-19AS (2.59 ug/L and 1.49 ug/L, respectively) in both January and May 1992. Phenol was detected in these two wells (approximately 1.7 ug/L) as well as W-16AS and W-18AS in January but not in May. The most recent results from each offsite well were negative for chlorophenols, except well W-19AS that had 1.2 ug/L of trichlorophenol, but has not been sampled since the inception of the groundwater pump and treat system.

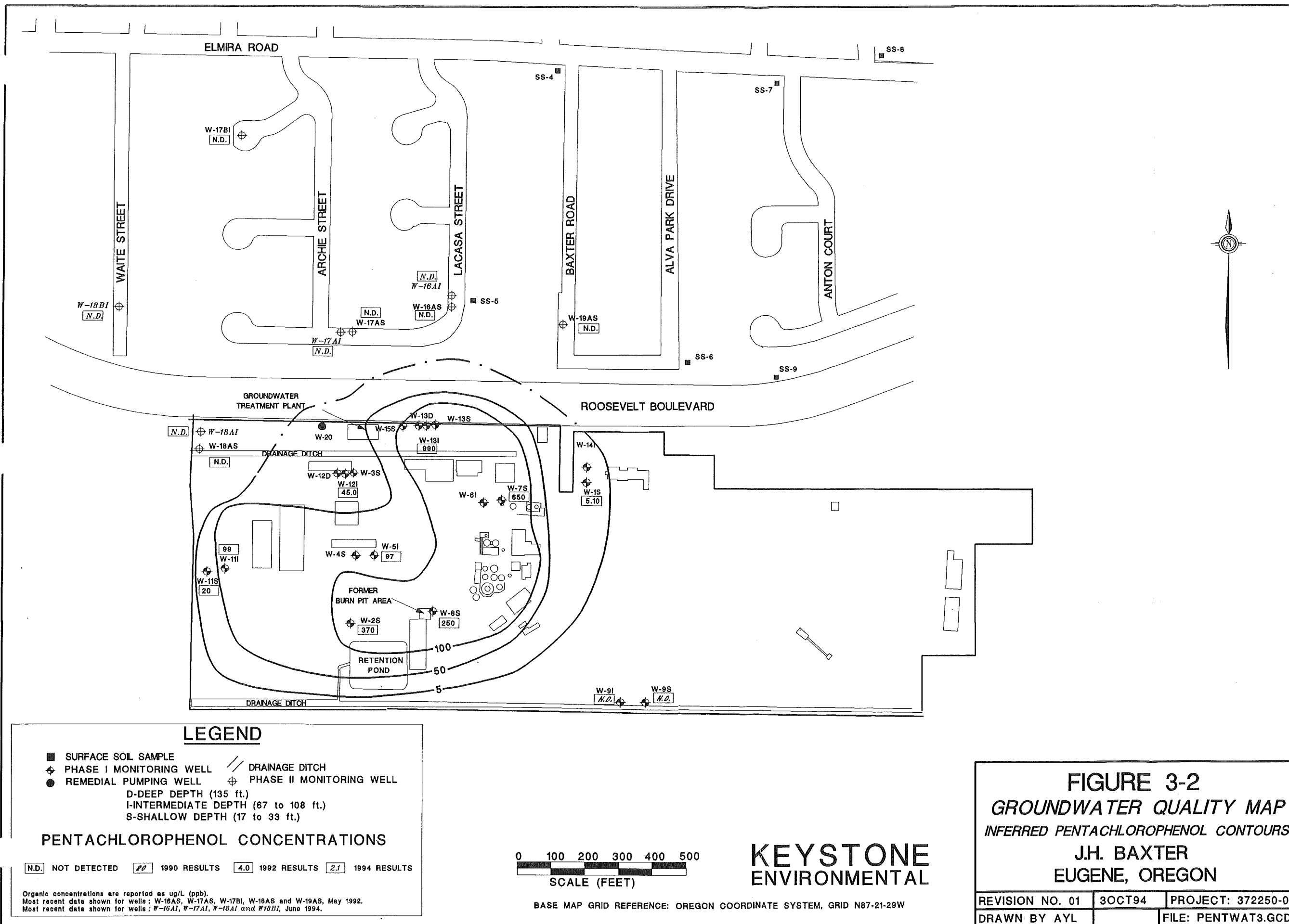
Figure 3-2 displays the extent of PCP in the groundwater based on the most recent analytical results from each well. The figure suggests that PCP contaminated groundwater is generally contained to onsite areas.

#### **VOAs**

Volatile aromatics have not been detected in any of the Phase II wells. This indicates that VOA content in the groundwater is limited to onsite locations. VOAs have been detected in onsite well W-7S. The Phase I RI VOA data indicated benzene may have migrated offsite, but it or any other VOAS have never been detected in the offsite wells.

#### **Arsenic, Chromium, Copper and Zinc**

Total or dissolved chromium and copper have not been detected in the offsite groundwater and were not previously detected in most of the onsite wells. Zinc has been detected offsite in the groundwater at well W-18BI at approximately 0.4 mg/L.



However, in the nearest upgradient well to W-18BI which is W-18AI, the zinc concentration is much lower (.016 mg/L). This suggests the zinc in W-18BI may be from an offsite source. Arsenic has also been detected in the offsite groundwater but at very low concentrations (highest arsenic concentrations was .0025 mg/L at W-17AS).

Well W-8S, located near the former burnpit, had the highest concentration of arsenic. Arsenic was present in May of 1992 at 0.18 mg/L in W-8S. The nearest downgradient wells to W-8S, which are W-5I and W-4S, did not contain arsenic. This indicates that the extent of arsenic in the groundwater on the site is limited to the vicinity of well W-8S. The onsite groundwater in the vicinity of wells W-8S and to a lesser degree well W-7S are contaminated with metals. Offsite groundwater contamination is restricted to zinc in the groundwater at well W-16AI.

### 3.3 Sediment (Ditch)

The nature and extent of PCOCs in the sediment in the ditch on the southern boundary of the site, which exits the site to the west and eventually enters the floodway channel along Roosevelt Boulevard, is discussed in this section. A total of eight sediment samples have been obtained in the ditch; four during the Phase I RI (SS-1 to SS-4) and four as part of the Phase II RI (SD-8 to SD-11). The Phase I sediment samples were collected in the onsite portion of the ditch and all the samples for the Phase II RI were obtained at offsite locations in the ditch (Figure 2-2).

PAHs were detected in all of the offsite and onsite sediment samples. The highest PAH concentrations were found in the onsite samples downstream of the surface water retention pond which drains into the ditch. Total PAH in these samples ranged from approximately 6 to 31 ug/g. The nearest offsite sample which was collected at J.H. Baxter's western property boundary (SD-8) had a total PAH concentration of only 1.9 ug/g. The samples collected in the ditch west of Bertelsen Road (SD-10 and SD-11) had total PAH concentrations of only 0.05 ug/g (ppm).

PCP was not detected in any of the offsite sediment samples but several other chlorinated phenolic compounds were detected. The highest concentration of

chlorinated phenols was found in sample SD-8 which is at the J.H. Baxter property boundary. Dichlorophenol was detected at SD-11 at 510 ug/kg, which is the furthest downstream sediment sampling location. PCP was detected in the onsite ditch sediment samples at concentrations ranging from approximately 0.1 (SS-3) ug/g to 5 ug/g (SS-4).

VOAs were not detected in any of the sediment samples obtained offsite. They were detected in the onsite samples but at low concentrations (ie. approximately 0.05 ug/g).

Arsenic, chromium, copper and zinc were detected in all of the sediment samples. If a reasonable assumption is made that onsite sample SS-3, which is at the most upstream location sampled in the ditch (southwest corner of plant property), is representative of natural background metal concentrations in the ditch sediments then arsenic, copper and zinc are present at elevated concentrations in sediment samples SS-2, SS-1, SS-4 and SD-8, which are within or at the J.H. property boundary.

Arsenic was present at 36.8 ug/g in SS-3, whereas it is at concentrations of 115 ug/g at SS-1, 220 ug/g at SS-2, 82.8 ug/g at SS-4 and 104 ug/g at SD-8. Further downstream samples which include SD-9, SD-10 and SD-11 have arsenic concentrations ranging between approximately 6 ug/g and 26 ug/g (background levels).

Copper in SS-3 was approximately 53 ug/g. In the remaining onsite samples copper was detected at concentrations of 172 ug/g (SS-1), 574 ug/g (SS-2) and 932 ug/g (SS-4). Sample SD-8 which is close to the plant property boundary had a copper concentration of 424 ug/g. Again, like arsenic, downstream copper concentrations from this point decrease significantly to within background levels (approximately 20 to 60 ug/g).

Zinc concentrations were elevated compared to the background concentration of zinc (estimated at 80 ug/g (SS-3)) at sample locations SS-1, SS-2, SS-4 and SD-8. Offsite ditch concentrations were within the estimated background concentration except at SD-11 where the zinc concentration increased to 107 ug/g.



Although, in general, it is apparent that metal concentrations increased between location SD-10 and SD-11, the concentrations are still within background levels. A potential reason for the increase in the concentrations is a culvert which supplies water to the ditch and is located just west of the SD-10 sampling location.

Figures 3-3 and 3-4, display the organic and metal concentrations detected in the onsite and offsite ditch sediments, respectively.

### 3.4 Surface Water (Ditch)

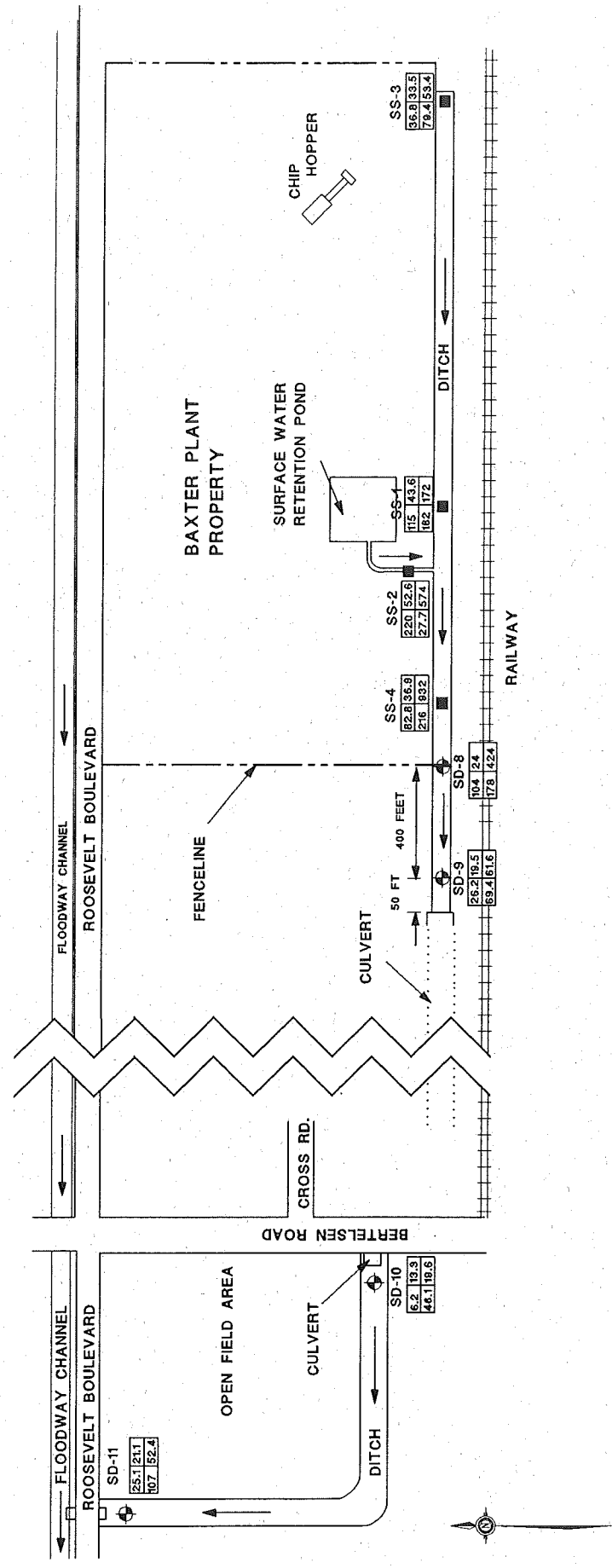
PAHs were detected in all of the surface water samples except SW-3 which is located at the most upstream point in the ditch on the J.H. Baxter property. PAH concentrations decreased rapidly between SW-2 and the J.H. Baxter property boundary. At SW-8, which is situated at the Baxter property boundary, the total PAH concentration was 2.7 ug/L. At SW-9, which is downstream of SW-8, the total PAH concentration was 3.4 ug/L. At further downstream sample locations SW-10 and SW-11 the total PAH concentration is less than 1 ug/L. Other culverts, and surface ditches enter this ditch as it proceeds offsite towards the Roosevelt floodway channel, providing opportunity for the introduction of PCOCs from offsite sources. The railway right-of-way which parallels the ditch may provide a potential source for PAH from creosote treated ties.

PCP was detected in both the onsite and offsite surface waters. The concentration of PCP in the surface water at the time of sampling at the Baxter property boundary was 266 ug/L. At the furthest downstream sample location, SW-11, PCP was detected at a concentration of 26 ug/L. The Oregon fresh water chronic criteria and acute criteria for PCP are 13 ug/L and 20 ug/L, respectively.

VOAs consisting of toluene, ethylbenzene and xylenes were detected in surface water samples collected from the onsite and offsite portions of the ditch. However, the concentrations were low, particularly offsite (ie. less than 1 ug/L). These concentrations are considerably less than the available Oregon fresh water criteria for these compounds. A potential source of these constituents is gasoline which







**LEGEND**

SD-9 SEDIMENT SAMPLING LOCATION (MARCH 1993)

SS-1 SEDIMENT SAMPLING LOCATION (MAY 1990)

**METAL CONCENTRATIONS**

ARSENIC 0.05 ND, CHROMIUM 0.21 ND, COPPER

ND - NOT DETECTED

Metal concentrations are reported as ug/g (ppm). Data is a schematic representation of the investigative area and is not to scale.

★ NOTE: Location of structures on property are approximate.

**FIGURE 3-4**

**SEDIMENT QUALITY MAP**

**METALS**

**J.H. BAXTER**

**EUGENE, OREGON**

REVISION NO. 01 04OCT94 PROJECT: 372250-09

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KEYSTONE ENVIRONMENTAL

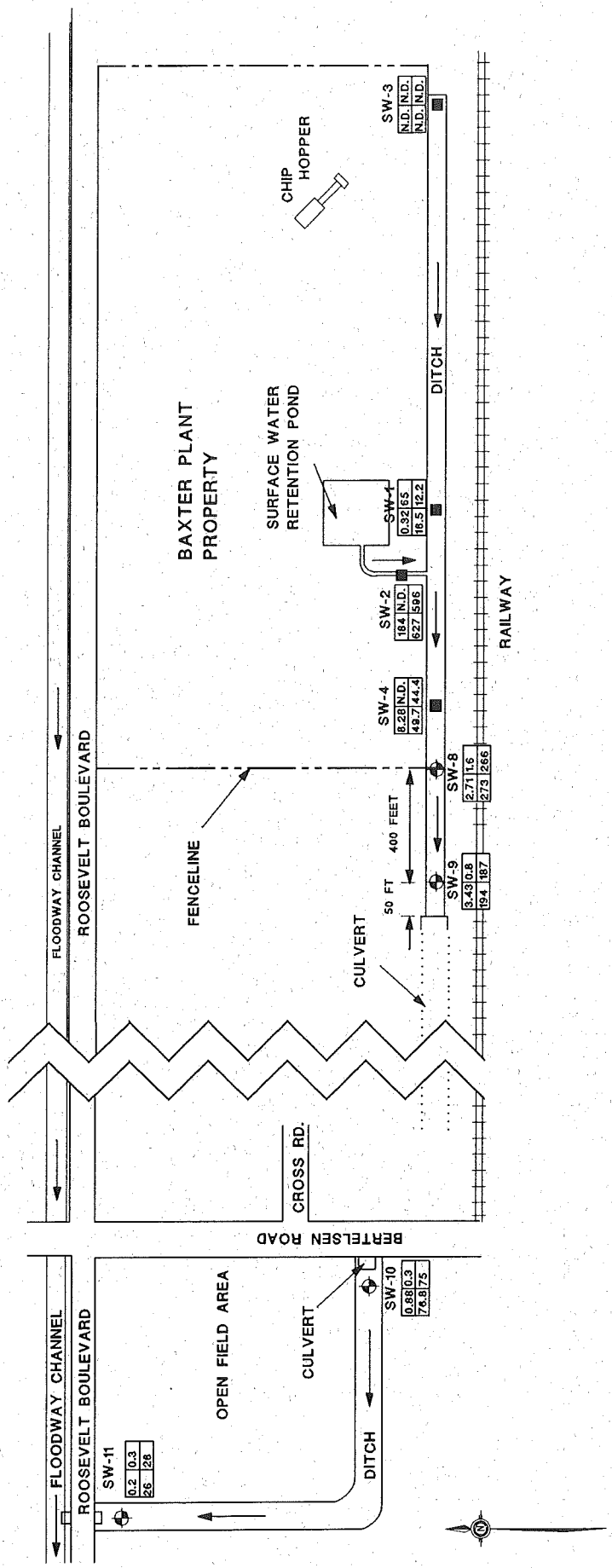
J.H. Baxter  
372250 10/94

contains these compounds which are often used to identify the potential presence of gasoline constituents in soil and water.

Chromium was not detected in any of the surface water samples collected from the ditch. Arsenic, copper and zinc were present in the onsite and offsite surface water in the ditch. At the upstream location SW-3, arsenic and zinc were detected at .01 mg/L and .03 mg/L, respectively. Copper was not detected at SW-3. Copper concentrations in the offsite ditch water exceed the fresh water criteria which is 12 ug/L for chronic effects and 18 ug/L for acute effects. The copper concentration at the furthest downstream sample location was 28.4 ug/L.

Zinc concentrations in the ditch exceeded fresh water criteria onsite downstream of the retention pond and offsite at SW-9. The chronic fresh water criteria for zinc is 110 ug/L. Arsenic concentrations in the ditch varied from 1,760 ug/L at SW-2 to 28.4 ug/L at SW-11 the furthest downstream sampling location.

Figures 3-5 and 3-6, show the organic and metal concentrations in the onsite and offsite ditch surface waters, respectively.



### LEGEND

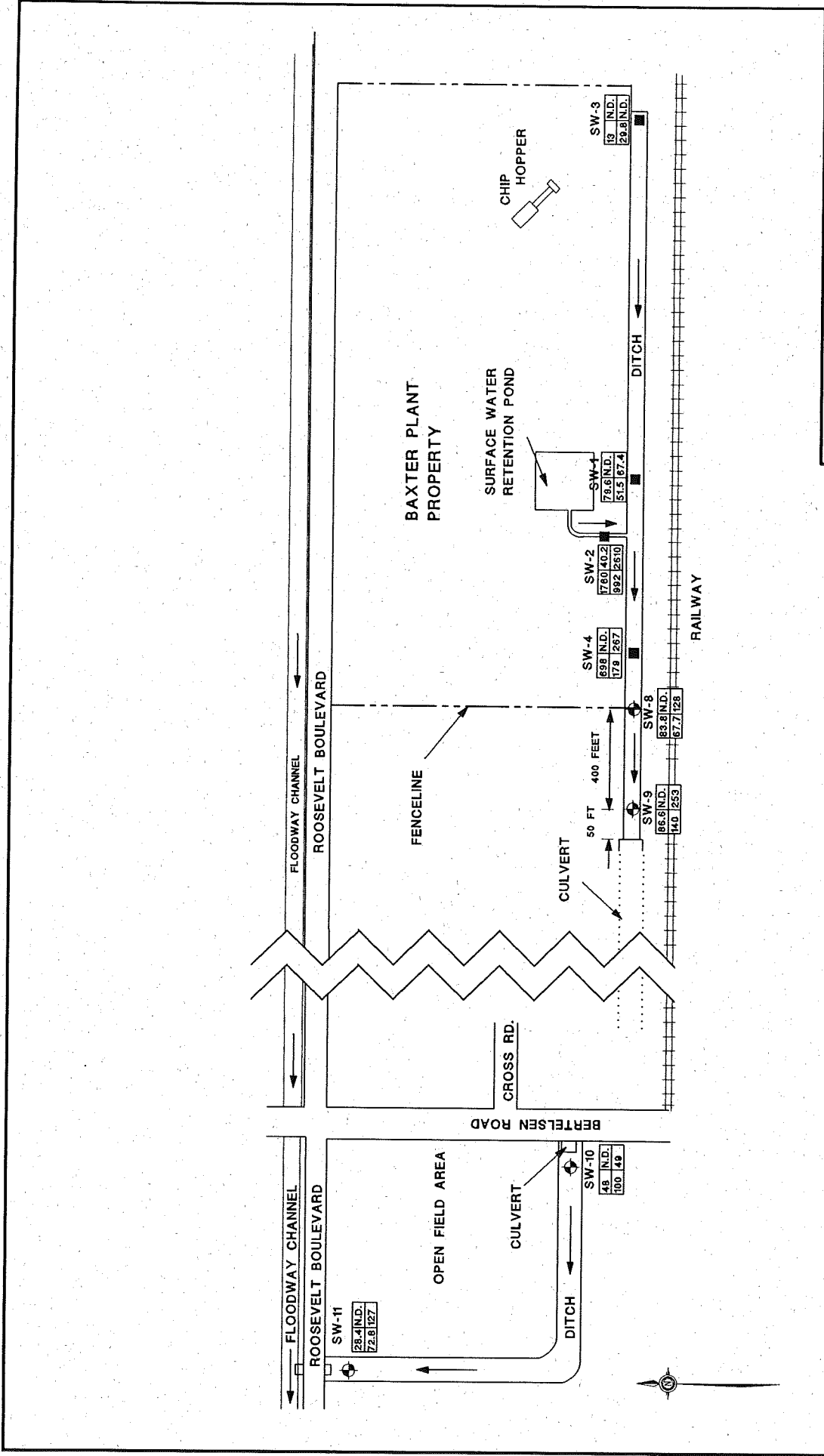
SW-9 SURFACE WATER SAMPLING LOCATION (MARCH 1993) ■ LOCATION (MAY 1990)  
ORGANIC CONCENTRATIONS  
TOTAL PAHs 0.05(ND) TOTAL VOLATILE AROMATICS  
TOTAL CHLOROPHENOLS 0.21(ND) PENTACHLOROPHENOLS  
ND - NOT DETECTED  
Organic concentrations are reported as ug/L (ppb).  
Drawing is a schematic representation of the investigative area and is not to scale.  
\*NOTE: Location of structures on property are approximate.

FIGURE 3-5  
SURFACE WATER QUALITY MAP  
ORGANICS  
J.H. BAXTER  
EUGENE, OREGON

KEYSTONE  
ENVIRONMENTAL

REVISION NO. 01 04OCT94 PROJECT: 372250-09  
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**FIGURE 3-6**

**SURFACE WATER QUALITY MAP**

**METALS**

**J.H. BAXTER**

**EUGENE, OREGON**

**KEYSTONE ENVIRONMENTAL**

REVISION NO. 01 04OCT94 PROJECT: 372250-09

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## **4.0 QUANTITATIVE PUBLIC HEALTH RISK ASSESSMENT**

### **4.1 Introduction**

This section presents the Phase II RI quantitative Public Health Risk Assessment (PHRA) performed for J.H. Baxter and Company wood preserving facility in Eugene, Oregon. The Phase I PHRA investigated the potential for chemical constituents to affect public health under a no action scenario. The Phase II PHRA investigation incorporates the recently installed interim groundwater pump and treat system. The pump and treat system was constructed to prevent offsite migration of contaminated groundwater. Therefore, for this PHRA the quality of offsite groundwater is used to determine risk to the offsite residents associated with groundwater.

The Phase II data permits additional pathways to be evaluated for onsite workers and residents. Future onsite residents are not considered in the Phase II PHRA since there are no foreseeable plans to decommission the plant and convert the site to residential use. Future residence scenarios were evaluated and presented in the Phase I PHRA. The new residential development immediately north of the site which was vacant during the Phase I is now inhabited. However, the ingestion and inhalation of groundwater pathways for residents will not be considered in the Phase II PHRA since all offsite residents who were previously using well water as drinking and bathing water are now on City supplied water. The Phase I PHRA addressed potential risks resulting from ingestion of groundwater from drinking, and also dermal contact and inhalation of volatile compounds while bathing (Phase I PHRA August 1991 report).

### **4.2 Risk Assessment Method**

The Phase II PHRA was conducted using two methods. First, the standardly applied deterministic approach was used, which provides a single point estimate of risk and provides only a qualitative evaluation of uncertainty. Deterministic means that a single value for each exposure factor is used to produce one risk value.

If the total risk level of a receptor for a given exposure pathway was greater than  $1 \times 10^{-6}$  and probability distributions were available for relevant exposure factors, then the risk was re-evaluated using a stochastic approach. However, two risk scenarios, which meet these criteria, were not re-evaluated using stochastic methods since exposure factor distributions were not available in these two cases. These scenarios were dermal contact by a child with offsite soils and inhalation by a child resident of soil particulates originating from the site. The risk scenarios which were evaluated stochastically were;

- o ingestion of on site soils by plant workers,
- o ingestion of off site soils by a child resident,
- o ingestion of off site soils by an adult resident,
- o inhalation of on site soils by plant workers,
- o inhalation of on site soils by off site adult residents, and
- o dermal contact with off site soils by an adult resident.

#### **Standard or Deterministic Method**

The deterministic approach was performed in accordance with the Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual (Part A, U.S. EPA, 1989a), Supplemental Risk Assessment Guidance for Superfund, EPA Region 10, 1991 and Supplemental Guidance to RAGS: Calculating the Concentration Term, EPA 1992. In addition to these guidance documents, the Superfund Exposure Assessment Manual (U.S. EPA, 1988) and the Exposure Factors Handbook (U.S. EPA, 1989b) were also utilized. The PHRA identifies areas of interest and chemical constituents at the site. This information, together with the geographical, demographic, chemical, physical, and biological characteristics of the site are brought together to identify potential exposure pathways and receptors. The chemical and physical properties of the constituents present are then used to estimate concentrations at the end points of these exposure pathways. Finally, intakes by potential receptors are determined and combined with the toxicological properties to estimate the potential public health risks posed by constituents at the site.



In the performance of the standard risk method for the Phase II PHRA, the 95% UCL (upper confidence limit) of the arithmetic mean or the maximum detected concentration of PCOCs were used for quantitative public health risk calculations. If the 95% UCL was greater than the maximum detected PCOC concentration, then the maximum detected concentration was used in the risk calculation.

### **Stochastic Method**

The stochastic or probabilistic method utilizes statistical information on exposure factors such as body weight, ingestion rate and exposure duration to determine risks which are represented as probability distributions. Random values from exposure factor distributions are picked and used to calculate an individual risk level (Monte Carlo Method) using the same equation used for the deterministic approach. However, a large number of simulations are run to provide many possible risk value outcomes which then comprise a probability distribution. To ensure that all portions of the exposure factor probability distributions are used in the process many simulations are required. For the stochastic analysis performed in this report a total of 2,000 simulations were run for each PCOC in each risk scenario.

An advantage of the probabilistic approach is that it permits a quantitative evaluation of uncertainty. The stochastic approach also provides a means for incorporating variability in exposure factors and site specific information. For example, in this assessment, statistics on workers employment length at the Baxter plant were incorporated into the risk calculations.

Probabilistic distributions for exposure factors were obtained from the paper, "Exposure Factors Manual", Journal of Soil Contamination, 3(1):47-117(1994) and J.H. Baxter employee records. A total of eight exposure factors were given probability distributions in the assessment. They included;

- o adult body weight,
- o weekly hours at home, adult residents,
- o years at one residence, adults
- o adult soil ingestion rate,

- o child soil ingestion rate,
- o adult inhalation rate, on site worker
- o adult inhalation rate, off site resident, and
- o length of worker employment at plant.

Details on these distributions are presented in Report 7, Assumption Distributions, in Appendix D.

Probability distributions were not used for reference doses and cancer slope factors in the stochastic risk assessment. These values remain the same as those used in the standard approach which are the upper 95th percentile confidence limit values. As in the standard risk method the 95% UCL of the arithmetic mean or the maximum detected concentration of PCOCs were used for exposure point concentrations in the stochastic risk calculations. If the 95% UCL was greater than the maximum detected PCOC concentration, then the maximum detected concentration was used. For not detected PCOCs one-half the sample quantitation limit was used unless this value was greater than the maximum detected PCOC concentration in the medium. The maximum detected PCOC value was used in this situation.

#### **4.3 PHRA Organization**

The components of the Phase II PHRA include:

- o toxicity assessment;
- o fate and transport;
- o identification of potential constituents of concern;
- o identification of potential exposure pathways and potentially affected populations;
- o exposure assessment, deterministic and stochastic;
- o risk characterization, deterministic and stochastic; and
- o sources of uncertainty.

This PHRA is divided into 10 sections, with Section 4.4 describing the potential for constituents to give rise to adverse effects in an exposed population. Section 4.5



discusses environmental fate and transport processes. Potential constituents of concern (PCOCs) are identified in Section 4.6, which defines compounds at the site having the greatest relative potential to affect human health and the environment. Section 4.7 discusses current exposure scenarios, and identifies associated onsite and offsite potential exposure pathways and receptors. The exposure assessment presented in Section 4.8 estimates the type and magnitude of exposures to chemicals of potential concern that are present at the site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks in Section 4.9 that are associated with the site. Section 4.10 discusses sources of uncertainties in the Phase II PHRA.

Appendix B of the report presents the Phase II analytical data. Appendix C consists of toxicological profiles of the PCOCs. Appendix D presents the computer generated reports from the stochastic assessment with statistical descriptions for the probability distributions generated for each PCOC in each scenario evaluated.

#### **4.4    Toxicity Assessment**

The purpose of this section is to identify the potential health effects associated with exposure to constituents at the site. A toxicological evaluation characterizes the inherent toxicity of a compound. It consists of the review of scientific data to determine the nature and extent of the human health effects associated with exposure to the various chemicals. The end product is a toxicological profile of each PCOC.

Toxicological profiles provide both qualitative and quantitative data regarding their actual or potential human health and environmental effects. Constituent characteristics of toxicological profiles include acute and chronic systemic effects, and carcinogenic, mutagenic, and teratogenic properties that may effect both human and environmental receptors. Should relevant data exist, bioaccumulation and bioconcentration properties are included, especially for evaluation of aquatic receptors. Toxicological profiles also provide endpoints, routes of exposure, and doses in human and/or animal studies. Toxicological profiles for the PCOCs assessed in the Phase II investigation are provided in Appendix C.

Information on potential toxic effects of chemicals include data on both humans and animals. Human epidemiological data from occupational exposures are often insufficient for determining quantitative indices of toxicity due to uncertainties in exposure estimates, and to inherent difficulties in determining causal relationships from epidemiological studies. For this reason, animal bioassays are conducted under controlled conditions and their results extrapolated to humans in two stages. First, to account for species differences, conversion factors are applied to extrapolate from test animals to humans. Second, the relatively high doses administered to test animals must be extrapolated to the lower doses more typical of human exposures. For potential noncarcinogens, safety factors are applied to animal results when developing acceptable human doses. For potential carcinogens, mathematical models are used to extrapolate from potential risks at high doses to potential risks at lower doses.

#### **4.4.1 Dose-Response Evaluation**

An important component of the risk assessment process is the relationship between the dose of a compound (amount to which an individual or population is exposed) and the potential for adverse health effects resulting from exposure to that dose. Available toxicological information may indicate that many of the site-related constituents have both noncarcinogenic and potential carcinogenic health effects in humans and/or experimental animals. Although many compounds may potentially cause health and environmental impacts, dose-response relationships and the potential for exposure must be evaluated before the risks to receptors can be determined. Dose-response relationships correlate the magnitude of the dose with the probability of potential effects. The published information on doses and responses is used in conjunction with information on the nature and magnitude of human exposure in order to develop an estimate of health risks.

Standard reference doses and/or carcinogenic slope factors have been developed for many compounds. The following sections provide a brief description of these and other quantitative indices of toxicity pertinent to the risk assessment.

Quantitative indices of toxicity are used in identifying constituents of concern for evaluation in the PHRA. The hierarchy (U.S. EPA 1989a) for choosing these values is as follows:

- o Integrated Risk Information System (IRIS);
- o Health Effects Assessment Summary Tables (HEAST); and,
- o other EPA documents.

The IRIS data base is updated monthly and contains both verified RfD's (reference doses) and CSF's (cancer slope factors). The EPA has formed a RfD Workgroup to review existing data used to derive RfD's. Once this task has been completed the verified RfD appears in IRIS. Like the RfD Workgroup, EPA has also formed the Carcinogen Risk Assessment Verification Endeavor (CRAVE) Workgroup to review and validate toxicity values used in developing CSF's. Once the slope factors have been verified via extensive peer review, they also appear in the IRIS data base.

The HEAST provides both interim (unverified) and verified RfD's and CSF's. This document is published quarterly and incorporates any applicable changes to its data base.

Other EPA reference documents can be used to obtain quantitative indices of toxicity only after review of the literature demonstrates that the referenced data are current.

#### **4.4.1.1 Noncarcinogenic Compounds**

The **Reference Dose (RfD)** is developed for chronic and/or subchronic human exposure to chemicals and is based solely on the noncarcinogenic effects of chemical substances. It is defined as an estimate of a daily dose for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfD is usually expressed as dose (mg) per unit body weight (kg) per unit time (day). It is generally derived by dividing a no-observed-(adverse)-effect-level (NOAEL or NOEL) or a lowest observed-adverse-effect-level (LOAEL) for the critical toxic effect by an appropriate "uncertainty

factor (UF)." NOAELS, etc., are determined from laboratory or epidemiological toxicity studies.

The uncertainty factor (UF) is based on the availability of toxicity data. Uncertainty factors usually consist of multiples of 10, where each factor represents a specific area of uncertainty naturally present in the extrapolation process. These uncertainty factors are presented below and were taken from the "Risk Assessment Guidance Document for Superfund, Volume I, Human Health Evaluation Manual (Part A)" (U.S. EPA 1989a):

- o A UF of 10 is used to account for variation in the general population and is intended to protect sensitive subpopulations (e.g., elderly, children).
- o A UF of 10 is used when extrapolating from animals to humans. This factor is intended to account for the interspecies variability between humans and other mammals.
- o A UF of 10 is used when a NOAEL is derived from a subchronic study instead of a chronic study and is used as the basis for a chronic RfD.
- o A UF of 10 is used when a LOAEL is used instead of a NOAEL. This factor is intended to account for the uncertainty associated with extrapolating from LOAELs to NOAELs.

By incorporating uncertainty factors the RfD maintains a margin of safety so that potential chronic human health effects are not underestimated.

#### **4.4.1.2 Carcinogenic Compounds**

The U.S. EPA weight-of-evidence for a compound's potential carcinogenicity is defined as follows:

- o Group A Known human carcinogens;

- o Group B Probable human carcinogens. Group B is subdivided into B1 - limited human carcinogenicity data, and B2 - animal carcinogenicity data but no human data.
- o Group C Possible human carcinogens;
- o Group D Not classifiable as to its carcinogenicity;
- o Group E Evidence of noncarcinogenicity for humans.

**Carcinogenic Slope Factors (CSFs)** are used to estimate an upper-bound lifetime probability of an individual potentially developing cancer as a result of exposure to a particular level of a potential carcinogen (U.S. EPA 1989a). This factor is generally reported in units of kg-day/mg and is derived through an assumed low-dosage linear multistage model and an extrapolation from high to low dose-responses determined from animal studies. The value used in reporting the slope factor is the upper 95 percent confidence limit. CSFs are also accompanied by weight-of-evidence classifications which designate the strength of the evidence that a particular compound is a potential human carcinogen.

#### **4.4.2 Regulatory Standards and Guidelines**

This section presents a description of available regulatory standards or guidelines for use in evaluating risks associated with PCOCs. Regulatory standards and guidelines may be used for comparative purposes to infer the potential for health risks and environmental impacts. Relevant regulatory standards and guidelines include the Oregon State Water Quality Criteria (Table 20, Chapter 340, Division 41, Oregon Administrative Rules), EPA Ambient Water Quality Criteria, Maximum Contaminant Levels, Maximum Contaminant Level Goals, and Health Advisories. A summary of relevant water quality criteria are presented in Table 4-1 for the PCOCs at the site.

#### **4.5 Fate and Transport Processes**

The potential for a chemical to migrate spatially in an environmental setting is a critical component in assessing the potential for human and environmental exposure. The environmental mobility of a chemical is influenced primarily by its physical and

TABLE 4-1  
Relevant Water Quality Standards  
and Guidelines

| Compounds                  | MCL<br>ug/L | MCLG<br>ug/L | ODW<br>ug/L | OREGON<br>FWCC<br>ug/L | OREGON<br>FWAC<br>ug/L | OREGON<br>WFIHH<br>ug/L |
|----------------------------|-------------|--------------|-------------|------------------------|------------------------|-------------------------|
| Naphthalene                | -           | -            | 20          | 620*                   | 2300*                  | -                       |
| Acenaphthylene             | -           | -            | -           | -                      | -                      | -                       |
| Acenaphthene               | -           | -            | -           | 520*                   | 1700*                  | -                       |
| Fluorene                   | -           | -            | -           | -                      | -                      | -                       |
| Phenanthrene               | -           | -            | -           | -                      | -                      | -                       |
| Anthracene                 | -           | -            | -           | -                      | -                      | -                       |
| Fluoranthene               | -           | -            | -           | -                      | 3980*                  | 42                      |
| Pyrene                     | -           | -            | -           | -                      | -                      | -                       |
| Benzo(g,h,i,)perylene      | -           | -            | -           | -                      | -                      | -                       |
| Chrysene                   | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Benzo(a)anthracene         | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Benzo(b)fluoranthene       | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Benzo(k)fluoranthene       | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Benzo(a)pyrene             | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Dibenzo(a,h)anthracene     | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| Indeno(1,2,3-cd)pyrene     | 0.2         | 0.0          | -           | -                      | -                      | 0.028**                 |
| 2-Chlorophenol             | -           | -            | 40          | 2000*                  | 4380*                  | -                       |
| 2,4-Dichlorophenol         | -           | -            | 20          | 365*                   | 2020*                  | 3090                    |
| 4-Chloro-3-Methylphenol    | -           | -            | -           | -                      | 30*                    | -                       |
| 2,4,6-Trichlorophenol      | -           | -            | -           | 970*                   | -                      | 1.2**                   |
| 2,4-Dinitrophenol          | -           | -            | -           | 150*                   | 230*                   | -                       |
| 4-Nitrophenol              | -           | -            | 60          | 150*                   | 230*                   | -                       |
| 2,3,5,6-Tetrachlorophenol  | -           | -            | -           | -                      | -                      | -                       |
| 2-Methyl-4,6-Dinitrophenol | -           | -            | -           | 150*                   | 230*                   | -                       |
| Pentachlorophenol          | 1.0         | 0.0          | -           | 13***                  | 20***                  | 1010                    |
| Arsenic (5+)               | 50          | -            | -           | 48*                    | 850*                   | 0.022**                 |
| Arsenic (3+)               | 50          | -            | -           | 190                    | 360                    | -                       |
| Chromium (6+)              | 50          | -            | -           | 11                     | 16                     | 50                      |
| Chromium (3+)              | 50          | -            | -           | 210                    | 1700                   | 170                     |
| Copper                     | -           | -            | -           | 12                     | 18                     | -                       |
| Zinc                       | -           | -            | 2000        | 110                    | 120                    | -                       |
| Benzene                    | 5           | -            | -           | -                      | 5300*                  | .00066**                |
| Toluene                    | 1000        | -            | -           | -                      | 17500*                 | 14300                   |
| Chlorobenzene              | -           | -            | -           | 50*                    | 250*                   | 488                     |
| Ethylbenzene               | 700         | -            | -           | -                      | 32000*                 | 1400                    |
| Xylenes                    | 10000       | -            | -           | -                      | -                      | -                       |
| Styrene                    | 100         | -            | -           | -                      | -                      | -                       |
| 2,3,7,8-TCDD               | -           | -            | -           | .000038*               | .01*                   | .000013**               |

"-" Not Available.

MCL - Maximum Contaminant Level (U.S. EPA).

MCLG - Maximum Contaminant Level Goal (U.S. EPA)

ODW - Office of Drinking Water's Lifetime Health Advisories.

FWCC - Oregon Fresh Water Chronic Criteria, Oregon Administrative Rules, Chapter 340

FWAC - Oregon Fresh Water Acute Criteria, Oregon Administrative Rules, Chapter 340

WFIHH - Oregon Water and Fish Ingestion Human Health Criteria, Chapter 340

\* Insufficient data to develop criteria, value is lowest observed effect level.

\*\* Value presented is 10-6 risk concentration.

\*\*\* pH dependent criteria (7.8 used).



chemical properties in combination with the physical and chemical properties of the environment.

The long-term environmental fate and distribution of constituents will be influenced by three main factors.

- o The physical-chemical properties of the individual constituents.
- o The physical-chemical properties of the environmental setting.
- o Reactions in the environment which modify the chemical structure and behavior of the contaminants.

These factors determine the potential for a chemical to migrate in the environment. The extent of migration is a critical aspect in the assessment of potential human exposures. Spatial migration of a compound is primarily dependent upon its mobility and persistence, and its prevalence at the location of interest. These factors are discussed below.

#### **4.5.1 Mobility and Persistence**

Persistence and mobility are characteristics that are used in identifying constituents of concern. Physical and chemical properties of a compound control its transport and fate in the environment. For example, these attributes determine whether a chemical will readily volatilize into the air or be transported via advection or diffusion through the soil, groundwater, and surface waters. These characteristics also describe a chemical's tendency to adsorb onto soil/sediment particles, in turn reducing its mobility through the environment.

Persistence of a chemical in the environment depends on factors such as the microbial content of soil and water and the ability of these organisms to degrade the chemical. In addition, chemical and photochemical degradation may contribute to the elimination of a particular compound.

Persistence and mobility are influenced by such factors as specific gravity, vapor pressure, water solubility, octanol/water partition coefficient, organic carbon

partition coefficient, Henry's Law constant and the diffusion coefficient. Calculated values, which were obtained using approximation methods, are presented when literature values are unavailable. A discussion of the environmental significance of each of these parameters follows.

- o Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at a given temperature. Its primary use is to determine whether a constituent will have a tendency to float or sink in water if it is present as a pure compound or at very high concentrations.
- o Vapor pressure (Vp) provides an indication of the rate at which a chemical may volatilize. It is of primary significance at environmental interfaces such as surface soil/air and surface water/air. Vapor pressures are generally inversely related to boiling point temperatures; that is, chemicals with low boiling points usually have high vapor pressures at ambient temperatures. Thus, chemicals with high vapor pressures such as benzene, are expected to enter the atmosphere much more readily than chemicals with low vapor pressures such as metals and some PAHs. Volatilization is therefore, primarily an environmental fate process for volatile organics in surface waters and surface soils.
- o Water solubility has a great effect on constituent mobility. The rate at which a chemical leaches by infiltrating precipitation is directly proportional to its solubility in water. More soluble chemicals are more readily leached than less soluble chemicals. Water solubilities for lighter organic chemicals, such as monocyclic aromatics, are usually several orders of magnitude greater than for PAHs.
- o The octanol/water partition coefficient ( $K_{ow}$ ) is a measure of the equilibrium partitioning of chemicals between an organic phase and water. It is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. The



octanol/water partition coefficient is also used to estimate bioconcentration factors in aquatic organisms.

- o The organic carbon partition coefficient (K<sub>oc</sub>) indicates the tendency of an organic chemical to bind to the organic fraction of soil/sediment particles. Chemicals with high (K<sub>oc</sub>) generally have low water solubilities. This parameter may be used to infer the relative rates at which the more mobile chemicals (monocyclic aromatics) are transported in the aqueous media. Chemicals such as PAHs are relatively immobile in the environment and are preferentially bound to the soil phase.
- o Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface-water bodies and from groundwater. The ratio of these two parameters is the Henry's Law constant (H) and is used to calculate the equilibrium contaminant concentrations in the vapor (air) versus the liquid (water) phases for the dilute solutions commonly encountered in environmental settings.

A semi-quantitative assessment of mobility has been developed (Laskowski, 1983) that uses water solubility (S), vapor pressure (VP) and the organic carbon partition coefficient (K<sub>OC</sub>). Laskowski defines a mobility index (MI) as:

$$MI = \log((S \times VP)/K_{OC})$$

A scale to evaluate MI is presented by Ford and Gurba (1984):

| <u>Relative MI</u> | <u>Mobility Descriptor</u> |
|--------------------|----------------------------|
| MI > 5             | extremely mobile           |
| 0 < MI < 5         | very mobile                |
| -5 < MI < 0        | slightly mobile            |
| -10 < MI < -5      | immobile                   |
| MI < -10           | very immobile              |

#### **4.5.2 Prevalence**

Frequency of detection and PCOC concentrations in various environmental media are parameters that characterize the extent of constituents. Constituents which are detected at a low percentage of sampling locations are not considered prevalent but are still included in the risk assessment. In this report, only those constituents of concern that were not detected in any of the sampled media are not retained for quantitative evaluation.

#### **4.6 Identification of Potential Constituents of Concern**

This section identifies potential constituents of concern (PCOCs) for the J.H. Baxter and Company wood preserving facility based on the analytical results of the Phase II RI. Four environmental media were investigated during the Phase II RI: soil, groundwater, and offsite ditch surface water and sediments. The first part of this section discusses criteria used in selecting PCOCs for evaluation. The second part of the section applies these criteria to select PCOCs for the site.

##### **4.6.1 Criteria for Selecting PCOCs**

PCOCs are site-related constituents used to quantitatively estimate potential human exposures. Site PCOCs were selected based first on prevalence, then criteria such as toxicity, mobility, and persistence. Analytical data from sampled media are evaluated using these criteria and PCOCs are either screened or retained for quantitative evaluation.

In addition to these compound-specific characteristics, results were compared with current established criteria for a specific compound in groundwater (Maximum Contaminant Levels/Maximum Contaminant Level Goals--MCLs/MCLGs), surface water (Oregon Water Quality Criteria), and other media where available.

#### **4.6.2 Selection of Potential Constituents of Concern**

Only those compounds detected in all media will be discussed in the following sections. The compounds which were not detected in onsite and offsite surface soils, offsite groundwater, offsite sediment and offsite surface water and therefore eliminated from further assessment are:

- o phenol
- o 2-nitrophenol
- o 2,4-dimethylphenol

The minimum and maximum concentrations detected in the compounds retained within each media sampled, their frequency of detection, detection limits and the location of the maximum concentration for individual compounds are summarized in Tables 4-2 through 4-6. The analytical data for individual samples from all media are summarized in tables in Section 2.0 of this report.

#### **4.7 Identification of Potential Sources and Exposure Pathways**

Potential exposure pathways are routes through which PCOCs may migrate from a source to a receptor. Potential exposure to a PCOC is dependent upon the existence of a reasonable exposure pathway. These pathways require four components: 1) a source; 2) the release of a PCOC from a source and subsequent migration through environmental media; 3) contact between a potential receptor and the medium; and 4) uptake by the receptor.

This section discusses the stages leading to potential human exposures from PCOCs identified in Section 4.6. It begins by establishing processes for the migration of PCOCs from one medium to another, or from one point to another within a medium. Next, the potential human and environmental receptors and exposure pathways are identified and subjected to detailed evaluation.

**TABLE 4-2**  
**Offsite Groundwater Analytical Data Summary**

| Compounds                            | Sample<br>Quantitation<br>limit<br>ug/L | Minimum<br>Detected<br>Value<br>ug/L | Maximum<br>Detected<br>Value<br>ug/L | Location of<br>Maximum<br>Detected<br>Value<br>ug/L | Frequency<br>of<br>Detection | Percent<br>Frequency<br>of<br>Detection |
|--------------------------------------|-----------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------------------------|------------------------------|-----------------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                                         |                                      |                                      |                                                     |                              |                                         |
| Naphthalene                          | 2.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Acenaphthylene                       | 2.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Acenaphthene                         | 2.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Fluorene                             | 0.2                                     | 0.589                                | 0.589                                | W-18BI                                              | 1/7                          | 14.3%                                   |
| Phenanthrene                         | 0.5                                     | 0.104                                | 0.161                                | W-17AI                                              | 3/7                          | 42.9%                                   |
| Anthracene                           | 0.5                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Fluoranthene                         | 0.2                                     | 0.329                                | 0.329                                | W-18BI                                              | 1/7                          | 14.3%                                   |
| Pyrene                               | 0.2                                     | 0.522                                | 0.522                                | W-18BI                                              | 1/7                          | 14.3%                                   |
| Benzo(g,h,i)perylene                 | 0.1                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| <b>Potentially Carcinogenic PAHs</b> |                                         |                                      |                                      |                                                     |                              |                                         |
| Chrysene                             | 0.2                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Benzo(a)anthracene                   | 0.0                                     | 0.029                                | 0.029                                | W-18BI                                              | 1/7                          | 14.3%                                   |
| Benzo(b)fluoranthene                 | 0.0                                     | 0.045                                | 0.045                                | W-18BI                                              | 1/7                          | 14.3%                                   |
| Benzo(k)fluoranthene                 | 0.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Benzo(a)pyrene                       | 0.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Dibenzo(a,h)anthracene               | 0.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Indeno(1,2,3-cd)pyrene               | 0.1                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| <b>Phenolic Compounds</b>            |                                         |                                      |                                      |                                                     |                              |                                         |
| Phenol                               | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2-Chlorophenol                       | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2-Nitrophenol                        | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2,4-Dimethylphenol                   | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2,4-Dichlorophenol                   | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 4-Chloro-3-Methylphenol              | 0.5-1                                   | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2,4,6-Trichlorophenol                | 1.0                                     | 1.2                                  | 1.2                                  | W-19AS                                              | 1/7                          | 14.3%                                   |
| 2,4-Dinitrophenol                    | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 4-Nitrophenol                        | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2,3,5,6-Tetrachlorophenol            | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 2-Methyl-4,6-Dinitrophenol           | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Pentachlorophenol                    | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| <b>Metals (total)</b>                |                                         |                                      |                                      |                                                     |                              |                                         |
| Arsenic                              | 10.0                                    | 1.4                                  | 1.4                                  | W-17AS                                              | 1/7                          | 14.3%                                   |
| Chromium                             | 10.0                                    | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Copper                               | 30.0                                    | 8.0                                  | 8.0                                  | W-16AS                                              | 1/7                          | 14.3%                                   |
| Zinc                                 | 20.0                                    | 6.0                                  | 400.0                                | W-18BI                                              | 6/7                          | 85.7%                                   |
| <b>Volatile Compounds</b>            |                                         |                                      |                                      |                                                     |                              |                                         |
| 1,3-dichlorobenzene                  | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 1,4-dichlorobenzene                  | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| 1,2-dichlorobenzene                  | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Benzene                              | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Ethyl benzene                        | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Toluene                              | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |
| Chlorobenzene                        | 1.0                                     | -                                    | -                                    | -                                                   | 0/7                          | 0.0%                                    |

NOTE: Offsite data from wells include W-16AS,W-16AI,W-17AS,W-17AI,W-18BI and W-19AS.  
 "-" indicates compound not detected. Most recent data from each well is presented (May/92 or Feb/94)

**TABLE 4-3**  
**Onsite Soil Analytical Data Summary**

| Compounds                            | Range of<br>Adjusted<br>Sample<br>Quantitation<br>limit<br>ug/kg | Minimum<br>Detected<br>Value<br>ug/kg | Maximum<br>Detected<br>Value<br>ug/kg | Location with<br>Maximum<br>Detected<br>Value<br>ug/kg | Frequency<br>of<br>Detection | Percent<br>Frequency<br>of<br>Detection |
|--------------------------------------|------------------------------------------------------------------|---------------------------------------|---------------------------------------|--------------------------------------------------------|------------------------------|-----------------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Naphthalene                          | 76-4600                                                          | 87.2                                  | 421.0                                 | B-26                                                   | 5/27                         | 18.5%                                   |
| Acenaphthylene                       | 76-4600                                                          | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| Acenaphthene                         | 73-2300                                                          | 112.0                                 | 7310.0                                | B-11                                                   | 5/27                         | 18.5%                                   |
| Fluorene                             | 7.3-230                                                          | 11.1                                  | 5440.0                                | B-11                                                   | 12/27                        | 44.4%                                   |
| Phenanthrene                         | 3.7-4.4                                                          | 5.5                                   | 19700.0                               | B-11                                                   | 23/27                        | 85.2%                                   |
| Anthracene                           | 3.7-120                                                          | 4.6                                   | 2420.0                                | B-7                                                    | 13/27                        | 48.1%                                   |
| Fluoranthene                         | 7.4-8.8                                                          | 24.7                                  | 13200.0                               | B-7                                                    | 22/27                        | 81.5%                                   |
| Pyrene                               | 7.4-87                                                           | 12.0                                  | 15000.0                               | B-7                                                    | 22/27                        | 81.5%                                   |
| Benzo(g,h,i,)perylene                | 1.9-2.4                                                          | 2.1                                   | 3490.0                                | B-11                                                   | 25/27                        | 92.6%                                   |
| <b>Potentially Carcinogenic PAHs</b> |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Chrysene                             | 5.5-62                                                           | 13.5                                  | 30700.0                               | B-11                                                   | 23/27                        | 85.2%                                   |
| Benzo(a)anthracene                   | .76-8.7                                                          | 3.7                                   | 14300.0                               | B-11                                                   | 24/27                        | 88.9%                                   |
| Benzo(b)fluoranthene                 | 0.7                                                              | 1.3                                   | 13100.0                               | B-11                                                   | 27/27                        | 100.0%                                  |
| Benzo(k)fluoranthene                 | .74-8.7                                                          | 1.1                                   | 3960.0                                | B-11                                                   | 23/27                        | 85.2%                                   |
| Benzo(a)pyrene                       | .76-8.7                                                          | 2.6                                   | 4440.0                                | B-11                                                   | 24/27                        | 88.9%                                   |
| Dibenzo(a,h)anthracene               | 1.1-33                                                           | 12.8                                  | 15200.0                               | B-11                                                   | 15/27                        | 55.5%                                   |
| Indeno(1,2,3-cd)pyrene               | 1.9-21                                                           | 2.8                                   | 4520.0                                | B-11                                                   | 23/27                        | 85.2%                                   |
| <b>Phenolic Compounds</b>            |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Phenol                               | 18-187                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2-Chlorophenol                       | 18-187                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2-Nitrophenol                        | 18-187                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2,4-Dimethylphenol                   | 18-187                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2,4-Dichlorophenol                   | 18-187                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 4-Chloro-3-Methylphenol              | 18-187                                                           | 56                                    | 56                                    | B-10                                                   | -                            | -                                       |
| 2,4,6-Trichlorophenol                | 34-362                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2,4-Dinitrophenol                    | 34-2130                                                          | 362                                   | 362                                   | B-13                                                   | 1/27                         | 3.7%                                    |
| 4-Nitrophenol                        | 34-362                                                           | -                                     | -                                     | -                                                      | 0/27                         | 0.0%                                    |
| 2,3,5,6-Tetrachlorophenol            | 34-213                                                           | 8110                                  | 21500                                 | B-7                                                    | 2/27                         | 7.4%                                    |
| 2-Methyl-4,6-Dinitrophenol           | 34-2130                                                          | 173                                   | 173                                   | B-20                                                   | 1/27                         | 3.7%                                    |
| Pentachlorophenol                    | 34-207                                                           | 1930                                  | 182000                                | B-11                                                   | 3/27                         | 12.1%                                   |
| <b>Metals</b>                        |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Arsenic                              | 1000                                                             | 2240                                  | 2390000                               | B-20                                                   | 27/27                        | 100.0%                                  |
| Chromium                             | 1000                                                             | 10200                                 | 468000                                | B-20                                                   | 27/27                        | 100.0%                                  |
| Copper                               | 2500                                                             | 22900                                 | 4090000                               | B-20                                                   | 27/27                        | 100.0%                                  |
| Zinc                                 | 2000                                                             | 25900                                 | 1790000                               | B-20                                                   | 27/27                        | 100.0%                                  |
| <b>Volatile Compounds</b>            |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Benzene                              | 21-27                                                            | 25.0                                  | 73.0                                  | B-28                                                   | 6/27                         | 22.2%                                   |
| Toluene                              | 21-27                                                            | 24.0                                  | 250.0                                 | B-13                                                   | 10/27                        | 37.0%                                   |
| Chlorobenzene                        | 21-27                                                            | 31.0                                  | 224.0                                 | B-11                                                   | 4/27                         | 14.8%                                   |
| Ethylbenzene                         | 21-27                                                            | 24.0                                  | 36.0                                  | B-14                                                   | 5/27                         | 18.5%                                   |
| Xylenes                              | 31-40                                                            | 32.0                                  | 123.0                                 | B-14                                                   | 11/27                        | 40.7%                                   |
| Styrene                              | 31-40                                                            | 96.0                                  | 96.0                                  | B-11                                                   | 1/27                         | 3.7%                                    |
| <b>Dioxin/Furans</b>                 |                                                                  |                                       |                                       |                                                        |                              |                                         |
| 2,3,7,8-TCDD Equivalents**           | 2.3-27.8*                                                        | 13                                    | 150                                   | B-23                                                   | 3/3                          | 100.0%                                  |

NOTE: "-" indicates compound not detected. "\*" range for individual dioxin/furan compounds.

\*\*\* dioxin/furans expressed as a total equivalent concentration of 2,3,7,8-TCDD in parts per trillion (PPT).

**TABLE 4-4**  
**Offsite Soil Analytical Data Summary**

| Compounds                            | Range of<br>Adjusted<br>Sample<br>Quantitation<br>limit<br>ug/kg | Minimum<br>Detected<br>Value<br>ug/kg | Maximum<br>Detected<br>Value<br>ug/kg | Location with<br>Maximum<br>Detected<br>Value<br>ug/kg | Frequency<br>of<br>Detection | Percent<br>Frequency<br>of<br>Detection |
|--------------------------------------|------------------------------------------------------------------|---------------------------------------|---------------------------------------|--------------------------------------------------------|------------------------------|-----------------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Naphthalene                          | 70                                                               | 78.4                                  | 108.0                                 | SS-2/SS-8                                              | 3/10                         | 30.0%                                   |
| Acenaphthylene                       | 70                                                               | 77.7                                  | 77.7                                  | SS-9                                                   | 1/10                         | 10.0%                                   |
| Acenaphthene                         | 70                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Fluorene                             | 7                                                                | 7.2                                   | 23.3                                  | SS-2                                                   | 2/10                         | 10.0%                                   |
| Phenanthrene                         | 3.5                                                              | 4.8                                   | 145.0                                 | SS-2                                                   | 9/10                         | 90.0%                                   |
| Anthracene                           | 3.5                                                              | 3.9                                   | 17.1                                  | SS-9                                                   | 3/10                         | 30.0%                                   |
| Fluoranthene                         | 7                                                                | 8.2                                   | 256.0                                 | SS-2                                                   | 9/10                         | 90.0%                                   |
| Pyrene                               | 7                                                                | 8.7                                   | 94.5                                  | SS-2                                                   | 6/10                         | 60.0%                                   |
| Benzo(g,h,i)perylene                 | 1.7                                                              | 4.5                                   | 54.0                                  | SS-2                                                   | 5/10                         | 50.0%                                   |
| <b>Potentially Carcinogenic PAHs</b> |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Chrysene                             | 5                                                                | 5.5                                   | 113.0                                 | SS-2                                                   | 7/10                         | 70.0%                                   |
| Benzo(a)anthracene                   | 1.7                                                              | 2.2                                   | 77.6                                  | SS-2                                                   | 10/10                        | 100.0%                                  |
| Benzo(b)fluoranthene                 | 1.7                                                              | 1.9                                   | 72.9                                  | SS-2                                                   | 10/10                        | 100.0%                                  |
| Benzo(k)fluoranthene                 | .7                                                               | 1.3                                   | 74.2                                  | SS-2                                                   | 8/10                         | 80.0%                                   |
| Benzo(a)pyrene                       | .7                                                               | 1.2                                   | 50.8                                  | SS-2                                                   | 10/10                        | 100.0%                                  |
| Dibenzo(a,h)anthracene               | 1                                                                | 3.2                                   | 36.1                                  | SS-2                                                   | 9/10                         | 90.0%                                   |
| Indeno(1,2,3-cd)pyrene               | 1.7                                                              | 2.1                                   | 109.0                                 | SS-2                                                   | 9/10                         | 90.0%                                   |
| <b>Phenolic Compounds</b>            |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Phenol                               | 17                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 2-Chlorophenol                       | 17                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 2-Nitrophenol                        | 17                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 2,4-Dimethylphenol                   | 17                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 2,4-Dichlorophenol                   | 17                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 4-Chloro-3-Methylphenol              | 17                                                               | 32.0                                  | 32.0                                  | SS-2                                                   | 1/10                         | 10.0%                                   |
| 2,4,6-Trichlorophenol                | 33                                                               | 245.0                                 | 245.0                                 | SS-4                                                   | 1/10                         | 10.0%                                   |
| 2,4-Dinitrophenol                    | 33                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 4-Nitrophenol                        | 33                                                               | 51.0                                  | 51.0                                  | SS-1                                                   | 1/10                         | 10.0%                                   |
| 2,3,5,6-Tetrachlorophenol            | 33                                                               | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 2-Methyl-4,6-Dinitrophenol           | 33                                                               | 64.0                                  | 64.0                                  | SS-1                                                   | 1/10                         | 10.0%                                   |
| Pentachlorophenol                    | 33-330                                                           | 104.0                                 | 550.0                                 | SS-2                                                   | 2/10                         | 20.0%                                   |
| <b>Metals</b>                        |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Arsenic                              | 1000 - 5000                                                      | 3000                                  | 7000                                  | SS-5                                                   | 6/10                         | 60.0%                                   |
| Chromium                             | 1000                                                             | 4000                                  | 45600                                 | SS-2                                                   | 10/10                        | 100.0%                                  |
| Copper                               | 2500                                                             | 8540                                  | 47500                                 | SS-9                                                   | 10/10                        | 100.0%                                  |
| Zinc                                 | 2500                                                             | 24100                                 | 440000                                | SS-2                                                   | 10/10                        | 100.0%                                  |
| <b>Volatile Compounds</b>            |                                                                  |                                       |                                       |                                                        |                              |                                         |
| Benzene                              | 20-200                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Toluene                              | 20-200                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Chlorobenzene                        | 20-200                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Ethylbenzene                         | 20-200                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Xylenes                              | 30-300                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| Styrene                              | 30-300                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 1,3-Dichlorobenzene                  | 40-400                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 1,4-Dichlorobenzene                  | 40-400                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |
| 1,2-Dichlorobenzene                  | 40-400                                                           | -                                     | -                                     | -                                                      | 0/10                         | 0.0%                                    |

NOTE: "-" Indicates Not Detected



**TABLE 4-5**  
**Offsite Sediment Analytical Data Summary**  
(SD-8, Duplicate SD-8, SD-9, SD-10, SD-11)

| Compounds                            | Sample<br>Quantitation<br>limit<br>ug/Kg | Minimum<br>Detected<br>Value<br>ug/Kg | Maximum<br>Detected<br>Value<br>ug/Kg | Location with<br>Maximum<br>Detected<br>Value<br>ug/Kg | Frequency<br>of<br>Detection | Percent<br>Frequency<br>of<br>Detection |
|--------------------------------------|------------------------------------------|---------------------------------------|---------------------------------------|--------------------------------------------------------|------------------------------|-----------------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                                          |                                       |                                       |                                                        |                              |                                         |
| Naphthalene                          | 70.0                                     | 105.0                                 | 160.0                                 | SD-8                                                   | 3/5                          | 60.0%                                   |
| Acenaphthylene                       | 70.0                                     | 106.0                                 | 145.0                                 | SD-9                                                   | 2/5                          | 40.0%                                   |
| Acenaphthene                         | 70.0                                     | 140.0                                 | 252.0                                 | SD-8                                                   | 2/5                          | 40.0%                                   |
| Fluorene                             | 7.0                                      | 14.7                                  | 24.1                                  | SD-8                                                   | 3/5                          | 60.0%                                   |
| Phenanthrene                         | 3.5                                      | 13.2                                  | 57.1                                  | SD-8                                                   | 3/5                          | 60.0%                                   |
| Anthracene                           | 3.5                                      | 6.2                                   | 23.2                                  | SD-8                                                   | 3/5                          | 60.0%                                   |
| Fluoranthene                         | 7.0                                      | 31.3                                  | 86.3                                  | SD-8                                                   | 3/5                          | 60.0%                                   |
| Pyrene                               | 7.0                                      | 8.2                                   | 203.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Benzo(g,h,i)perylene                 | 1.7                                      | 2.9                                   | 165.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| <b>Potentially Carcinogenic PAHs</b> |                                          |                                       |                                       |                                                        |                              |                                         |
| Chrysene                             | 5.0                                      | 9.2                                   | 509.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Benzo(a)anthracene                   | 1.7                                      | 1.5                                   | 64.9                                  | SD-8                                                   | 5/5                          | 100.0%                                  |
| Benzo(b)fluoranthene                 | 1.7                                      | 4.1                                   | 124.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Benzo(k)fluoranthene                 | 0.7                                      | 18.2                                  | 36.4                                  | SD-8                                                   | 5/5                          | 100.0%                                  |
| Benzo(a)pyrene                       | 0.7                                      | 1.2                                   | 126.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Dibenzo(a,h)anthracene               | 1.0                                      | 8.8                                   | 362.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Indeno(1,2,3-cd)pyrene               | 0.7                                      | 2.4                                   | 104.0                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| <b>Phenolic Compounds</b>            |                                          |                                       |                                       |                                                        |                              |                                         |
| Phenol                               | 170                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2-Chlorophenol                       | 170                                      | 1320                                  | 1900                                  | SD-8                                                   | 2/5                          | 40.0%                                   |
| 2-Nitrophenol                        | 170                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2,4-Dimethylphenol                   | 170                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2,4-Dichlorophenol                   | 170                                      | 210                                   | 530                                   | SD-9                                                   | 3/5                          | 60.0%                                   |
| 4-Chloro-3-Methylphenol              | 170                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2,4,6-Trichlorophenol                | 330                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2,4-Dinitrophenol                    | 330                                      | 420                                   | 420                                   | SD-11                                                  | 1/5                          | 20.0%                                   |
| 4-Nitrophenol                        | 330                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2,3,5,6-Tetrachlorophenol            | 330                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 2-Methyl-4,6-Dinitrophenol           | 330                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| Pentachlorophenol                    | 330                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| <b>Metals</b>                        |                                          |                                       |                                       |                                                        |                              |                                         |
| Arsenic                              | 1000                                     | 6240                                  | 104000                                | SD-8                                                   | 5/5                          | 100.0%                                  |
| Chromium                             | 1000                                     | 13300                                 | 25500                                 | SD-8                                                   | 5/5                          | 100.0%                                  |
| Copper                               | 2500                                     | 19600                                 | 479000                                | SD-8                                                   | 5/5                          | 100.0%                                  |
| Zinc                                 | 2500                                     | 46100                                 | 178000                                | SD-8                                                   | 5/5                          | 100.0%                                  |
| <b>Volatile Compounds</b>            |                                          |                                       |                                       |                                                        |                              |                                         |
| Benzene                              | 0.2                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| Toluene                              | 0.2                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| Ethyl benzene                        | 0.2                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| Xylenes                              | 0.3                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| Styrene                              | 0.3                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 1,3-Dichlorobenzene                  | 0.4                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 1,4-Dichlorobenzene                  | 0.4                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |
| 1,2-Dichlorobenzene                  | 0.4                                      | -                                     | -                                     | -                                                      | 0/5                          | 0.0%                                    |

NOTE: "-" indicates compound not detected.

**TABLE 4-6**  
**Offsite Surface Water Analytical Data Summary**  
(SW-8, Duplicate SW-8, SW-9, SW-10, SW-11)

| Compounds                            | Range of Sample Quantitation limit ug/L | Minimum Detected Value ug/L | Maximum Detected Value ug/L | Location with Maximum Detected Value ug/L | Frequency of Detection | Percent Frequency of Detection |
|--------------------------------------|-----------------------------------------|-----------------------------|-----------------------------|-------------------------------------------|------------------------|--------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                                         |                             |                             |                                           |                        |                                |
| Naphthalene                          | 2-4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Acenaphthylene                       | 2-4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Acenaphthene                         | 2-4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Fluorene                             | 0.2-0.4                                 | 0.481                       | 0.481                       | SW-8                                      | 1/5                    | 20.0%                          |
| Phenanthrene                         | 0.1-0.2                                 | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Anthracene                           | 0.1-0.2                                 | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Fluoranthene                         | 0.400                                   | 0.322                       | 0.416                       | SW-8                                      | 2/5                    | 40.0%                          |
| Pyrene                               | 0.400                                   | 0.429                       | 0.503                       | SW-8                                      | 3/5                    | 60.0%                          |
| Benzo(g,h,i)perylene                 | 0.100                                   | 0.133                       | 0.394                       | SW-8                                      | 4/5                    | 80.0%                          |
| <b>Potentially Carcinogenic PAHs</b> |                                         |                             |                             |                                           |                        |                                |
| Chrysene                             | 0.300                                   | 0.273                       | 0.273                       | SW-9                                      | 1/5                    | 20.0%                          |
| Benzo(a)anthracene                   | 0.040                                   | 0.074                       | 0.251                       | SW-8                                      | 4/5                    | 80.0%                          |
| Benzo(b)fluoranthene                 | 0.040                                   | 0.078                       | 0.528                       | SW-8                                      | 5/5                    | 100.0%                         |
| Benzo(k)fluoranthene                 | 0.040                                   | 0.094                       | 0.124                       | SW-8                                      | 3/5                    | 60.0%                          |
| Benzo(a)pyrene                       | 0.040                                   | 0.094                       | 0.361                       | SW-8                                      | 5/5                    | 100.0%                         |
| Dibenzo(a,h)anthracene               | 0.060                                   | 0.333                       | 1.120                       | SW-8                                      | 4/5                    | 80.0%                          |
| Indeno(1,2,3-cd)pyrene               | 0.100                                   | 0.105                       | 0.221                       | SW-8                                      | 4/5                    | 80.0%                          |
| <b>Phenolic Compounds</b>            |                                         |                             |                             |                                           |                        |                                |
| Phenol                               | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2-Chlorophenol                       | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2-Nitrophenol                        | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2,4-Dimethylphenol                   | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2,4-Dichlorophenol                   | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 4-Chloro-3-Methylphenol              | 0.5-1                                   | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2,4,6-Trichlorophenol                | 1-2                                     | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2,4-Dinitrophenol                    | 1-2                                     | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 4-Nitrophenol                        | 1-2                                     | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| 2,3,5,6-Tetrachlorophenol            | 2.0                                     | 1.8                         | 7.2                         | SW-8                                      | 3/4                    | 75.0%                          |
| 2-Methyl-4,6-Dinitrophenol           | 1-2                                     | -                           | -                           | -                                         | 0/4                    | 0.0%                           |
| Pentachlorophenol                    | 2.0                                     | 26.0                        | 266.0                       | SW-8                                      | 4/4                    | 100.0%                         |
| <b>Metals (total)</b>                |                                         |                             |                             |                                           |                        |                                |
| Arsenic                              | 10.0                                    | 28.4                        | 86.6                        | SW-9                                      | 5/5                    | 100.0%                         |
| Chromium                             | 10.0                                    | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Copper                               | 25.0                                    | 28.0                        | 253.0                       | SW-9                                      | 5/5                    | 100.0%                         |
| Zinc                                 | 20.0                                    | 67.7                        | 140.0                       | SW-9                                      | 5/5                    | 100.0%                         |
| <b>Volatile Compounds</b>            |                                         |                             |                             |                                           |                        |                                |
| Benzene                              | 0.2                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Toluene                              | 0.5                                     | 0.3                         | 0.6                         | SW-8/SW-9                                 | 5/5                    | 100.0%                         |
| Chlorobenzene                        | 0.2                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| Ethylbenzene                         | 0.2                                     | 0.2                         | 0.6                         | SW-8                                      | 3/5                    | 60.0%                          |
| Xylenes                              | 0.3                                     | 0.6                         | 0.9                         | SW-8                                      | 2/5                    | 40.0%                          |
| Styrene                              | 0.3                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| 1,3-Dichlorobenzene                  | 0.4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| 1,4-Dichlorobenzene                  | 0.4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |
| 1,2-Dichlorobenzene                  | 0.4                                     | -                           | -                           | -                                         | 0/5                    | 0.0%                           |

NOTE: "-" indicates compound not detected.



#### 4.7.1 Potential Sources and Migration Routes

The migration of PCOCs associated with the historical operation of the wood preserving facility can potentially occur by the following routes:

- o Downward migration of PCOCs from surface and subsurface soils to groundwater bearing zones and subsequent off-site migration;
- o Surface water runoff to the retention pond and subsequent offsite migration via the drainage ditch located along the southern boundary of the site;
- o Migration of windblown dust;

This section presents a qualitative discussion of the projected long-term environmental fate and distribution of the site associated PCOCs, from the perspective of potential human exposure.

#### **Volatile Organic Compounds**

VOCs tend to be relatively mobile in the environment. This fact is reflected in their moderate to high water solubilities, high vapor pressures, low  $K_{ow}$  and  $K_{oc}$  values, and high mobility indices. VOCs were present in the onsite surface soils and could potentially migrate offsite in the groundwater or by wind blown dust. In groundwater VOC concentrations can be expected to decrease due to volatilization, dispersion, chemical reactions such as biodegradation and physical reactions such as adsorption onto the organic component of subsurface soils. VOCs have not been detected in the offsite groundwater and with the addition of the interim groundwater pump and treat system groundwater will be prevented from migrating offsite.

### **Phenolic Compounds**

Pentachlorophenol (PCP) is a primary constituent of concern at the site and a known process related compound. PCP was chosen to represent the fate and transport of the phenolics. Phenolic compounds (represented by PCP) could potentially be released to the environment from onsite soils by dissolution, leaching, and by erosion of soils from wind and rain. The environmental mobility of phenolics tends to be less than that of VOCs.

Phenolic compounds are fairly soluble in aqueous solution. Phenolics will dissociate in aqueous solution, depending on the solution pH. Low pH enhances their solubility. Under mildly acidic to neutral groundwater conditions (pH 5.6-7.0), the phenolics will dissociate moderately and could potentially be transported as solutes by groundwater advection. As with the VOCs, solution concentrations may be reduced because of retardation from adsorption processes and hydrodynamic dispersion during transport. Surface water concentrations will be reduced along the ditch by adsorption and dilution. Low Henry's Law Constant values indicate that volatilization from soils and waters will not be appreciable.

### **Polycyclic Aromatic Hydrocarbons (PAHs)**

Generally, PAHs will not migrate appreciable distances through groundwater or surface waters as solutes. Low water solubilities, high  $K_{ow}$ 's and  $K_{oc}$ 's indicate a strong tendency for adsorption. Their mobility indices indicate that they are essentially immobile from a physical-chemical standpoint. Exceptions are naphthalene, methylnaphthalene and anthracene, which are slightly mobile in solution (groundwater and surface water) due to higher water solubilities compared to other PAHs.

PAHs, except naphthalene, anthracene and methylnaphthalene lack sufficient vapor pressures to be transmitted via vaporization and subsequent airborne transport. However, shallow surface soil particles containing adsorbed PAHs could potentially be subject to airborne transport and deposition.

## **Metals**

Metals are found as solid complexes at normal temperature and pressure conditions such as those present in soils at the site. Metal ions exist in pure solutions as hydrated ions. However, saturated groundwater, as opposed to a pure solution, is a highly complex geochemical system which is heavily influenced by the geo-minerology of the soil matrix. Most metals have fairly limited mobility in soil and groundwater because of ion exchange or sorption onto the surface of mineral grains, particularly clay minerals. They can also form precipitates of varying solubility under specific conditions. Conditions that promote mobility include an acidic, sandy soil with low organic and clay content. Metals may also be mobile if attached to a mobile colloid (fine grained particles with electrostatic surface charges, eg. clay minerals).

Transport of metallic species in groundwater is mainly a function of the metal's solubility in solution under the conditions in the soil-solution matrix. The metal must be dissolved (i.e., in solution) for leaching and transport by advection with the groundwater to occur. Generally, dynamic and reversible processes control solubility and transport of the dissolved metal ions. Such processes include precipitation/dissolution, adsorption/desorption, and ion exchange.

## **Dioxins/Furans**

The physical and chemical properties of dioxin and furans are similar to the properties of heavier PAHs. They will not migrate appreciable distances through groundwater or surface waters as solutes. Low water solubilities, high  $K_{ow}$ 's and  $K_{oc}$ 's indicate a strong tendency for adsorption. Dioxins and furans have low vapor pressures. Transport via air or surface water of soil particles containing adsorbed dioxins and furans is a primary migration mechanism.

#### **4.7.2 Potential Human Receptors and Exposure Pathways**

In choosing potential human receptor groups, exposure scenarios are developed by considering information relevant to the site, such as land use of both the site and the surrounding area. These scenarios comprise potential exposure to soils, groundwater, surface water/sediment, and air.

The following are the potential human receptors assessed in the quantitative public health risk analysis presented in Section 4.6:

- o on-site workers;
- o nearby residents (adult and child)- exposure to PCOCs originating from the site.

The various exposure scenarios for the offsite residents and onsite workers to PCOCs associated with the site are presented below.

##### **Onsite Workers**

The onsite workers exposure to site PCOCs will be quantitatively assessed for two potential exposure scenarios. These are:

- o incidental ingestion of PCOCs in onsite surface soils;
- o inhalation of airborne particulates carrying PCOCs from onsite surface soils.

Fugitive dust emissions on the plant site may result from wind erosion of surface soils. PCOCs adhering to these airborne soil particles may be inhaled by onsite workers. Dermal contact and subsequent incidental ingestion of soils is a potential exposure route for site workers.

As in the Phase I PHRA, dermal exposure to onsite soils for onsite workers was not retained as a potential pathway. Onsite workers are required to wear long pants,

long sleeved shirts and gloves while they work in the site yard. Dermal exposure is therefore minimized to contact of airborne soil with the face skin, a contact which would not result in significant intake. The plant also has a dust control program to minimize workers exposure to dust on the site.

Groundwater and vapors from surface soils are not considered as exposure for onsite workers. The concentration of volatile organics in the surface soils are very low (all VOCs less than 1 ppm).

### **Residents**

Potential PCOC exposure to nearby residents will be evaluated for the following pathways:

- o dermal exposure to PCOCs in offsite groundwater;
- o ingestion and dermal exposure to PCOCs in offsite surface soils;
- o inhalation of airborne particulates carrying PCOCs from onsite surface soils;
- o dermal exposure and ingestion of PCOCs in offsite surface waters; and
- o dermal exposure and ingestion of PCOCs in offsite sediments.

Exposure to groundwater PCOCs by ingestion or inhalation are not considered relevant exposure pathways in this PHRA, since all local offsite residents are now connected to City water. Dermal exposure to groundwater may still occur, as residents may continue to use well water for the irrigation of their lawns.

Recently, a groundwater pump and treat system was constructed on the site to prevent contaminated groundwater from migrating offsite. Therefore, for this PHRA onsite groundwater data is not considered relevant to the assessment of the offsite residents. Offsite groundwater data obtained from the Phase II wells is used to determine offsite dermal risk from groundwater.

Exposure to PCOCs for human receptors by ingestion and dermal contact with offsite soils has been retained for assessment. In order to evaluate these exposure pathways offsite surface soils samples were collected during the Phase II RI.

The drainage ditch which carries the facility's surface runoff water is not sufficient to support fishing or swimming activities. The ditch could, however, be used by children as a play area. Hence, the potential exists for dermal contact to both surface water and sediment.

Another potential exposure pathway includes the ingestion of fish and water in a receiving water body downstream of the surface water drainage course discharge. Insufficient data are available to quantitatively assess this migration route. However, this pathway will be retained for qualitative assessment.

#### **4.8 Risk Assessment**

This section presents and discusses the quantitative risks to the human receptors identified in Section 4.7. The risks were estimated for the retained PCOCs according to the receptor characteristics and the exposure pathways defined previously. The risks are presented as hazard indices (HI) for noncarcinogenic compounds and as risk levels (RL) for carcinogenic compounds.

Risk level is calculated as the dose (chemical intake) multiplied by the Cancer Slope Factor (CSF):

$$RL = \text{Dose} \times \text{CSF} \quad (\text{eq. 4.1})$$

The hazard index is calculated as the dose divided by the Reference Dose (RfD) for a particular chemical:

$$HI = \text{Dose} / \text{RfD} \quad (\text{eq. 4.2})$$

A dose is defined as the mass of a compound (mg) taken in per day by a receptor (per kg of body weight). Doses can be calculated for a lifetime exposure (for



carcinogenic effects) or for chronic/subchronic exposures (noncarcinogenic effects).

A dose is generally estimated as follows:

$$\text{Dose} = \frac{C \times CR \times EFD}{BW} \times \frac{1}{AT} \quad (\text{eq. 4.3})$$

Where:

Dose = intake; the amount of chemical at the exchange boundary (mg/kg body weight-day)

C = chemical concentration; the average concentration contacted over the exposure period (e.g., mg/liter water)

CR = contact rate; the amount of contaminated medium contacted per unit time or event (e.g., liters/day)

EFD = exposure frequency and durations; describes how long and how often exposure occurs. Often calculated using two terms (EF and ED), where:

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight; the average body weight (kg)

AT = averaging time; period over which exposure is averaged (days)

In determining chemical intake doses for the deterministic and stochastic approaches, the 95% UCL of the arithmetic mean concentration or the maximum detected concentration for each PCOC was used. The maximum detected concentration was used when the 95% UCL concentration was greater than the maximum detected PCOC concentration. The sample concentrations were assumed

to be lognormally distributed. To calculate the 95% UCL of the arithmetic mean of lognormally distributed concentrations the following equation was used (Gilbert, 1987):

$$95\%UCL = EXP(M + 0.5 \times SD^2 + SD \times H_{95} / (n-1)^{1/2}) \text{ (eq.4.4)}$$

where:

|        |   |                                                                          |
|--------|---|--------------------------------------------------------------------------|
| 95%UCL | = | 95% upper confidence level of arithmetic mean for lognormal distribution |
| M      | = | arithmetic mean of the natural logarithms of PCOC concentrations         |
| SD     | = | standard deviation of the natural logarithm of PCOC concentrations       |
| H95    | = | the H-statistic value for the 95% confidence level                       |
| n      | = | the number of sample concentrations in a data set                        |

Table 4-7 summarizes the PCOC concentrations used to determine the doses for risk levels and hazard indexes. The equations used to determine the overall carcinogenic and noncarcinogenic risks presented by the site, which are the same for the deterministic and stochastic assessments, are discussed below.

4.8.1 Quantification of Carcinogenic Effects

Quantitative risk calculations for potentially carcinogenic compounds estimate risk as the potential excess individual lifetime cancer risk. This estimate is the potential lifetime cancer risk that is over and above the background cancer risk in unexposed individuals. For example, an excess lifetime cancer risk level (RL) of  $1 \times 10^{-6}$  indicates that, for lifetime exposure, one additional case of cancer is expected per one million exposed individuals. The risk level (RL) is compared to maximum acceptable risk levels set by governmental agencies. The U.S. EPA (1989a) recommends a target risk range of  $10^{-4}$  to  $10^{-6}$  which the U.S. EPA considers to be safe and protective of public health. Although this is the target range for the U.S. EPA, it is not necessarily the target range for DEQ.



**TABLE 4-7**  
**Concentrations of Retained PCOCs**  
**used for the Standard and Stochastic**  
**Risk Approaches**

| Compounds                            | Soil<br>Onsite<br>ug/Kg | Soil<br>Offsite<br>ug/Kg | Groundwater<br>Offsite<br>ug/L | Sediment<br>Offsite<br>ug/Kg | Surface Water<br>Offsite<br>ug/L |
|--------------------------------------|-------------------------|--------------------------|--------------------------------|------------------------------|----------------------------------|
| <b>Non Carcinogenic PAHs</b>         |                         |                          |                                |                              |                                  |
| Naphthalene                          | 421.0                   | 84.5                     | 6.39                           | 160.0                        | -                                |
| Acenaphthylene                       | -                       | -                        | -                              | 145.0                        | -                                |
| Acenaphthene                         | 829.1                   | -                        | -                              | 252.0                        | -                                |
| Fluorene                             | 568.5                   | 13.0                     | 0.59                           | 24.1                         | 0.48                             |
| Phenanthrene                         | -                       | -                        | 0.16                           | 57.1                         | -                                |
| Anthracene                           | 854.7                   | 15.4                     | -                              | 23.2                         | -                                |
| Fluoranthene                         | 13200.0                 | 256.0                    | 0.33                           | 86.3                         | 0.42                             |
| Pyrene                               | 15000.0                 | 94.5                     | 0.52                           | 203.0                        | 0.50                             |
| Benzo(g,h,i)perylene                 | -                       | -                        | -                              | 165.0                        | 0.39                             |
| <b>Potentially Carcinogenic PAHs</b> |                         |                          |                                |                              |                                  |
| Chrysene                             | 30700.0                 | 17.6                     | -                              | 509.0                        | 0.27                             |
| Benzo(a)anthracene                   | 14300.0                 | 77.6                     | 0.03                           | 64.9                         | 0.25                             |
| Benzo(b)fluoranthene                 | 13100.0                 | 72.4                     | 0.05                           | 124.0                        | 0.53                             |
| Benzo(k)fluoranthene                 | 3960.0                  | 74.2                     | -                              | 36.4                         | 0.12                             |
| Benzo(a)pyrene                       | 4440.0                  | 50.8                     | -                              | 126.0                        | 0.36                             |
| Dibenzo(a,h)anthracene               | 15200.0                 | 36.1                     | -                              | 362.0                        | 1.12                             |
| Indeno(1,2,3-cd)pyrene               | 4520.0                  | 96.5                     | -                              | 104.0                        | 0.22                             |
| B(a)P (equivalents)                  | 23258                   | 119.1                    | 0.0                            | 526.0                        | 1.59                             |
| <b>Phenolic Compounds</b>            |                         |                          |                                |                              |                                  |
| 2-Chlorophenol                       | -                       | -                        | -                              | 1900.0                       | -                                |
| 2,4-Dichlorophenol                   | -                       | -                        | -                              | 530.0                        | -                                |
| 4-Chloro-3-Methylphenol              | -                       | -                        | -                              | -                            | -                                |
| 2,4,6-Trichlorophenol                | -                       | 83.9                     | 1.20                           | -                            | -                                |
| 2,4-Dinitrophenol                    | 91.3                    | -                        | -                              | 420.0                        | -                                |
| 4-Nitrophenol                        | -                       | -                        | -                              | -                            | -                                |
| 2,3,5,6-Tetrachlorophenol            | -                       | -                        | -                              | -                            | 7.20                             |
| 2-Methyl-4,6-Dinitrophenol           | -                       | -                        | -                              | -                            | -                                |
| Pentachlorophenol                    | 3991.3                  | 545.5                    | -                              | 1.3                          | 266.00                           |
| <b>Metals</b>                        |                         |                          |                                |                              |                                  |
| Arsenic                              | 356997.0                | 7000.0                   | 1.40                           | 104000.0                     | 86.60                            |
| Chromium                             | 46639.0                 | 45600.0                  | -                              | 25500.0                      | -                                |
| Copper                               | -                       | -                        | 8                              | 47900.0                      | 253.00                           |
| Zinc                                 | 220166.3                | 194255.4                 | 400.00                         | 178000.0                     | 140.00                           |
| <b>Volatile Compounds</b>            |                         |                          |                                |                              |                                  |
| Benzene                              | 18.2                    | -                        | -                              | -                            | -                                |
| Toluene                              | 31.1                    | -                        | -                              | -                            | 0.60                             |
| Chlorobenzene                        | -                       | -                        | -                              | -                            | -                                |
| Ethylbenzene                         | 16.1                    | -                        | -                              | -                            | 0.60                             |
| Xylenes                              | 42.2                    | -                        | -                              | -                            | 0.90                             |
| Styrene                              | 20.8                    | -                        | -                              | -                            | -                                |
| <b>Dioxin/furans</b>                 |                         |                          |                                |                              |                                  |
| 2,3,7,8-TCDD Equivalents (PPB)       | 0.15                    | NA                       | NA                             | NA                           | NA                               |

NOTE:

"-" Not detected. NA Not Analyzed.

Concentrations in *italic* are 95% UCL of arithmetic mean.

Other concentrations are maximum detected PCOC concentrations.

Maximum detected PCOC concentrations used when the 95% UCL of arithmetic mean concentration was greater than the maximum detected PCOC concentration.

B(a)P equivalents is equivalent concentration of benzo(a)pyrene for all carcinogenic PAHs.

**KEYSTONE**  
**ENVIRONMENTAL**

For potential carcinogens, the potential excess lifetime cancer risk level (RL) for each potential receptor group can be calculated by multiplying the computed intake for incidental ingestion, dermal absorption, and inhalation for each PCOC, by its respective oral or inhalation cancer slope factors. CSFs are not provided for dermal exposures. The U.S. EPA recommends that the oral CSF be used to characterize dermal risk as shown in the following risk equation (U.S. EPA, 1989a):

$$RL = \sum_i (CSF_{oral(i)} \times CDI_{ing(i)}) + \sum_i (CSF_{oral(i)} \times CDI_{derm(i)}) + \sum_i (CSF_{inh(i)} \times CDI_{inh(i)}) \quad (\text{eq. 4.5})$$

where:

RL = excess lifetime potential cancer risk level for compound *i*, unitless

$CSF_{inh(i)}$  = cancer slope factor for compound *i* for exposure via inhalation  $[(\text{mg/kg/day})^{-1}]$

$CSF_{oral(i)}$  = cancer slope factor for compound *i* for exposure via incidental ingestion,  $[(\text{mg/kg/day})^{-1}]$

$CDI_{ing(i)}$  = chronic daily intake of compound *i* via incidental ingestion (mg/kg/day)

$CDI_{derm(i)}$  = chronic daily intake of compound *i* via dermal contact, (mg/kg/day)

$CDI_{inh(i)}$  = chronic daily intake of compound *i* via inhalation (mg/kg/day).

The cancer slope factor is defined in most instances as an upper 95th percentile confidence limit of the probability of a response based on experimental animal data and the CDI is defined as the exposure expressed as mass of a substance contacted per unit body weight per unit time, averaged over a long period of time (i.e. seven

years to a lifetime). The above equation was derived assuming that cancer is a non-threshold process and that the potential excess risk level is proportional to the cumulative intake over a lifetime.

The above equation is only valid at low risk levels (i.e. below estimated risks of 0.01). When estimated risks are high (i.e. greater than 0.01) the following equation should be used.

$$RL_i = 1 - \exp(-CDI_i \times CSF_i) \quad (\text{eq. 4.6})$$

The carcinogenic compounds retained for quantitative risk analysis and their respective CSFs and weight-of evidence classifications are presented in Table 4-8.

In Table 4-8, only one of the carcinogenic PAH compounds is presented, benzo(a) pyrene. The other carcinogenic PAHs, which include; benzo(a)anthracene, benzo(b) and (k) fluoranthene, indeno (1,2,3-cd) pyrene, chrysene, and dibenzo(a,h)anthracene, do not have CSFs. The standard approach in risk is to equate all carcinogenic PAHs to benzo (a) pyrene using relative potency factors (RPFs). An equivalent concentration of benzo (a) pyrene is determined by summing the individual carcinogenic PAH concentrations multiplied by corresponding RPFs. The RPFs used by DEQ for risk assessment of carcinogenic PAHs are;

- o 0.01 for chrysene,
- o 0.1 for benzo(a)anthracene, benzo (b) and (k) fluoranthene, indeno (1,2,3-cd)pyrene, and
- o 1.0 for dibenzo (a,h) anthracene and benzo (a) pyrene.

The benzo (a) pyrene equivalent concentration is then used to determine the dose estimate and subsequently the corresponding risk level. Therefore, the following sections present the total risks associated with carcinogenic PAHs as benzo(a)pyrene (eq).

TABLE 4-8  
SUMMARY OF PCOC CANCER SLOPE FACTORS  
AND REFERENCE DOSES  
J.H. Baxter and Company  
Wood Preserving Facility  
Eugene, Oregon

| Compound                             | Cancer Slope Factor Oral (1) | Cancer Slope Factor Inhalation (1) | Reference Dose Oral (2) mg/kg/day | Reference Dose Inhalation mg/cubic m | Weight of Evidence Classification (3) | Uncertainty Factor |
|--------------------------------------|------------------------------|------------------------------------|-----------------------------------|--------------------------------------|---------------------------------------|--------------------|
| <b>Volatile Compounds</b>            |                              |                                    |                                   |                                      |                                       |                    |
| Benzene                              | 0.029 (8)                    | NA                                 | NA                                | NA                                   | A                                     | NA                 |
| Ethylbenzene                         | NA                           | NA                                 | 0.1 (8)                           | 1.0 (8)                              | D                                     | 1000               |
| Styrene                              | 0.03 (11)                    | 0.002 (11)                         | 0.2 (9)                           | NA                                   | B2                                    | 1000               |
| Toluene (5)                          | NA                           | NA                                 | 0.2 (9)                           | 0.4 (8)                              | D                                     | 1000               |
| Xylenes                              | NA                           | NA                                 | 2.0 (9)                           | NA                                   | D                                     | 100                |
| <b>Phenolics</b>                     |                              |                                    |                                   |                                      |                                       |                    |
| 2,3,5,6-Tetrachlorophenol            | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| 2,4,6-Trichlorophenol                | 0.011 (8)                    | .011(9)                            | NA                                | NA                                   | B2                                    | NA                 |
| 2,4-Dichlorophenol                   | NA                           | NA                                 | 0.003 (8)                         | NA                                   | D                                     | 100                |
| 2,4-Dimethylphenol                   | NA                           | NA                                 | 0.02 (8)                          | NA                                   | D                                     | 3000               |
| 2,4-Dinitrophenol                    | NA                           | NA                                 | 0.002 (8)                         | NA                                   | D                                     | 1000               |
| 2-Chlorophenol                       | NA                           | NA                                 | 0.005 (8)                         | NA                                   | D                                     | 1000               |
| 2-Methyl-4,6-dinitrophenol           | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| 2-Nitrophenol                        | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| 4-Chloro-3-methylphenol              | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| 4-Nitrophenol                        | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| Pentachlorophenol                    | 0.12 (8)                     | NA                                 | 0.03 (8)                          | NA (4)                               | B2                                    | 100                |
| Phenol                               | NA                           | NA                                 | 0.6 (8)                           | NA                                   | D                                     | 100                |
| <b>Metals</b>                        |                              |                                    |                                   |                                      |                                       |                    |
| Arsenic                              | 1.75 (6)                     | 50 (8)                             | 0.0003 (8)                        | NA                                   | A                                     | 3                  |
| Chromium(6+)                         | NA                           | 41 (11)                            | 1 (8)                             | NA                                   | A(inhalation)                         | 100                |
| Copper                               | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| Zinc                                 | NA                           | NA                                 | 0.3 (8)                           | NA                                   | D                                     | 3                  |
| <b>Noncarcinogenic PAHs</b>          |                              |                                    |                                   |                                      |                                       |                    |
| Acenaphthene                         | NA                           | NA                                 | 0.06 (8)                          | NA                                   | D                                     | 3000               |
| Acenaphthylene                       | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| Anthracene                           | NA                           | NA                                 | 0.3 (8)                           | NA                                   | D                                     | 3,000              |
| Benzo(g,h,i)perylene                 | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| Fluoranthene                         | NA                           | NA                                 | 0.04 (8)                          | NA                                   | D                                     | 3000               |
| Fluorene                             | NA                           | NA                                 | 0.04 (8)                          | NA                                   | D                                     | 3000               |
| Naphthalene                          | NA                           | NA                                 | 0.004 (10)                        | NA                                   | D                                     | 10000              |
| Phenanthrene                         | NA                           | NA                                 | NA                                | NA                                   | D                                     | NA                 |
| Pyrene                               | NA                           | NA                                 | 0.03 (8)                          | NA                                   | D                                     | 3000               |
| <b>Potentially Carcinogenic PAHs</b> |                              |                                    |                                   |                                      |                                       |                    |
| Benzo(a)Pyrene (eq)                  | 7.3 (10)                     | 6.1 (10)                           | NA                                | NA                                   | B2                                    | NA                 |
| <b>Dioxins</b>                       |                              |                                    |                                   |                                      |                                       |                    |
| 2,3,7,8-TCDD (eq)                    | 156000(7)                    | 330000(7)                          | NA                                | NA                                   | B2                                    | NA                 |

Notes:

NA - Not Available

Benzo(a)Pyrene (eq) - all carcinogenic PAHs are equated to Benzo(a)Pyrene.

2,3,7,8-TCDD (eq) - all dioxin/furan compounds equated to 2,3,7,8-TCDD.

(1) units of (1/mg/kg/day)

(2) units of (mg/kg/day)

(3) See Table 4-1 for description of classification

(4) Inhalation reference doses have not been determined, therefore the oral RfD will be used as a surrogate for the inhalation exposure route.

(5) Withdrawn from IRIS Data Base as of 07/01/90, but was re-entered on 8/01/90

(6) Estimated from a unit risk value of 5E-5 1/(ug/l) assuming a 70kg adult ingests 2 l/day.

(7) RfD (inhalation) given in mg/m3. Converted to mg/day/kg by multiplying by inhalation rate (m3/day) and dividing by bodyweight (kg).

References:

(7) U.S. EPA, Health Effects Assessment summary Tables, Third Quarter, FY-1989, July.

(8) U.S. EPA, 1994:IRIS Data Base. Current as of the date of this report.

(9) U.S. EPA, Health Assessment Summary Tables. FY-March, 1993. Annual Update 540-R-93-058.

(10) Carcinogenic PAHs other than B(a)P are included by equating to B(a)P using relative toxicity to B(a)P factors.

(11) U.S. EPA, Health Assessment Summary Tables, Third Quarter, FY-1990, July.

The dosage estimates and their associated RLs are presented in Section 4.9. When CSFs were not available for the inhalation or oral pathway, then an RL was not calculated for that pathway.

#### 4.8.2 Quantification of Noncarcinogenic Effects

In contrast to the above approach for potentially carcinogenic effects, the potential for health effects for noncarcinogenic compounds assumes a threshold toxicological effect. Therefore, the potential for noncarcinogenic effects are calculated by comparing chronic intake levels with threshold levels (reference doses) below which noncarcinogenic effects are unlikely. The hazard index is calculated as the dose divided by the RfD (eq. 4.2).

The dose reaching the receptor can thus be compared to the chemical concentration that could induce adverse chronic and/or subchronic human health effects. If the resulting HI is greater than one, the estimated chemical intake is greater than the concentration at which adverse health effects may result. If the HI is less than one, the estimated chemical intake is less than the RfD, and the receptors are not deemed at risk.

Since chemical intake can occur through multiple pathways (eg. inhalation, ingestion, dermal), the overall risk characterization must consider each chemical and its corresponding exposure pathway(s). For noncarcinogens, the Hazard Quotient (HQ) for each potential receptor group can be computed by dividing the sum of the computed intakes for ingestion, dermal contact, and inhalation by the appropriate reference dose (RfD) (U.S. EPA, 1989a):

$$HI = \frac{\sum_i (CDI_{ing(i)} / RfD_{ing(i)}) + \sum_i (CDI_{derm(i)} / RfD_{derm(i)}) + \sum_i (CDI_{inh(i)} / RfD_{inh(i)})}{\sum_i (RfD_{ing(i)} + RfD_{derm(i)} + RfD_{inh(i)})} \quad (\text{eq. 4.7})$$

Where:

HI = Hazard Index (unitless)

$RfD_{ing(i)}$  = Reference Dose for compound  $i$  for exposure via incidental ingestion, (mg/kg/day)

$RfD_{inh(i)}$  = Reference Dose for compound  $i$  for exposure via inhalation, contact (mg/kg/day)

$CDI_{ing(i)}$  = chronic daily intake of compound  $i$  via incidental ingestion (mg/kg/day)

$CDI_{derm(i)}$  = chronic daily intake of compound  $i$  via dermal contact, (mg/kg/day)

$CDI_{inh(i)}$  = chronic daily intake of compound  $i$  via inhalation, (mg/kg/day)

RfDs used to calculate HI's can be found in Table 4-8. When RfDs were not available for the inhalation or oral pathway, a hazard index was not calculated for that pathway. The procedures for computing chronic daily intakes (CDIs) of compound  $i$  are described in the following sections.

#### **4.8.3 Exposure Scenarios Assessed**

The following subsections present the quantitative methodologies and assumptions used to determine chronic daily intakes (CDIs) for the potential exposure pathways that were summarized in Section 4.7. For four of the exposure scenarios addressed, inhalation of soil particulates (Section 4.8.3.9), ingestion of offsite soils (Section 4.8.3.7), dermal contact with offsite soils (Section 4.8.3.8), and ingestion of onsite soils (Section 4.8.3.6), assumptions are presented for both the deterministic and stochastic risk approaches.



#### 4.8.3.1 Dermal Contact with Offsite Groundwater

##### Resident (Adult)

As described earlier, adults may be exposed to PCOCs via dermal contact with groundwater during lawn watering activities in the summer. Although well water will no longer be used for consumptive and bathing uses, residents may use their well water for irrigating lawns and gardens. The chronic daily intake for dermal exposure to offsite groundwater,  $CDI_{\text{derm}(i)}$ , was calculated using the following equation:

$$CDI_{\text{derm}(i)} = \frac{CW \times SA \times PC \times CF \times ET \times EF \times ED}{BW \times AT} \quad (\text{eq. 4.8})$$

Where:

|    |   |                                                                        |
|----|---|------------------------------------------------------------------------|
| CW | = | Concentration of compound in groundwater (mg/liters)                   |
| SA | = | Skin surface area available for contact (cm <sup>2</sup> )             |
| PC | = | Chemical-specific dermal permeability constant (cm/hr)                 |
| CF | = | Volumetric conversion factor for water (1 liter/1000 cm <sup>3</sup> ) |
| ET | = | Exposure time (hr/day)                                                 |
| EF | = | Exposure frequency (days/year)                                         |
| ED | = | Exposure duration (years)                                              |
| BW | = | Body weight (kg)                                                       |
| AT | = | Averaging time (days)                                                  |

To determine the CDI for groundwater exposure during lawn watering, several assumptions were made. The receptor was assumed to be an adult with an average exposed skin surface area (SA) of 1840 cm<sup>2</sup> (hands and feet, U.S. EPA, 1989). The exposure time (ET) was assumed to be 1 hour/day. The frequency of exposure was assumed to be 3 days per week through the months of June, July and August. This results in an exposure frequency (EF) of 36 days/year. The averaging time (AT) for noncarcinogens was estimated to be 30 years (10,950 days) and for carcinogens at 70

years (25,550 days). The average adult body weight (BW) was set equal to 70 kg (U.S. EPA, 1989a).

The permeability constant (PC) reflects the movement of the chemical across the skin and into the blood stream. It is important to evaluate this process to determine actual absorption doses, however, many compounds do not have literature PC values. For this assessment, it is assumed that PCOCs are carried through the skin barrier at the same rate as that of water (U.S. EPA, 1988), which, in all likelihood would be the controlling factor in PCOC absorption. Therefore, rather than using the pure compound permeability constant, the permeability constant for water ( $8.0 \times 10^{-4}$  cm/hr) will be used.

#### **4.8.3.2 Dermal Contact with Surface Water in Offsite Ditch**

During the course of their daily recreational activities, children could play in the offsite ditch. Thus, the children could potentially be exposed to PCOCs in the surface water via dermal contact. The dermal exposure to the water in the ditch was calculated using equation 4.8. The maximum concentrations of PCOCs in the offsite surface water were used to calculate the CDIs (Table 4-7).

The following assumptions are made for a child's exposure to surface waters in the offsite ditch:

- o A child age 6 to 10 years old was selected to represent the age range that children are likely to play in a ditch. The skin surface area (SA) exposed for dermal absorption by children 6 to 10 years old was estimated to be hands and feet representing 1,100 cm<sup>2</sup> of skin surface area (U.S. EPA, 1989c).
- o The permeability constant (PC) for water given in Section 4.8.3.1, dermal contact of groundwater, of  $8.0 \times 10^{-4}$  cm/hr is used (U.S. EPA, 1989a). The exposure time (ET) and exposure frequency (EF) are defined as 4 hours/day and 12 days/year, respectively. The twelve days per year represent four events during June, July and August.



- o Exposure duration is defined to span a 5 year period (representing the age group 6 to 10 years old) with an average body weight (BW) of 28 kg (U.S. EPA, 1985g). The averaging time for noncarcinogens and potential carcinogens is 1,825 days and 25,550 days, respectively.

#### 4.8.3.3 Dermal Contact of Sediments in Offsite Ditch

Dermal contact with PCOCs in ditch sediments may occur during children's recreational activities.  $CDI_{\text{derm}(i)}$ , the absorbed dose of compound  $i$  via dermal contact, is given by:

$$CDI_{\text{derm}(i)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \quad (\text{eq. 4.9})$$

Where:

|     |   |                                                                        |
|-----|---|------------------------------------------------------------------------|
| CS  | = | Chemical concentration in sediments (mg/kg)                            |
| CF  | = | Conversion factor ( $10^{-6}$ kg/mg)                                   |
| SA  | = | Skin Surface area available for contact ( $\text{cm}^2/\text{event}$ ) |
| AF  | = | Sediment to Skin Adherence Factor ( $\text{mg}/\text{cm}^2$ )          |
| ABS | = | Absorption Factor (unitless)                                           |
| EF  | = | Exposure Frequency (events/year)                                       |
| ED  | = | Exposure Duration (years)                                              |
| BW  | = | Body Weight (kg)                                                       |
| AT  | = | Averaging Time (period over which exposure is averaged in days)        |

The concentration of PCOCs employed in the assessment are the maximum concentrations detected in the sediments collected offsite in the ditch (Table 4-7).

A skin surface area (SA) for dermal exposure to sediments of  $1,100 \text{ cm}^2$  representing the child's feet and hands (6 to 10 years old) has been employed (U.S. EPA, 1989b). The recommended residential RME exposure factor for contact rate of soils of  $1.0 \text{ mg}/\text{cm}^2$  is used to provide a conservative estimate of exposure (EPA Region 10,

Supplemental Guidance Document, August 1991). The sediment exposure may also be reduced by surface waters washing off sediment from the skin.

Dermal absorption factors (ABS) used for volatiles, phenolics, PAHs and metals were 0.5, 0.05, 0.5 and 0.0 (negligible), respectively. The source for these ABS values is the document U.S. EPA Region I, Draft Final Supplement Risk Assessment Guidance, April 1989 and DEQ for the ABS value for PAHs. The exposure frequency (EF) for contact with sediments is estimated to be 12 events/year, i.e. once a week during June, July and August. The exposure duration (ED) and body weight (BW) are 5 years (representing the age group 6 to 10 years) and 28 kg, respectively.

An averaging time of 70 years or 25,550 days was used for exposure to potentially carcinogenic compounds and of 1,825 days (5 years) was used for noncarcinogenic exposure (U.S. EPA, 1989a).

**4.8.3.4 Incidental Ingestion of Sediment in Offsite Ditch**

This pathway was evaluated for children playing in the offsite ditch. The exposure frequency (EF), exposure duration (ED), averaging times (AT) and body weight (BW) are the same as those presented above for the dermal contact scenarios. The fraction of soil ingested by a child (FI) was assumed to be 0.25 since only a fraction of their total daily soil intake (FI) will originate from the ditch sediment. The typical ingestion rate (IR) for soils by children of 200 mg soil/day was used in the dose calculation equation.

The exposure was calculated with the following equation:

$$CDI_{(ing)i} = \frac{IR \times FI \times EF \times ED \times CS \times CF}{BW \times AT} \quad (\text{eq. 4.10})$$

Where:

- IR = Ingestion Rate (mg soil/day)
- FI = Fraction of ditch sediment ingested
- EF = Exposure frequency (days/year)

|    |   |                                            |
|----|---|--------------------------------------------|
| ED | = | Exposure duration (years)                  |
| CS | = | Chemical concentration in soil             |
| CF | = | Conversion factor (10 <sup>-6</sup> kg/mg) |
| BW | = | Body weight (kg)                           |
| AT | = | Averaging time (days)                      |

#### 4.8.3.5 Incidental Ingestion of Water in Offsite Ditch

This pathway was evaluated using the same exposure scenario as the ingestion of sediments by children. The exposure frequency (EF) was assumed to be 12 days/year and the exposure duration (ED) 5 years (noncarcinogens). The surface water ingestion rate for children 6 to 10 years old was estimated at 0.05 liters/day. This value was based on daily water intakes of children provided in the Exposure Factors Handbook (U.S. EPA 1989b) of 0.5 liters/day multiplied by a fraction intake factor of 0.1.

The exposure was calculated with the following equation:

$$CDI_{(ing)i} = \frac{IR \times EF \times ED \times CW}{BW \times AT} \quad (\text{eq. 4.11})$$

Where:

|    |   |                                                         |
|----|---|---------------------------------------------------------|
| IR | = | Ingestion Rate (liters/day)                             |
| EF | = | Exposure frequency (days/year)                          |
| ED | = | Exposure duration (years)                               |
| CW | = | Concentration of the compound in groundwater (mg/liter) |
| BW | = | Body weight (kg)                                        |
| AT | = | Averaging time (days)                                   |

#### **4.8.3.6 Incidental Ingestion of Onsite Soil**

##### **Deterministic Approach**

This pathway was evaluated for onsite workers using the same assumptions made for the Phase I PHRA but incorporating the Phase II RI surface soil data. The exposure frequency (EF) was assumed to be 250 days/year, based on a 8 hour work day, and the fraction of on-site soil ingested by a worker (FI) was estimated at 0.5 since only a fraction of their total daily soil intake (FI) will originate from the site. The exposure duration (ED) was 25 years (recommended EPA Region 10), the body weight at 70 kg, and the ingestion rate at 100 mg/day. The averaging times (AT) were estimated as 9,125 days for noncarcinogens and 25,550 days for carcinogens. Equation 4.9 was used to estimate the CDI.

##### **Stochastic Approach**

Several of the input parameters used for the deterministic approach remained the same for the stochastic approach. These input parameters remain as single values and are not represented by a probability distribution. These parameters include an exposure frequency of 250 days/year, a fraction intake (FI) of onsite soil of 0.5, and an averaging time (AT) of 9,125 days for noncarcinogens and 25,550 for carcinogens. Input parameters which were represented by probability distributions in the stochastic analysis were the adult ingestion rate (IR), adult body weight (BW) and the exposure duration which was estimated using plant employee data supplied by J.H. Baxter. The arithmetic mean (ie. average) length of employment at the plant is 14.5 years which is less than the standard RME default value of 25 years. The probability distributions used for the ingestion rate, body weight and employee duration are provided in Appendix D, Report 7, assumptions D1, D9 and D16. The arithmetic means for the distributions for the ingestion rate, body weight and employee duration were approximately 45 mg/day, 71 kg, and 14.5 years, respectively.

#### **4.8.3.7 Incidental Ingestion of Offsite Soil**

##### **Deterministic Approach**

###### **Child**

Offsite surface soil samples taken as part of the Phase II investigation allow this pathway to be evaluated. The ages 1 to 6 years, are the ages when children are most likely to ingest soils (Walter et al. 1980, Cooper 1957, Charney et al. 1980, Sayre et al. 1974). The daily intake during the summer months for children within this age range is 200 mg/day (U.S. EPA 1991). The average number of days per year that the child would ingest the aforementioned daily intake is 350 days/year (U.S. EPA 1991). The average body weight for a child aged 1 to 6 years was estimated at 15 kg (U.S. EPA, 1991). The exposure duration used was 6 years. The averaging times were 2,190 days (6 years) for noncarcinogens and 25,550 days for carcinogens.

###### **Adult**

In addition to young children ingesting soils while playing, adults can ingest soils while working in the yard or gardening. Using the data provided by U.S. EPA Human Health Supplementary Guidance Evaluation Manual 1991, adults on average ingest 100 mg/day (IR) of soil and/or dust over 350 days/year (EF). The exposure duration (ED) used was 24 years (EPA Region 10, 1991) and the average times of exposure were 10,950 days (30 years) for noncarcinogenic effects and 25,550 days for carcinogenic effects. The average body weight (BW) used for the adult was 70 kg.

##### **Stochastic Approach**

###### **Child and Adult**

Probability distributions were used for the ingestion rate (child and adult), adult body weight, and years at one residence for adults. The approximate means of these distributions were 71 kg (adult body weight), 60 mg/day (adult ingestion rate) 45

mg/day (child ingestion rate) and 12 years (adult resident duration) (see Report 7, Appendix D). The exposure duration for the child, frequency and averaging times used were identical to those used in the deterministic approach.

The offsite surface soil ingestion exposures were calculated with the following equation:

$$CDI_{(ing)i} = \frac{IR \times EF \times ED \times CS \times CF}{BW \times AT} \quad (\text{eq. 4.12})$$

Where:

- IR = Ingestion Rate (mg soil/day)
- EF = Exposure frequency (days/year)
- ED = Exposure duration (years)
- CS = Chemical concentration in soil
- CF = Conversion factor (10<sup>-6</sup> kg/mg)
- BW = Body weight (kg)
- AT = Averaging time (days)

**4.8.3.8 Dermal Contact with Offsite Surface Soils**

**Deterministic**

Child

Dermal contact with PCOCs in offsite surface soils while children are playing is a potential exposure route. For this exposure scenario, an age range of 1 to 6 years old is used for the CDI estimate. Therefore, a body weight of 15 kg, an averaging time of 2,190 days for noncarcinogens and 25,550 days for carcinogens, and an exposure duration of 6 years was used for the dose estimate. The exposure frequency was estimated at 150 events/year (Hawley 1985). An exposed skin surface area of 2,940 cm<sup>2</sup> (hands, legs and feet, U.S. EPA 1989b) was used in the dose calculation. Equation 4.8 presented earlier for the dose estimate of dermally contacting sediments in the ditch was also appropriate for determining the dose in this scenario.



Adult

Adults working in the yard or gardening during the summer months potentially expose themselves dermally to PCOCs in the offsite surface soils. The exposure frequency for this scenario is 43 events/year. The exposure duration is taken to be 24 years and the averaging times are 10,950 days (30 years, noncarcinogens) and 25,550 days (carcinogens). The skin area assumed to be exposed for this scenario are the lower legs, hands and feet of the adult which results in an exposed skin surface area of approximately 3,840 cm<sup>2</sup>.

**Stochastic**

A stochastic assessment for the adult was performed using probability distributions for body weight and exposure duration. These distributions are presented in Report 7 of Appendix D as assumptions D1 and D7.

**4.8.3.9 Inhalation of Soil Particulates**

**Deterministic Approach**

During the course of their outdoor activities, neighboring residents and site workers may be exposed to PCOCs through inhalation of soil particulates. Exposures via inhalation are difficult to assess given the spatial and temporal variation of constituents in air. The CDI via inhalation is given by:

$$CDI_{inh(i)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

(eq. 4.13)

Where:

- CA

=

Constituent concentration in air (mg/m<sup>3</sup>)
- IR

=

Inhalation rate (m<sup>3</sup>/hr)
- ET

=

Exposure time (hr/d)

EF = Exposure frequency (d/yr)  
ED = Exposure duration (yrs)  
BW = Body weight (kg)  
AT = Averaging time (d)

Where:

$$CA = PM10 \times Fs \times Cs \times Cf \qquad (eq. 4.13)$$

PM10 = Respirable particulate concentration (mg/m<sup>3</sup>)  
Cf = Conversion factor (1 x10<sup>-6</sup> mg/kg)  
Fs = Fraction of particulate which is on-site soil  
Cs = Constituent concentration in on-site soil (mg/kg)

Residents

For the residential scenario assessment, the inhalation rates (IR) for children (ages 1 to 6) and adults was estimated to be 20 m3/day (EPA Region 10 standard default exposure factors, 1991). An exposure time (ET) of 8 hours per day was considered to be the same for both adults and children, however, the exposure frequency (EF) was estimated to be 250 days/year for children and 104 days/year for the adult because children would be outdoors more often (5 days per week for the child and 2 days per week for the adult). The exposure durations were defined for children and adults as 6 years and 30 years, respectively.

Onsite Workers

For the onsite worker’s exposure, an inhalation rate (IR) of 20 m3/day (EPA Region 10, Industrial RME, 1991) was used. The exposure time (ET) was estimated at 8 hours/day and the exposure frequency (EF) was estimated as 250 days (based on a work week of five days). The exposure duration was defined as 30 years. An average body weight (BW) of 70 kg was employed in the assessment.



To estimate the airborne concentration of PCOCs, values of 10.24 ug/m<sup>3</sup> and 0.25 were employed for offsite PM10 particulate concentration and fraction of particulate which originates from onsite soil (Fs), respectively. These values were employed in the Phase I PHRA.

Average body weights (BW) for children and adults are 15 kg and 70 kg, respectively. Averaging times (AT) for noncarcinogenic effects are 2,190 days (child) and 10,950 day (adults) and for potential carcinogens are 25,550 days.

#### **Stochastic Approach**

Stochastic simulations were performed only for the onsite worker and the adult resident. A probability distribution was not available for the child resident. Probability distributions were used for inhalation rates of the resident adult and the onsite worker. Distributions were also used for body weights and the exposure duration for the onsite worker and resident adult. The details of the distributions used are provided in Report 7 of Appendix D.

#### **4.9 Risk Characterization**

This section presents and discusses estimated potential risk levels and hazard indices for identified human receptors who could potentially be exposed to PCOCs via the potential exposure pathways discussed in Section 4.4.3.

Estimated potential risk levels (RLs) are compared to a target risk range of 10<sup>-4</sup> to 10<sup>-6</sup> which the U.S. EPA considers to be safe and protective of public health (U.S. EPA, 1989a). A value of 1.0 is used for comparison of the hazard index (HI). However, DEQ does not use the EPA target risk range unless it becomes evident during the feasibility study that their cleanup goal of background is unfeasible technically or economically.

Table 4-9 presents the total overall potential risk levels (RL) for residential receptors (adult and child), and onsite workers for the standard risk analysis approach. Table 4-10 presents the overall total potential hazard indices for residential receptors

TABLE 4-9  
OVERALL POTENTIAL RISK LEVELS FOR ALL EXPOSURE PATHWAYS AND RECEPTORS ASSESSED  
DETERMINISTIC APPROACH

| COMPOUNDS             | RESIDENTS  |           |          |            |           |          | WORKERS    |           |          |
|-----------------------|------------|-----------|----------|------------|-----------|----------|------------|-----------|----------|
|                       | ADULT      |           |          | CHILD      |           |          | ADULT      |           |          |
|                       | Inhalation | Ingestion | Dermal   | Inhalation | Ingestion | Dermal   | Inhalation | Ingestion | Dermal   |
| B(a)P (eq)            | 2.56E-09   | 4.09E-07  | 1.20E-06 | 9.93E-09   | 9.66E-07  | 3.18E-06 | 1.71E-08   | 3.00E-05  | NA       |
| 2,4,6-Trichlorophenol | NA         | 4.30E-10  | 1.40E-10 | NA         | 1.01E-09  | 3.18E-10 | NA         | NA        | NA       |
| Pentachlorophenol     | NA         | 3.07E-08  | 9.07E-09 | NA         | 2.06E-07  | 3.20E-08 | NA         | 8.37E-08  | NA       |
| Arsenic               | 5.29E-07   | 5.75E-06  | 2.18E-09 | 1.24E-06   | 1.48E-05  | 4.47E-08 | 2.12E-06   | 1.09E-04  | NA       |
| Chromium              | 5.67E-08   | NA        | NA       | 1.32E-07   | NA        | NA       | 2.27E-07   | NA        | NA       |
| Benzene               | NA         | NA        | NA       | NA         | NA        | NA       | NA         | 9.21E-11  | NA       |
| Styrene               | 1.23E-15   | NA        | NA       | 2.88E-15   | NA        | NA       | 4.94E-15   | 1.09E-10  | NA       |
| 2,3,7,8-TCDD(eq)      | 1.47E-09   | NA        | NA       | 3.42E-09   | NA        | NA       | 5.88E-09   | 4.09E-06  | NA       |
| Subtotal              | 5.90E-07   | 6.19E-06  | 1.21E-06 | 1.39E-06   | 1.60E-05  | 3.26E-06 | 2.37E-06   | 1.43E-04  | 0.00E+00 |
| TOTAL                 | 7.99E-06   |           |          | 2.06E-05   |           |          | 1.46E-04   |           |          |

TABLE 4-10  
OVERALL POTENTIAL HAZARD INDICES FOR ALL EXPOSURE PATHWAYS AND RECEPTORS ASSESSED  
DETERMINISTIC APPROACH

| COMPOUNDS          | RESIDENTS  |           |          |            |           |          | WORKERS    |           |          |
|--------------------|------------|-----------|----------|------------|-----------|----------|------------|-----------|----------|
|                    | ADULT      |           |          | CHILD      |           |          | ADULT      |           |          |
|                    | Inhalation | Ingestion | Dermal   | Inhalation | Ingestion | Dermal   | Inhalation | Ingestion | Dermal   |
| Naphthalene        | NA         | 2.89E-05  | 5.79E-05 | NA         | 2.72E-04  | 8.76E-04 | NA         | 5.15E-05  | NA       |
| Acenaphthene       | NA         | NA        | NA       | NA         | 2.47E-07  | 2.71E-06 | NA         | 6.76E-06  | NA       |
| Fluorene           | NA         | 4.45E-07  | 8.70E-07 | NA         | 4.89E-06  | 1.35E-05 | NA         | 6.95E-06  | NA       |
| Anthracene         | NA         | 7.03E-08  | 1.33E-07 | NA         | 6.61E-07  | 2.12E-06 | NA         | 1.39E-06  | NA       |
| Fluoranthene       | NA         | 8.77E-06  | 1.65E-05 | NA         | 8.25E-05  | 2.59E-04 | NA         | 1.61E-04  | NA       |
| Pyrene             | NA         | 4.32E-06  | 8.18E-06 | NA         | 4.17E-05  | 1.31E-04 | NA         | 2.45E-04  | NA       |
| 2-Chlorophenol     | NA         | NA        | NA       | NA         | 2.23E-05  | 2.45E-05 | NA         | NA        | NA       |
| 2,4-Dichlorophenol | NA         | NA        | NA       | NA         | 1.04E-05  | 1.14E-05 | NA         | NA        | NA       |
| 2,4-Dinitrophenol  | NA         | 2.51E-05  | 4.70E-06 | NA         | 1.23E-05  | 1.36E-05 | NA         | 2.23E-05  | NA       |
| Pentachlorophenol  | NA         | 3.20E-02  | 9.68E-06 | NA         | 7.55E-04  | 1.10E-04 | NA         | 6.51E-05  | NA       |
| Arsenic            | NA         | 6.25E-05  | 0.00E+00 | NA         | 3.35E-01  | 1.19E-03 | NA         | 5.82E-01  | NA       |
| Chromium           | NA         | 8.87E-04  | 2.77E-06 | NA         | 5.86E-04  | NA       | NA         | 2.29E-05  | NA       |
| Zinc               | NA         | NA        | NA       | NA         | 8.28E-03  | 1.93E-06 | NA         | 3.59E-04  | NA       |
| Toluene            | 2.39E-11   | NA        | NA       | 3.61E-11   | 1.76E-07  | 1.24E-08 | 5.75E-11   | 7.58E-08  | NA       |
| Ethylbenzene       | 4.64E-12   | NA        | NA       | 7.81E-12   | 3.53E-07  | 2.48E-08 | 1.19E-11   | 7.88E-08  | NA       |
| Xylenes            | NA         | NA        | NA       | NA         | 2.64E-08  | 1.86E-09 | NA         | 1.03E-08  | NA       |
| Styrene            | NA         | NA        | NA       | NA         | NA        | NA       | NA         | 5.10E-08  | NA       |
| Subtotal           | 2.85E-11   | 3.30E-02  | 1.01E-04 | 4.39E-11   | 3.45E-01  | 2.64E-03 | 6.94E-11   | 5.83E-01  | 0.00E+00 |
| TOTAL              | 3.31E-02   |           |          | 3.48E-01   |           |          | 5.83E-01   |           |          |

NA - Not Available

(adult and child), and onsite workers for the standard (deterministic) risk approach. Tables 4-11 through 4-15, 4-16a, 4-17a, 4-18a and 4-19a present the deterministic approach risk levels and hazard indices for PCOCs in each potential exposure pathway addressed.

A stochastic risk assessment was performed for four exposure scenarios. These scenarios were the ingestion of offsite soils by child and adult residents, the ingestion of onsite soils by workers, the dermal contact of offsite soils by adult residents and the inhalation of soil particulates by workers and adult residents. The stochastic results are summarized in Tables 4-16b, 4-17b, 4-18b, and 4-19b.

#### **4.9.1 Risk Levels**

##### **Deterministic Method Results**

The total potential risk level (RL) for adult residents, child residents and onsite workers are estimated to be  $7.99 \times 10^{-6}$ ,  $2.06 \times 10^{-5}$  and  $1.46 \times 10^{-4}$ , respectively. The total risk level for onsite workers marginally exceeds the EPA target risk level range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ .

From Table 4-9, it is evident that the RL associated with the ingestion pathway for onsite workers, which is  $1.43 \times 10^{-4}$ , exceeds the EPA target range as a result of the risk associated with arsenic in the soil. The risk levels associated with the ingestion pathway for residents and the inhalation pathway for residents and onsite workers exceed  $1 \times 10^{-6}$ .

##### **Stochastic Method Results**

Tables 4-16b, 4-17b, 4-18b and 4-19b, present the stochastic approach risk levels for ingestion of onsite soils by workers, ingestion of offsite soils by adult residents, dermal contact of offsite soils by adult residents and the inhalation of onsite soil particulates by workers and adult and child residents. These Tables present three statistical parameters for risks from each PCOC; the mode, the mean and the 95th percentile risks. The mode value is the risk that has the highest probability of

occurring. The mean is the average distribution risk and the 95th percentile risk is the risk where only 5% of the risk values exceed this value.

The deterministic risk level for ingestion of onsite soil by the onsite worker (Table 4-16a) is  $1.43 \times 10^{-4}$ . The stochastic result for the same exposure scenario (Table 4-16b) shows the most probable risk (mode risk) to be  $3.18 \times 10^{-6}$ , a mean risk of  $5.34 \times 10^{-5}$  and a 95th percentile risk of  $2.64 \times 10^{-4}$ . These values are within or near the acceptable risk range defined by the U.S. EPA of  $10^{-4}$  to  $10^{-6}$ .

For the ingestion of offsite soil, the mode and mean stochastic risk values are lower than the corresponding deterministic values (Table 4-17b). The 95th percentile risk levels for the child ( $1.5 \times 10^{-5}$ ) and adult resident ( $8.65 \times 10^{-6}$ ) are similar to the corresponding deterministic risks of  $1.44 \times 10^{-6}$  and  $6.2 \times 10^{-6}$  for the child and adult resident, respectively.

The stochastic risk results for the dermal contact of offsite soils by the adult resident, presented in Table 4-18b, are a mode risk of  $1.95 \times 10^{-7}$ , a mean risk value of  $5 \times 10^{-7}$  and a 95th percentile risk of  $1.46 \times 10^{-6}$ . The risk derived using the standard approach was  $1.2 \times 10^{-6}$ .

Table 4-19b presents the stochastic risk levels for the inhalation exposure pathway. The risk levels for the mode, mean and 95th percentile risks for the adult resident are  $2.69 \times 10^{-8}$ ,  $1.39 \times 10^{-7}$  and  $4.21 \times 10^{-7}$ , respectively. These risk levels are all less than was derived from the deterministic approach ( $6 \times 10^{-7}$ ). For the onsite worker the 95th percentile risk ( $7.79 \times 10^{-6}$ ) was moderately greater than the deterministic risk level ( $2.37 \times 10^{-6}$ ).

The only risk level to exceed  $10^{-4}$  was for ingestion of onsite soils by workers. The risk levels for this scenario marginally exceeded  $10^{-4}$ . The risk level from the standard approach was  $1.43 \times 10^{-4}$  and the risk level associated with the 95th percentile in the stochastic approach was  $2.62 \times 10^{-4}$ .

TABLE 4-11  
DERMAL CONTACT OF OFFSITE GROUNDWATER  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND              | RESIDENT(ADULT) |          |
|-----------------------|-----------------|----------|
|                       | RL              | HI       |
| B(a)P (eq)            | 4.80E-11        | NA       |
| Naphthalene           | NA              | 3.31E-06 |
| Fluorene              | NA              | 3.05E-08 |
| Fluoranthene          | NA              | 1.71E-08 |
| Pyrene                | NA              | 3.61E-08 |
| 2,4,6-Trichlorophenol | 1.17E-11        | NA       |
| Arsenic               | 2.18E-09        | 9.68E-06 |
| Zinc                  | NA              | 2.77E-06 |
| TOTAL                 | 2.24E-09        | 1.58E-05 |

TABLE 4-12  
DERMAL CONTACT OF WATER IN DITCH OFFSITE(CHILD)  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND          | RESIDENT(CHILD) |          |
|-------------------|-----------------|----------|
|                   | RL              | HI       |
| Fluorene          | NA              | 4.97E-08 |
| Fluoranthene      | NA              | 4.30E-08 |
| Pyrene            | NA              | 6.93E-08 |
| Pentachlorophenol | 9.42E-09        | 3.66E-05 |
| Arsenic           | 4.47E-08        | 1.19E-03 |
| Zinc              | NA              | 1.93E-06 |
| Toluene           | NA              | 1.24E-08 |
| Ethylbenzene      | NA              | 2.48E-08 |
| Xylenes           | NA              | 1.86E-09 |
| B(a)P (eq)        | 3.44E-09        | NA       |
| TOTAL             | 5.76E-08        | 1.23E-03 |

NOTES: NA - Not Available.  
B(a)P (eq) represents the total risk from carcinogenic PAHs equated to Benzo(a) Pyrene.

TABLE 4-13  
DERMAL CONTACT OF SEDIMENT IN DITCH OFFSITE(CHILD)  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND           | RESIDENT(CHILD) |          |
|--------------------|-----------------|----------|
|                    | RL              | HI       |
| Naphthalene        | NA              | 2.58E-05 |
| Acenaphthene       | NA              | 2.71E-06 |
| Fluorene           | NA              | 3.89E-07 |
| Anthracene         | NA              | 4.99E-08 |
| Fluoranthene       | NA              | 1.39E-06 |
| Pyrene             | NA              | 4.37E-06 |
| 2-Chlorophenol     | NA              | 2.45E-05 |
| 2,4-Dichlorophenol | NA              | 1.14E-05 |
| 2,4-Dinitrophenol  | NA              | 1.36E-05 |
| Arsenic            | 0.00E+00        | 0.00E+00 |
| Chromium           | NA              | 0.00E+00 |
| Zinc               | 0.00E+00        | 0.00E+00 |
| B(a)P (eq)         | 1.77E-07        | NA       |
| TOTAL              | 1.77E-07        | 8.42E-05 |

TABLE 4-14  
INGESTION OF SEDIMENT IN DITCH, CHILD RESIDENT  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND           | RESIDENT(CHILD) |          |
|--------------------|-----------------|----------|
|                    | RL              | HI       |
| Naphthalene        | NA              | 2.35E-06 |
| Acenaphthene       | NA              | 2.47E-07 |
| Fluorene           | NA              | 3.54E-08 |
| Anthracene         | NA              | 4.54E-09 |
| Fluoranthene       | NA              | 1.27E-07 |
| Pyrene             | NA              | 3.97E-07 |
| 2-Chlorophenol     | NA              | 2.23E-05 |
| 2,4-Dichlorophenol | NA              | 1.04E-05 |
| 2,4-Dinitrophenol  | NA              | 1.23E-05 |
| Arsenic            | 7.63E-07        | 2.04E-02 |
| Chromium           | NA              | 1.50E-06 |
| Zinc               | NA              | 3.48E-05 |
| B(a)P (eq)         | 1.67E-08        | NA       |
| TOTAL              | 7.80E-07        | 2.05E-02 |

NA – Not Available

B(a)P (eq) represents the total risk from carcinogenic PAHs equated to Benzo(a) Pyrene.



**TABLE 4-15**  
**INGESTION OF SURFACE WATER FROM DITCH, CHILD RESIDENT**  
**RISK LEVELS AND HAZARD INDICES**  
**DETERMINISTIC APPROACH**

| COMPOUND          | RESIDENT(CHILD) |                 |
|-------------------|-----------------|-----------------|
|                   | RL              | HI              |
| Fluorene          | NA              | 7.06E-07        |
| Fluoranthene      | NA              | 6.11E-07        |
| Pyrene            | NA              | 9.84E-07        |
| Pentachlorophenol | 1.34E-07        | 5.21E-04        |
| Arsenic           | 6.36E-07        | 1.69E-02        |
| Zinc              | NA              | 2.74E-05        |
| Toluene           | NA              | 1.76E-07        |
| Ethylbenzene      | NA              | 3.52E-07        |
| Xylenes           | NA              | 2.64E-08        |
| B(a)P (eq)        | 4.89E-08        | NA              |
| <b>TOTAL</b>      | <b>8.19E-07</b> | <b>1.75E-02</b> |

**TABLE 4-16a**  
**INGESTION OF ONSITE SOILS, ONSITE WORKERS**  
**RISK LEVELS AND HAZARD INDICES**  
**DETERMINISTIC APPROACH**

| COMPOUND          | WORKER          |                 |
|-------------------|-----------------|-----------------|
|                   | RL              | HI              |
| Naphthalene       | NA              | 5.15E-05        |
| Acenaphthene      | NA              | 6.76E-06        |
| Fluorene          | NA              | 6.95E-06        |
| Anthracene        | NA              | 1.39E-06        |
| Fluoranthene      | NA              | 1.61E-04        |
| Pyrene            | NA              | 2.45E-04        |
| 2,4-Dinitrophenol | NA              | 2.23E-05        |
| Pentachlorophenol | 8.37E-08        | 6.51E-05        |
| Arsenic           | 1.09E-04        | 5.82E-01        |
| Chromium          | NA              | 2.29E-05        |
| Zinc              | NA              | 3.59E-04        |
| Toluene           | NA              | 7.58E-08        |
| Ethylbenzene      | NA              | 7.88E-08        |
| Xylenes           | NA              | 1.03E-08        |
| Styrene           | 1.09E-10        | 5.10E-08        |
| B(a)P (eq)        | 3.00E-05        | NA              |
| Benzene           | 9.21E-11        | NA              |
| 2,3,7,8-TCDD(eq)  | 4.09E-06        | NA              |
| <b>TOTAL</b>      | <b>1.43E-04</b> | <b>5.83E-01</b> |

NA - Not Available

B(a)P (eq) represents the total risk from carcinogenic PAHs equated to Benzo(a) Pyrene.

TABLE 4-16b  
INGESTION OF ONSITE SOILS, ONSITE WORKERS  
RISK LEVELS AND HAZARD INDICES  
STOCHASTIC APPROACH

| COMPOUND          | WORKER   |          |                 |          |          |                 |
|-------------------|----------|----------|-----------------|----------|----------|-----------------|
|                   | RL       |          |                 | HI       |          |                 |
|                   | Mode     | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Naphthalene       | NA       | NA       | NA              | 1.14E-06 | 1.91E-05 | 9.48E-05        |
| Acenaphthene      | NA       | NA       | NA              | 1.50E-07 | 2.50E-06 | 1.24E-05        |
| Fluorene          | NA       | NA       | NA              | 1.54E-07 | 2.57E-06 | 1.28E-05        |
| Anthracene        | NA       | NA       | NA              | 3.08E-08 | 5.16E-07 | 2.56E-06        |
| Fluoranthene      | NA       | NA       | NA              | 3.58E-06 | 5.98E-05 | 2.97E-04        |
| Pyrene            | NA       | NA       | NA              | 5.42E-06 | 9.06E-05 | 4.50E-04        |
| 2,4-Dinitrophenol | NA       | NA       | NA              | 4.93E-07 | 8.24E-06 | 4.10E-05        |
| Pentachlorophenol | 1.85E-09 | 3.11E-08 | 1.54E-07        | 1.44E-06 | 2.41E-05 | 1.20E-04        |
| Arsenic           | 2.42E-06 | 4.05E-05 | 2.01E-04        | 1.29E-02 | 2.16E-01 | 1.07E+00        |
| Chromium          | NA       | NA       | NA              | 5.06E-07 | 8.45E-06 | 4.20E-05        |
| Zinc              | NA       | NA       | NA              | 7.96E-06 | 1.33E-04 | 6.61E-04        |
| Toluene           | NA       | NA       | NA              | 1.69E-09 | 2.82E-08 | 1.40E-07        |
| Ethylbenzene      | NA       | NA       | NA              | 1.79E-09 | 2.92E-08 | 1.45E-07        |
| Xylenes           | NA       | NA       | NA              | 2.29E-10 | 3.82E-09 | 1.90E-08        |
| Styrene           | 2.42E-12 | 4.04E-11 | 2.01E-10        | 1.13E-09 | 1.89E-08 | 9.38E-08        |
| BaP(eq)           | 6.65E-07 | 1.14E-05 | 5.50E-05        | NA       | NA       | NA              |
| Benzene           | 2.04E-12 | 3.41E-11 | 1.70E-10        | NA       | NA       | NA              |
| 2,3,7,8-TCDD      | 9.06E-08 | 1.51E-06 | 7.56E-06        | NA       | NA       | NA              |
| TOTAL             | 3.18E-06 | 5.34E-05 | 2.64E-04        | 1.29E-02 | 2.16E-01 | 1.07E+00        |

NA - Not Available



TABLE 4-17a  
INGESTION OF OFFSITE SOILS, RESIDENTS  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND              | RESIDENT(CHILD) |          | RESIDENT(ADULT) |          |
|-----------------------|-----------------|----------|-----------------|----------|
|                       | RL              | HI       | RL              | HI       |
| Naphthalene           | NA              | 2.70E-04 | NA              | 2.89E-05 |
| Fluorene              | NA              | 4.15E-06 | NA              | 4.45E-07 |
| Anthracene            | NA              | 6.56E-07 | NA              | 7.03E-08 |
| Fluoranthene          | NA              | 8.18E-05 | NA              | 8.77E-06 |
| Pyrene                | NA              | 4.03E-05 | NA              | 4.32E-06 |
| Pentachlorophenol     | 7.17E-08        | 2.34E-04 | 3.07E-08        | 2.51E-05 |
| Arsenic               | 1.34E-05        | 2.98E-01 | 5.75E-06        | 3.20E-02 |
| Chromium              | NA              | 5.83E-04 | NA              | 6.25E-05 |
| Zinc                  | NA              | 8.28E-03 | NA              | 8.87E-04 |
| B(a)P (eq)            | 9.00E-07        | NA       | 4.09E-07        | NA       |
| 2,4,6-Trichlorophenol | 1.01E-09        | NA       | 4.30E-10        | NA       |
| TOTAL                 | 1.44E-05        | 3.08E-01 | 6.19E-06        | 3.30E-02 |

TABLE 4-18a  
DERMAL CONTACT OF OFFSITE SOILS, RESIDENT  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND              | RESIDENT(CHILD) |          | RESIDENT(ADULT) |          |
|-----------------------|-----------------|----------|-----------------|----------|
|                       | RL              | HI       | RL              | HI       |
| Naphthalene           | NA              | 8.50E-04 | NA              | 5.46E-05 |
| Fluorene              | NA              | 1.31E-05 | NA              | 8.39E-07 |
| Anthracene            | NA              | 2.07E-06 | NA              | 1.33E-07 |
| Fluoranthene          | NA              | 2.58E-04 | NA              | 1.65E-05 |
| Pyrene                | NA              | 1.27E-04 | NA              | 8.14E-06 |
| Pentachlorophenol     | 2.26E-08        | 7.32E-05 | 9.07E-09        | 4.70E-06 |
| Arsenic               | 0.00E+00        | 0.00E+00 | 0.00E+00        | 0.00E+00 |
| Chromium              | 0.00E+00        | 0.00E+00 | 0.00E+00        | 0.00E+00 |
| Zinc                  | NA              | 0.00E+00 | NA              | 0.00E+00 |
| B(a)P (eq)            | 3.00E-06        | NA       | 1.20E-06        | NA       |
| 2,4,6-Trichlorophenol | 3.18E-10        | NA       | 1.28E-10        | NA       |
| TOTAL                 | 3.02E-06        | 1.32E-03 | 1.21E-06        | 8.49E-05 |

TABLE 4-19a  
INHALATION OF SOIL PARTICULATES  
RISK LEVELS AND HAZARD INDICES  
DETERMINISTIC APPROACH

| COMPOUND          | WORKERS  |          | RESIDENT(CHILD) |          | RESIDENT(ADULT) |          |
|-------------------|----------|----------|-----------------|----------|-----------------|----------|
|                   | RL       | HI       | RL              | HI       | RL              | HI       |
| Arsenic           | 2.12E-06 | NA       | 1.24E-06        | NA       | 5.29E-07        | NA       |
| Chromium          | 2.27E-07 | NA       | 1.32E-07        | NA       | 5.67E-08        | NA       |
| Toluene           | NA       | 5.75E-11 | NA              | 3.61E-11 | NA              | 2.39E-11 |
| Ethylbenzene      | NA       | 1.19E-11 | NA              | 7.81E-12 | NA              | 4.64E-12 |
| Styrene           | 4.94E-15 | NA       | 2.88E-15        | NA       | 1.23E-15        | NA       |
| B(a)P (eq)        | 1.71E-08 | NA       | 9.93E-09        | NA       | 2.56E-09        | NA       |
| 2,3,7,8-TCDD (eq) | 5.88E-09 | NA       | 3.42E-09        | NA       | 1.47E-09        | NA       |
| TOTAL             | 2.37E-06 | 6.94E-11 | 1.39E-06        | 4.39E-11 | 5.90E-07        | 2.85E-11 |

NA - Not Available

B(a)P (eq) represents the total risk from carcinogenic PAHs equated to Benzo(a) Pyrene.

TABLE 4-17b  
INGESTION OF OFFSITE SOILS, RESIDENTS  
RISK LEVELS AND HAZARD INDICES  
STOCHASTIC APPROACH

| COMPOUND              | RESIDENT(CHILD) |          |                 |          |          |                 |
|-----------------------|-----------------|----------|-----------------|----------|----------|-----------------|
|                       | RL              |          |                 | HI       |          |                 |
|                       | Mode            | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Naphthalene           | NA              | NA       | NA              | 8.28E-06 | 8.38E-05 | 2.82E-04        |
| Fluorene              | NA              | NA       | NA              | 1.27E-07 | 1.29E-06 | 4.33E-06        |
| Anthracene            | NA              | NA       | NA              | 2.01E-08 | 2.04E-07 | 6.85E-07        |
| Fluoranthene          | NA              | NA       | NA              | 2.51E-06 | 2.54E-05 | 8.54E-05        |
| Pyrene                | NA              | NA       | NA              | 1.24E-06 | 1.25E-05 | 4.20E-05        |
| Pentachlorophenol     | 2.20E-09        | 2.23E-08 | 7.48E-08        | 7.13E-06 | 7.21E-05 | 2.43E-04        |
| Arsenic               | 4.17E-07        | 4.17E-06 | 1.40E-05        | 9.13E-03 | 9.26E-02 | 3.11E-01        |
| Chromium              | NA              | NA       | NA              | 1.79E-05 | 1.81E-04 | 6.08E-04        |
| Zinc                  | NA              | NA       | NA              | 2.54E-04 | 2.57E-03 | 8.64E-03        |
| BaP(eq)               | 2.93E-08        | 2.96E-07 | 9.94E-07        | NA       | NA       | NA              |
| 2,4,6-Trichlorophenol | 3.11E-11        | 3.14E-10 | 1.05E-09        | NA       | NA       | NA              |
| TOTAL                 | 4.49E-07        | 4.49E-06 | 1.51E-05        | 9.42E-03 | 9.55E-02 | 3.21E-01        |
| COMPOUND              | RESIDENT(ADULT) |          |                 |          |          |                 |
|                       | RL              |          |                 | HI       |          |                 |
|                       | Mode            | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Naphthalene           | NA              | NA       | NA              | 7.57E-07 | 5.57E-06 | 3.23E-05        |
| Fluorene              | NA              | NA       | NA              | 1.17E-08 | 8.62E-08 | 5.00E-07        |
| Anthracene            | NA              | NA       | NA              | 1.80E-09 | 1.33E-08 | 7.69E-08        |
| Fluoranthene          | NA              | NA       | NA              | 2.31E-07 | 1.70E-06 | 9.84E-06        |
| Pyrene                | NA              | NA       | NA              | 1.14E-07 | 8.40E-07 | 4.87E-06        |
| Pentachlorophenol     | 1.01E-09        | 7.40E-09 | 4.30E-08        | 6.56E-07 | 4.83E-06 | 2.80E-05        |
| Arsenic               | 1.89E-07        | 1.38E-06 | 8.04E-06        | 8.41E-04 | 6.19E-03 | 3.59E-02        |
| Chromium              | NA              | NA       | NA              | 1.64E-06 | 1.21E-05 | 7.01E-05        |
| Zinc                  | NA              | NA       | NA              | 2.33E-05 | 1.72E-04 | 9.95E-04        |
| BaP(eq)               | 1.34E-08        | 9.83E-08 | 5.71E-07        | NA       | NA       | NA              |
| 2,4,6-Trichlorophenol | 1.43E-11        | 1.04E-10 | 6.07E-10        | NA       | NA       | NA              |
| TOTAL                 | 2.03E-07        | 1.49E-06 | 8.65E-06        | 8.68E-04 | 6.39E-03 | 3.70E-02        |

NA - Not Available

**TABLE 4-18b**  
**DERMAL CONTACT OF OFFSITE SOILS, RESIDENT**  
**RISK LEVELS AND HAZARD INDICES**  
**STOCHASTIC APPROACH**

| COMPOUND              | RESIDENT(ADULT) |          |                 |          |          |                 |
|-----------------------|-----------------|----------|-----------------|----------|----------|-----------------|
|                       | RL              |          |                 | HI       |          |                 |
|                       | Mode            | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Naphthalene           | NA              | NA       | NA              | 1.10E-05 | 2.79E-05 | 8.17E-05        |
| Fluorene              | NA              | NA       | NA              | 1.69E-07 | 4.31E-07 | 1.26E-06        |
| Anthracene            | NA              | NA       | NA              | 2.61E-08 | 6.63E-08 | 1.95E-07        |
| Fluoranthene          | NA              | NA       | NA              | 3.34E-06 | 8.49E-06 | 2.49E-05        |
| Pyrene                | NA              | NA       | NA              | 1.65E-06 | 4.20E-06 | 1.23E-05        |
| Pentachlorophenol     | 1.46E-09        | 3.73E-09 | 1.08E-08        | 9.49E-07 | 2.41E-06 | 7.08E-06        |
| Arsenic               | 0.00E+00        | 0.00E+00 | 0.00E+00        | 0.00E+00 | 0.00E+00 | 0.00E+00        |
| Chromium              | 0.00E+00        | 0.00E+00 | 0.00E+00        | 0.00E+00 | 0.00E+00 | 0.00E+00        |
| Zinc                  | NA              | 0.00E+00 | NA              | 0.00E+00 | 0.00E+00 | 0.00E+00        |
| BaP(eq)               | 1.94E-07        | 4.95E-07 | 1.45E-06        | NA       | NA       | NA              |
| 2,4,6-Trichlorophenol | 2.06E-11        | 5.25E-11 | 1.54E-10        | NA       | NA       | NA              |
| TOTAL                 | 1.95E-07        | 4.99E-07 | 1.46E-06        | 1.71E-05 | 4.35E-05 | 1.27E-04        |

NA - Not Available

TABLE 4-19b  
INHALATION OF SOIL PARTICULATES  
RISK LEVELS AND HAZARD INDICES  
STOCHASTIC APPROACH

| COMPOUND     | RESIDENT (ADULT) |          |                 |          |          |                 |
|--------------|------------------|----------|-----------------|----------|----------|-----------------|
|              | RL               |          |                 | HI       |          |                 |
|              | Mode             | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Arsenic      | 2.41E-08         | 1.24E-07 | 3.77E-07        | NA       | NA       | NA              |
| Chromium     | 2.58E-09         | 1.33E-08 | 4.03E-08        | NA       | NA       | NA              |
| Toluene      | NA               | NA       | NA              | 1.09E-12 | 5.61E-12 | 1.70E-11        |
| Ethylbenzene | NA               | NA       | NA              | 2.12E-13 | 1.09E-12 | 3.30E-12        |
| Styrene      | 7.58E-17         | 3.90E-16 | 1.18E-15        | NA       | NA       | NA              |
| BaP(eq)      | 1.94E-10         | 9.98E-10 | 3.03E-09        | NA       | NA       | NA              |
| 2,3,7,8-TCDD | 6.69E-11         | 3.44E-10 | 1.04E-09        | NA       | NA       | NA              |
| TOTAL        | 2.69E-08         | 1.39E-07 | 4.21E-07        | 1.30E-12 | 6.70E-12 | 2.03E-11        |
| COMPOUND     | ON SITE WORKERS  |          |                 |          |          |                 |
|              | RL               |          |                 | HI       |          |                 |
|              | Mode             | Mean     | 95th Percentile | Mode     | Mean     | 95th Percentile |
| Arsenic      | 1.17E-06         | 2.52E-06 | 6.97E-06        | NA       | NA       | NA              |
| Chromium     | 1.26E-07         | 2.70E-07 | 7.47E-07        | NA       | NA       | NA              |
| Toluene      | NA               | NA       | NA              | 3.18E-11 | 6.83E-11 | 1.89E-10        |
| Ethylbenzene | NA               | NA       | NA              | 6.59E-12 | 1.41E-11 | 3.91E-11        |
| Styrene      | 3.69E-15         | 7.91E-15 | 2.19E-14        | NA       | NA       | NA              |
| BaP(eq)      | 9.43E-09         | 2.03E-08 | 5.60E-08        | NA       | NA       | NA              |
| 2,3,7,8-TCDD | 3.25E-09         | 6.98E-09 | 1.93E-08        | NA       | NA       | NA              |
| TOTAL        | 1.31E-06         | 2.82E-06 | 7.79E-06        | 3.84E-11 | 8.24E-11 | 2.28E-10        |

NA - Not Available

#### 4.9.2 Hazard Indices

##### **Deterministic Method Results**

The total overall potential hazard index (HI) for adult residents, child residents and onsite workers are estimated to be  $3.31 \times 10^{-2}$ ,  $3.48 \times 10^{-1}$  and  $5.83 \times 10^{-1}$ , respectively. These hazard indices are less than 1.0 which is the target value and indicates that acute or chronic effects are not expected from ingestion of onsite or offsite soils and sediment, dermal contact with offsite soils or sediment and groundwater or inhalation of onsite soil particulates.

##### **Stochastic Method Results**

The stochastic hazard index results are provided in Tables 4-16b, 4-17b, 4-18b, and 4-19b. All hazard indices derived by the stochastic method were less than 1.0 except the hazard index for ingestion of soils by workers which had a 95th percentile hazard index of 1.07. However, the mode and mean hazard indices for this scenario were  $1.29 \times 10^{-2}$  and 0.216, respectively.

#### 4.10 Sources of Uncertainty

Uncertainties are encountered throughout the process of performing a PHRA. This section discusses the sources of uncertainty in the following activities:

- o analytical data;
- o identifying PCOCs;
- o indices of toxicity;
- o environmental fate and transport modeling; and
- o performing the exposure assessments.

A qualitative summary of the uncertainties associated with the deterministic risk assessment is summarized in Table 4-20 and is discussed below. Inherent in the stochastic approach is the ability to quantify uncertainty, since probability

TABLE 4-20  
SUMMARY OF UNCERTAINTIES  
DETERMINISTIC APPROACH  
EFFECT ON POTENTIAL RISKS AND HAZARD INDICES (1)

| Potential Uncertainty                                                                                                                                                                    | Potential<br>Magnitude for<br>Over-Estimation<br>of Risks | Potential<br>Magnitude for<br>Under-Estimation<br>of Risks | Magnitude for<br>Over or Under<br>Estimation<br>of Risks |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------|
| <u>Environmental Sampling and Analysis</u>                                                                                                                                               |                                                           |                                                            |                                                          |
| Sufficient samples may not have been collected to characterize the media being evaluated.                                                                                                |                                                           |                                                            | Low                                                      |
| Systematic or random errors in the chemical analysis may yield erroneous data.                                                                                                           |                                                           |                                                            | Low                                                      |
| <u>Development of Toxicological Profiles</u>                                                                                                                                             | Low                                                       |                                                            |                                                          |
| <u>Exposure Assessment</u>                                                                                                                                                               |                                                           |                                                            |                                                          |
| The standard assumptions regarding body weight, period exposure, life expectancy, population characteristics, and lifestyle may not be representative of the actual exposure situations. |                                                           |                                                            | Low                                                      |
| The amount of media intake is assumed to be constant and representative of any actual exposure.                                                                                          | Moderate                                                  |                                                            |                                                          |
| Assumption of daily lifetime exposure for residents.                                                                                                                                     | Moderate                                                  |                                                            |                                                          |
| Use of maximum measured values to estimate intakes.                                                                                                                                      | High                                                      |                                                            |                                                          |
| Compounds not quantitatively evaluated.                                                                                                                                                  |                                                           | Low                                                        |                                                          |
| Lack of references for cancer slope factors (CSF) or Reference Doses (RfD)                                                                                                               |                                                           | Moderate                                                   |                                                          |

(1) As a general guideline, assumptions marked as "Low" may affect estimates or risks by less than one order of magnitude; assumptions marked as "Moderate" may affect estimates of risk between one and two orders of magnitude; and assumptions marked as "High" may effect estimates by more than two orders of magnitude.



distributions are output for risk levels and hazard indices. The probability distributions for the risk levels and hazard indices are provided in Appendix D.

#### **4.10.1 Analytical Data**

The development of a risk assessment depends on the reliability and uncertainties with the analytical data available to the risk assessor. Analytical data are limited by the precision and accuracy of the method of analysis. In addition, the statistical methods used to compile and analyze the data (eg. detection frequencies) are subject to the overall uncertainty.

#### **4.10.2 Potential Constituents of Concern**

The identification of PCOCs begins with the prevalence of the compounds found during site investigation work. The compounds found at a site are dependent upon the analytical methods used during the investigation. For the J.H. Baxter site, dioxin/furans, PAHs, VOAs, acid extractable phenolics, and metals were selected as PCOCs. These constituents were selected due to the history of the facility and from the knowledge of the chemicals and processes used at the site.

#### **4.10.3 Indices of Toxicity**

In making quantitative estimates of the potential toxicity of different doses of a compound to humans, uncertainties arise from two sources. First, data on human exposure and effects are usually incomplete, if they are available at all. Therefore, animal studies are often used and uncertainties arise from the process of extrapolating animal results to humans. Second, to obtain observable effects with a manageable number of experimental subjects, high doses of a compound are often used. In this situation, a high dose means that high exposures are used in the experiment relative to typical environmental exposures. However, when applying the results of the experiment to more typical situations, the effects at the high doses must be extrapolated to effects at lower doses.

In extrapolating effects from animals to people and high doses to low doses, scientific judgement and conservative assumptions are employed. In selecting animal studies for use in dose-response calculations, the following factors are considered:

- o studies are preferred where the animal closely mimics human pharmacokinetics,
- o studies are preferred where dose intake and duration most closely mimics the intake route and duration for humans, and
- o studies are preferred which demonstrate the most sensitive response to the compound in question.

For compounds believed to cause threshold effects (i.e. potential noncarcinogens) safety factors are employed in the extrapolation of effects from animals to humans, and from high doses to low doses.

The use of conservative assumptions results in quantitative indices of toxicity that are not expected to underestimate actual toxic effects, but may overestimate these effects by an order of magnitude or more.

#### **4.10.4 Environmental Fate and Transport**

The assessment of the environmental fates and transport of PCOCs, are restricted by limited information on;

- o site geology and hydrogeology,
- o chemical, physical and biological conditions in the subsurface, and
- o meteorological conditions.

These factors contribute uncertainty to the risk procedure.



#### 4.10.5 Exposure Assessment

In performing exposure assessments, uncertainties arise from two main sources;

- o estimating the transport and fate of a compound in the environment, including estimating release and transport in a particular environmental medium, and
- o uncertainties arise in the estimation of chemical intakes resulting from contact by a receptor with a particular medium.

To estimate an intake, certain assumptions must be made about exposure events, exposure durations, and the corresponding assimilation of constituents by the receptor. Exposure factors have been generated by the scientific community and have undergone review by the U.S. EPA. The U.S. EPA has published an Exposure Factors Handbook which contains the best and latest values. Regardless of the validity of these exposure factors, they have been derived from a range of values generated by studies of limited numbers on individuals. In all instances values used in this risk assessment represent the upper 90 to 95 percentile of the population. For this risk assessment, scientific judgements and conservative assumptions agree with those of the U.S. EPA. Conservative assumptions designed as not to underestimate daily intakes were employed for the deterministic approach and should err conservatively, protecting human health.

For chromium, it is assumed that all the chromium detected is chromium VI rather than chromium III. A surface soil sample in the vicinity of sample B-20 was collected on May 18, 1994 and analyzed for both chromium III and VI. The chromium III concentration in the sample was 96.3 ug/g whereas chromium VI was not detected in the sample at a detection limit of 1 ug/g. This result suggests that chromium VI comprises less than 1% of the total chromium concentration detected in the soil samples at the site. Therefore, risk levels calculated for chromium are anticipated to be exaggerated by a factor of 100.

Uncertainties associated with each potential exposure pathway investigated are provided below.

#### **4.10.5.1      Ingestion of Soil, Sediment and Surface Water**

Uncertainty is associated with the dose estimate. It is assumed in the PHRA that 100 percent of each PCOC was absorbed by the receptor. This will overestimate the dose and consequently risk levels and hazard indices.

#### **4.10.5.2      Inhalation of PCOCs**

Again uncertainties are associated with dose estimates. It is assumed that 100 percent of soil particulates inhaled by the receptors carry PCOCs, the PCOCs are at maximum concentrations, and that 100 percent of the PCOCs are absorbed by the receptor's body. It was also assumed that the offsite residents inhale the same soil dust as the onsite workers. The concentration of PCOCs in the respirable soil fraction is expected to be similar to the PCOC concentrations in the soils analyzed because the shallow soils at the site are silty clays which are fine sediments. Generally, if soils are coarser, such as sand, inhalation risks may be underestimated because respirable soil particles would be smaller and thus have greater surface areas for PCOC adsorption.

#### **4.10.5.3      Dermal Contact of Groundwater and Surface Waters**

Uncertainty is associated with the dose estimate. It was assumed that PCOCs in groundwater and surface water are adsorbed at the same rate as the dermal permeability of water. This will overestimate the dose received by receptors.

## 5.0 QUALITATIVE ENVIRONMENTAL IMPACT ASSESSMENT

### 5.1 Introduction

In addition to people, environmental receptors may potentially be affected by exposure to potential constituents of concern (PCOCs). The following section presents the qualitative environmental impact assessment (EIA) which determines the potential effects of site PCOCs to environmental receptors.

The EIA is conducted in accordance to the Phase II RI Workplan. The objectives of the EIA are to establish potential exposure pathways and qualitatively describe the potential effects to environmental receptors. In order to achieve these objectives, the site PCOCs are evaluated in relation to the site geology, hydrogeology, and physical characteristics.

An ecological survey of the site was conducted to identify any potentially endangered or threatened species. The survey was performed Mr. Martin Schott, Ph.D. who is an ecologist and wetlands specialist.

The EIA is divided into the following four sections:

- o Section 5.2 defines the study areas and potential receptors and establishes the potential exposure pathways.
- o Section 5.3 identifies the PCOCs that have the greatest relative potential to affect the health of environmental receptors.
- o Section 5.4 characterizes the magnitude of environmental exposures to PCOCs that are present at the site.
- o Section 5.5 presents the findings of the ecological survey.
- o Section 5.6 presents the conclusions of the assessment.

- o Section 5.7 presents the sources of uncertainties of the assessment and the limitations of the analysis.

## **5.2 Definition of the Study Areas**

The study areas for this assessment are:

- i) The onsite surface soils.

Thirty-two soil borings were drilled on the Baxter property from which 32 surface soil samples (0 to 2.5 feet below grade) were collected and analyzed for VOAs, phenols, PAHs, arsenic, chromium, copper and zinc.

- ii) The offsite surface soils.

Surface soil samples were obtained at nine offsite surface locations. The soil samples were obtained at six locations north of the site and three were collected south of the site along 1st Avenue.

- iii) The offsite drainage ditch which accepts surface run off from the site and the outfall of the surface water retention pond.

This ditch is located at the southwest corner of the site. It is diverted underground and resurfaces on the west side of Bertelsen Road. The ditch then traverses westward for approximately 1/4 mile before it turns northward and drains into the floodway channel paralleling Roosevelt Boulevard.

Surface water and sediment samples were obtained at four offsite locations within the ditch.

- iv) The onsite surface water retention pond.

The retention pond is located in the southwest corner of the site and collects the surface water runoff produced at the site. The pond is accessible to humans and animals.

In order to assess potential environmental risks posed by the on site surface water retention pond, sediment and surface water samples were obtained prior to completion of the Phase I RI report. No further sampling of the retention pond was conducted in the Phase II RI. The risks posed by the surface water retention pond were discussed in the Phase I RI report and are summarized in Section 5.6 of this report.

The environmental receptors that use the subject areas at the J.H. Baxter site for living or feeding purposes include aquatic species, such as frogs, and benthic organisms (eg. worms), and terrestrial life, such as domestic animals, birds, mice, and rabbits. Three routes of exposure may be of concern for wildlife in the vicinity of contaminated surface waters, sediments, and soils: oral, inhalation, and dermal. Oral exposures may occur via ingestion of contaminated food (eg. aquatic prey) or water or incidental ingestion of contaminated soils or sediments during foraging and other activities. Inhalation of soil particulates containing PCOCs is a potential exposure pathway. Dermal exposures are likely to be most significant for burrowing animals (i.e. contact with contaminated soils) and animals that spend considerable amounts of time submerged in surface waters.

### **5.3 Selection of Potential Constituents of Concern**

The PCOCs retained for qualitative assessment in the EIA are all chemical species detected in the on site soils, off site soils, drainage ditch sediments, or drainage ditch surface water. The maximum concentrations of PCOCs retained for the environmental impact assessment are listed in Table 5-1 for each of the above source areas.

TABLE 5-1  
Maximum Concentrations for  
Retained PCOCs used for the  
Environmental Impact Assessment

| Compounds                            | Soil<br>Onsite<br>ug/Kg | Soil<br>Offsite<br>ug/Kg | Drainage Ditch<br>Sediment<br>Offsite<br>ug/Kg | Drainage Ditch<br>Surface Water<br>Offsite<br>ug/L |
|--------------------------------------|-------------------------|--------------------------|------------------------------------------------|----------------------------------------------------|
| <b>Non-Carcinogenic PAHs</b>         |                         |                          |                                                |                                                    |
| Naphthalene                          | 421                     | 108                      | 160                                            | -                                                  |
| Acenaphthylene                       | -                       | 77.7                     | 145                                            | -                                                  |
| Acenaphthene                         | 7310                    | -                        | 252                                            | -                                                  |
| Fluorene                             | 5440                    | 23.3                     | 24.1                                           | 0.481                                              |
| Phenanthrene                         | 19700                   | 145                      | 57.1                                           | -                                                  |
| Anthracene                           | 2420                    | 17.1                     | 23.2                                           | -                                                  |
| Fluoranthene                         | 13200                   | 256                      | 86.3                                           | 0.416                                              |
| Pyrene                               | 15000                   | 94.5                     | 203                                            | 0.503                                              |
| Benzo(g,h,i)perylene                 | 3490                    | 54                       | 165                                            | 0.394                                              |
| <b>Potentially Carcinogenic PAHs</b> |                         |                          |                                                |                                                    |
| Chrysene                             | 30700                   | 113.0                    | 509                                            | 0.273                                              |
| Benzo(a)anthracene                   | 14300                   | 77.6                     | 64.9                                           | 0.251                                              |
| Benzo(b)fluoranthene                 | 13100                   | 72.9                     | 124                                            | 0.528                                              |
| Benzo(k)fluoranthene                 | 3960                    | 74.2                     | 36.4                                           | 0.124                                              |
| Benzo(a)pyrene                       | 4440                    | 50.8                     | 126                                            | 0.361                                              |
| Dibenzo(a,h)anthracene               | 15200                   | 36.1                     | 362                                            | 1.12                                               |
| Indeno(1,2,3-cd)pyrene               | 4520                    | 109.0                    | 104                                            | 0.221                                              |
| <b>Phenolic Compounds</b>            |                         |                          |                                                |                                                    |
| 2-Chlorophenol                       | -                       | -                        | 1900                                           | -                                                  |
| 2,4-Dichlorophenol                   | -                       | -                        | 530                                            | -                                                  |
| 4-Chloro-3-Methylphenol              | 56                      | 32                       | -                                              | -                                                  |
| 2,4,6-Trichlorophenol                | -                       | 245                      | -                                              | -                                                  |
| 2,4-Dinitrophenol                    | 362                     | -                        | 420                                            | -                                                  |
| 4-Nitrophenol                        | -                       | 51                       | -                                              | -                                                  |
| 2,3,5,6-Tetrachlorophenol            | 21500                   | -                        | -                                              | 7.2                                                |
| 2-Methyl-4,6-Dinitrophenol           | 173                     | 64                       | -                                              | -                                                  |
| Pentachlorophenol                    | 182000                  | 550                      | -                                              | 266                                                |
| <b>Metals</b>                        |                         |                          |                                                |                                                    |
| Arsenic                              | 2390000                 | 7000                     | 104000                                         | 86.6                                               |
| Chromium                             | 468000                  | 45600                    | 25500                                          | -                                                  |
| Copper                               | 4090000                 | 47500                    | 47900                                          | 253                                                |
| Zinc                                 | 1790000                 | 440000                   | 178000                                         | 140                                                |
| <b>Volatile Compounds</b>            |                         |                          |                                                |                                                    |
| Benzene                              | 73                      | -                        | -                                              | -                                                  |
| Toluene                              | 250                     | -                        | -                                              | 0.6                                                |
| Chlorobenzene                        | 224                     | -                        | -                                              | -                                                  |
| Ethylbenzene                         | 36                      | -                        | -                                              | 0.6                                                |
| Xylenes                              | 123                     | -                        | -                                              | 0.9                                                |
| Styrene                              | 96                      | -                        | -                                              | -                                                  |
| <b>Dioxin/furans</b>                 |                         |                          |                                                |                                                    |
| 2,3,7,8-TCDD Equivalents             | 150 ng/kg               | NA                       | NA                                             | NA                                                 |

"-" not detected. "NA" not analyzed



Toxicological profiles are provided in Appendix C for each of the site PCOCs, as outlined below:

- o Non carcinogenic PAHs (polynuclear aromatic hydrocarbons) are profiled collectively.
- o Potentially carcinogenic PAHs are profiled collectively.
- o Chlorinated phenolics are profiled collectively, with the exception of pentachlorophenol which is profiled separately.
- o Nitrophenolics are profiled collectively.
- o Dioxins and furans are profiled collectively.
- o Each of the following compounds are profiled independently:

Arsenic, chromium, copper, zinc, benzene, toluene, chlorobenzene, ethylbenzene, xylenes, and styrene.

The toxicological profiles are located in Appendix C, and for sake of brevity, the profiles for each of the PCOCs are not summarized in detail herein. The toxicological profiles provide animal data, such as discussions of acute, subchronic, and chronic toxicity, developmental and reproductive effects, mutagenicity, and carcinogenicity, as well as environmental effects, regulatory standards and criteria, environmental fate and transport, and chemical and physical properties. The toxicological information provides the ability to compare contaminant concentrations at the site to those concentrations shown to cause potentially toxic effects to environmental receptors in similar situations. The discussions of environmental fate and transport and physical/chemical properties in the toxicological profiles define the potential for chemicals to persist within an environmental medium and their ability to migrate within an environment or move from one medium to another.

#### 5.4 Exposure Characterization

The objective of this section is to qualitatively describe the potential environmental risks that are posed by the site. The study methodology is as follows:

##### **Surface Soils and Sediments**

In order to allow for qualitative evaluations of potential environmental risk, the following steps are undertaken:

- o Where possible, contaminant concentrations in soils or sediments that have been shown to represent the lowest concentrations at which biological effects have been shown to occur are referenced from the toxicological profiles. These values are compared directly to the analytical data collected at the site.
- o Should the above information not be available, potential exposures to PCOCs in soils and sediments are qualitatively assessed according to guidance provided in the Wildlife Exposure Factors Handbook (U.S. EPA, 1993). The handbook focuses on oral exposures, which in most exposure scenarios is described as presenting the foremost risk. In order to allow for qualitative evaluations via the ingestion pathway, we have applied the following approach:
  - \* NOELs (no observed effect level) or LOELs (lowest observed effect level) for test species administered chemical compound are referenced from the toxicological profiles. The NOELs and LOELs are reported as mg-chemical / kg-body weight / day.
  - \* The NOEL or LOEL is divided by the maximum PCOC concentration (mg-chemical / kg-soil). This calculation provides the soil intake (mg-soil / kg-body weight / day) of an environmental receptor that would be required to exceed the NOEL or LOEL for the subject PCOC.



- \* The calculated soil intake value is then compared to the wildlife soil intakes as provided in Table 5-2:

**TABLE 5-2**  
**REPRESENTATIVE WILDLIFE SOIL INTAKES**

| Animal  | Percent Soil in Diet | Daily Soil Intake |
|---------|----------------------|-------------------|
| Ducks   | <2 to 11             | <1 to 6           |
| Mice    | <2 to 2.8            | <3 to 6           |
| Turtles | 4.5 to 5.9           | 0.3 to 0.5        |

**Notes:**

- 1) Percent soil in diet values are reported on a dry weight basis in the Wildlife Exposure Factors Handbook.
- 2) Daily soil intakes are estimated from the available data in the Wildlife Exposure Factors Handbook and are reported as grams of soil per day per kg body weight per day (g/kg-BW/day).

**Surface Water**

The potential exposure of aquatic biota to PCOCs in the ditch surface water is qualitatively assessed by comparing water quality criteria to the maximum detected constituent concentrations. The maximum constituent concentration approach assumes that the PCOCs will travel in the ditch and reach the water bodies without being affected by any mitigating factors such as biodegradation, volatilization, cation exchange, or sorption processes. As such, the maximum constituent concentration approach is conservative, and does not reflect the lower concentrations detected as one proceeds downstream from the plant site.

The following sections discuss the potential risks associated with the PCOCs identified for each of the source areas, as listed in Table 5-1.

#### **5.4.1 Onsite Surface Soils**

##### **PAHs**

Terrestrial life may be exposed to PAHs through dermal contact, inhalation of respirable soil particles, or incidental ingestion. The maximum, arithmetic mean, and geometric mean concentration of total PAHs detected in the onsite surface soils was 151 mg/kg, 11 mg/kg and 0.9 mg/kg, respectively. According to the sources listed in the toxicological profiles, sediment PAH concentrations in the range of 2 to 12 mg/kg have been shown to pose minimal effects or represent the lowest concentrations at which biological effects have been shown (or suggested) to occur. Assuming similar biological effects for surface soils, the data suggests that terrestrial receptors at the site are exposed to concentrations of PAHs in the onsite soils which may cause biological effects.

##### **Pentachlorophenol**

According to sources listed in the toxicological profile for pentachlorophenol (PCP), NOELs (no observed effect level) ranging from 3 mg/kg/day to 5 mg/kg/day were determined for rats administered PCP orally in their diet. Higher intakes were shown to cause developmental, reproductive, mutagenic, and carcinogenic effects. The maximum concentration detected in the onsite surface soils was 182 mg/kg. Applying the most conservative of the above animal NOEL data, an intake exceeding 16 grams of soil per day per kilogram body weight of an environmental receptor may pose a health risk. This intake exceeds those values reported in Table 5-2 for ducks and mice, and likely exceeds the total soil intake through inhalation of particulates with adsorbed PCP, dermal contact with PCP contained in the surface soils, and incidental ingestion of surface soils. The data suggests that the concentration of pentachlorophenol in the onsite surface soils does not pose risks to terrestrial life.

### Chlorinated Phenolics

Limited toxicological data is available for 4-chloro-3-methylphenol and 2,3,5,6-tetrachlorophenol, the chlorinated phenolic compounds detected in the onsite surface soils. Lethal doses (LD<sub>50</sub>) of these compounds for rats exceed values published for pentachlorophenol, a chlorinated phenol compound which has been studied more intensively. Since 4-chloro-3-methylphenol and 2,3,5,6-tetrachlorophenol were detected at concentrations significantly less than pentachlorophenol, it appears that chlorinated phenolics present in the on site surface soils do not pose risks to terrestrial life. Chlorinated phenolics are biodegradable at low concentrations.

### Nitrophenolics

The following nitrophenolic species were detected in the onsite surface soils:

- o 2,4-Dinitrophenol
- o 2-Methyl-4,6-dinitrophenol

Nitrophenolic compounds are generally mobile in the environment and their adsorption to soils is not strong. Nitrophenolics in exposed soils may be subject to photolysis. In addition, nitrophenolics are biodegradable at low concentrations.

No toxicological data are available to compare concentrations of 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol detected on the site to those concentrations shown to cause adverse effects to animals in field or laboratory studies. Therefore, the potential impacts of nitrophenolic compounds to environmental receptors at the site cannot be evaluated.

### **Dioxins and Furans**

The maximum total concentration of polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) detected in the onsite surface soils was 0.150 ug/kg (reported as 2,3,7,8-TCDD equivalents).

According to sources listed in the toxicological profile for dioxins and furans, a LOEL (lowest observed effect level) of 0.001 ug/kg/day of 2,3,7,8-TCDD was determined for rats. Higher intakes were shown to cause developmental, reproductive, mutagenic, and carcinogenic effects.

Based strictly on the LOEL for the rat and the maximum concentration of dioxins and furans detected in the onsite surface soils, an intake exceeding 6.7 grams of soil per day per kilogram body weight of an environmental receptor may pose a health risk. This quantity of soils is just above the range of soil intakes reported for mice in Table 5-2. Therefore, based on the maximum concentration of dioxins and furans in the onsite surface soils, a risk to terrestrial life through the cumulative effects of incidental ingestion, inhalation, and dermal contact may be present. The lower arithmetic and geometric mean concentrations, representative of overall site conditions, are not considered to pose risks to terrestrial life at the site.

### **Arsenic**

According to sources listed in the toxicological profile for arsenic, a NOEL (no observed effect level) of 2.1 mg/kg/day was determined for dogs administered arsenic (in the form of either sodium arsenate or sodium arsenite) orally in their diet. Higher intakes were shown to cause developmental, reproductive, mutagenic, and carcinogenic effects.

The maximum, arithmetic mean, and geometric mean concentration of arsenic detected in the onsite surface soils was 2390 mg/kg, 174.4 mg/kg and 25.3 mg/kg, respectively. Applying the above NOEL data, an intake of the most highly contaminated soils exceeding 0.9 grams per day per kilogram body weight of an

environmental receptor may pose a health risk. Although this level of intake may occur through incidental ingestion, inhalation or bioaccumulative effects, the lower arithmetic and geometric mean arsenic concentrations, representative of overall site conditions, are not considered to pose risks to terrestrial life at the site.

### **Chromium**

The toxicity of chromium is highly dependent on its oxidation state. The hexavalent form (Cr VI) is the most toxic, likely the result of its strong oxidizing capability. According to sources listed in the toxicological profile for chromium VI, NOELs (no observed effect level) ranging from 0.089 mg/kg/day to 2.5 mg/kg-bw/day were determined for rats and dogs administered Cr VI orally in their drinking water. Higher intakes were shown to cause developmental, reproductive, mutagenic, and carcinogenic effects. Chromium III is much less toxic than CR VI. According to sources listed in the toxicological profiles a NOEL of 1468 mg/kg-bw/day was reported for rats administered Cr III orally.

The maximum concentration of chromium detected in the onsite soils was 468 mg/kg. Applying the most conservative of the above animal NOEL data for Cr VI, an intake exceeding 0.19 grams of soil per day per kilogram body weight of an environmental receptor may pose a health risk. For chromium III, an improbable intake exceeding 3.14 kilograms of soil per day per kilogram body weight of an environmental receptor would be required to pose a health risk. In order to further assess the potential risks, a surface soil sample, obtained at B-20 which had the highest chromium concentration detected in the onsite soils, was analysed for chromium VI and chromium III. Chromium VI was not detected. This data suggests that the chromium detected in the onsite surface soils is primarily the more environmentally stable trivalent form. Chromium does therefore not appear to pose risks to terrestrial life at the site.

### **Copper**

Limited animal toxicological data is available for copper. No determination of a NOEL could be found in the literature. The maximum, arithmetic mean, and

geometric mean concentrations of copper detected in the onsite surface soils were 4090 mg/kg, 203 mg/kg, and 59 mg/kg. In comparison to several animal studies referenced in the toxicological profile, it is possible that at a concentration of 4,090 mg/kg copper creates a health risk to environmental receptors. However, at the arithmetic mean or geometric mean concentrations copper would not be expected to pose health risks to environmental receptors.

#### **Zinc**

Zinc is associated with low toxicity. NOEL values referenced in the toxicological profile ranged from 95 mg/kg/day to 188 mg/kg/day for rats and mice. The maximum concentration detected in the onsite surface soils was 1790 mg/kg. Applying the most conservative of the above NOEL data, an intake exceeding 53 grams of soil per day per kilogram body weight of an environmental receptor is required to pose a health risk. This level of intake by environmental receptors is not considered likely, and therefore, the concentration of zinc detected in the onsite surface soils does not pose a risk to terrestrial life.

#### **Volatile Compounds (Benzene, Toluene, Chlorobenzene, Ethylbenzene, Xylenes, Styrene)**

The maximum concentrations of the volatile compounds detected in the onsite surface soils are not expected to pose a risk to environmental receptors, based on a comparison with toxicity data provided in the toxicological profiles. The maximum VOA concentration detected were less than 1 ug/g (ppm).

#### **5.4.2 Offsite Surface Soils**

The assessment of offsite surface soils has been conducted in consideration of the concentrations detected during the Phase II RI. Sources of these PCOCs other than the J.H. Baxter site are not considered.



## **PAHs**

Terrestrial life may be exposed to PAHs through dermal contact, inhalation of respirable soil particles, or incidental ingestion. PAH concentrations detected in offsite surface soils are presented in Table 5-1. Off site environmental receptors are expected to be exposed to PAH compounds at concentrations significantly below those shown to individually cause potentially toxic effects to environmental receptors in similar situations. The maximum concentration of total PAHs detected in the offsite surface soils was 1.23 mg/kg. According to the sources listed in the toxicological profiles, sediment PAH concentrations in the range of 2 to 12 mg/kg have been shown to pose minimal effects or represent the lowest concentrations at which biological effects have been shown (or suggested) to occur. Assuming similar biological effects for surface soils, the data suggests that terrestrial receptors at the site are not exposed to concentrations of PAHs in the onsite soils which may cause biological effects.

## **Pentachlorophenol**

According to sources listed in the toxicological profile for pentachlorophenol (PCP), NOELs (no observed effect level) ranging from 3 mg/kg/day to 5 mg/kg/day were determined for rats administered PCP orally in their diet. Higher intakes were shown to cause developmental, reproductive, mutagenic, and carcinogenic effects. The maximum concentration of pentachlorophenol detected in the offsite surface soils was 0.550 mg/kg. Applying the most conservative of the above animal NOEL data, an intake exceeding 5.3 kilograms of soil per day per kilogram body weight of an environmental receptor may pose a health risk. This intake is not plausible, therefore, the data suggests that the concentration of pentachlorophenol in the off site surface soils does not pose risks to terrestrial life.

## **Chlorinated Phenolics**

Limited toxicological data is available for 4-chloro-3-methylphenol and 2,4,6-tetrachlorophenol, the chlorinated phenolic compound detected in the onsite surface

soils. Lethal doses (LD<sub>50</sub>) of these compounds for rats exceed values published for pentachlorophenol, a chlorinated phenol compound which has been studied more intensively. Since 4-chloro-3-methylphenol and 2,4,6-tetrachlorophenol were detected at concentrations less than pentachlorophenol, it appears that chlorinated phenolics present in the off site surface soils do not pose risks to terrestrial life. Chlorinated phenolics are biodegradable at low concentrations.

### **Nitrophenolics**

The following nitrophenolic species were detected in the onsite surface soils at low concentrations:

- o 4-Nitrophenol
- o 2-Methyl-4,6-dinitrophenol

Nitrophenolic compounds are generally mobile in the environment and their adsorption to soils is not strong. Nitrophenolics in exposed soils may be subject to photolysis. In addition, nitrophenolics are biodegradable at low concentrations.

No toxicological data is available to compare concentrations of 4-nitrophenol and 2-methyl-4,6-dinitrophenol detected on the site to those concentrations shown to cause adverse effects to animals in field or laboratory studies. Although toxicological data are too limited to provide a definitive argument, nitrophenolic compounds are not expected to pose significant risks to offsite environmental receptors.

### **Arsenic**

As discussed in Section 5.4.1, a NOEL of 2.1 mg/kg/day of arsenic was reported for dogs administered arsenic orally in their diet. The maximum, arithmetic mean, and geometric mean concentration of arsenic detected in the off site surface soils was 7 mg/kg, 4.3 mg/kg and 3.4 mg/kg, respectively. Applying the above NOEL data, an intake of the most highly contaminated soils exceeding 300 grams per day per kilogram body weight of an environmental receptor may pose a health risk. This



level of intake is not considered probable, and arsenic is not therefore considered to pose risks to off site terrestrial life.

### **Chromium**

As presented in Section 5.4.1, NOELs ranging from 0.089 mg/kg/day to 2.5 mg/kg-bw/day were determined for rats and dogs administered Cr VI orally, and a NOEL of 1468 mg/kg-bw/day was reported for rats administered Cr III orally.

The maximum concentration of chromium detected in the offsite soils was 45.6 mg/kg. Applying the most conservative of the animal NOEL data for Cr VI, an intake exceeding 2.0 grams of soil per day per kilogram body weight of an environmental receptor may pose a health risk. This intake is possible, however, it is important to note that this intake has been calculated by applying the maximum concentration detected offsite and conservatively assuming that all the chromium is the more highly toxic hexavalent oxidation state. Testing of onsite soils indicated the chromium was present in the less toxic trivalent state. If the offsite chromium was attributable to J.H. Baxter, rather than other industrial sources in the area, this lower toxicity trivalent form would be suspected. Therefore, it is felt that the concentration of chromium detected in the offsite surface soils does not pose a risk to offsite environmental receptors.

### **Copper**

Copper was detected at a maximum concentration of 47.5 mg/kg in the offsite surface soils. Although toxicological data are too limited to provide conclusive evidence, a comparison to several animal studies referenced in the toxicological profile suggests that the copper detected in the offsite surface soils does not pose a risk to environmental receptors.

### **Zinc**

Zinc is associated with low toxicity. NOEL values referenced in the toxicological profile ranged from 95 mg/kg/day to 188 mg/kg/day for rats and mice. Zinc was

detected at a maximum concentration of 440 mg/kg in the offsite surface soils. Applying the most conservative of the above NOEL data, an intake exceeding 216 grams of soil per day per kilogram body weight of an environmental receptor would be necessary to pose a health risk. This level of intake by environmental receptors is not considered likely, and therefore, the concentration of zinc detected in the off site surface soils does not pose a risk to terrestrial life.

#### **5.4.3 Offsite Drainage Ditch**

##### **5.4.3.1 Sediments**

The comparisons between contaminant concentrations, NOELs, and reasonable receptor intake levels as discussed in Sections 5.4.1 and 5.4.2 for the on and off site surface soils provides the basis on which potential toxicity of ditch sediments are evaluated. Where contaminant concentrations in the ditch were lower than those previously shown not to pose environmental risks, a brief summary statement only is provided.

#### **PAHs**

According to the sources listed in the toxicological profiles, sediment PAH concentrations in the range of 2 to 12 mg/kg have been shown to pose minimal effects or represent the lowest concentrations at which biological effects have been shown (or suggested) to occur. The maximum concentration of total PAHs detected in the sediments of the offsite drainage ditch was 1.9 mg/kg. The data suggests that when exposure to aqueous and terrestrial receptors is compared to this maximum concentration, there may be a potential for risk. In comparison to the concentration of PAHs further from the plant site, away from heavy industrial activity, a risk is not suggested.

#### **Chlorinated Phenolics**

Pentachlorophenol was not detected in the offsite ditch sediments. 2-Chlorophenol and 2,4-dichlorophenol, which are potential by-products of pentachlorophenol

biodegradation, were detected at levels which do not suggest that there is a risk to environmental receptors.

### **Nitrophenolics**

2,4-Dinitrophenol was detected at a maximum concentration of 420 ug/kg in the offsite ditch sediments. Although toxicological data are too limited to provide a definitive argument, nitrophenolic compounds detected in the offsite ditch sediments are not expected to pose significant risks to environmental receptors.

### **Arsenic**

A NOEL of 2.1 mg/kg/day of arsenic was reported for dogs administered arsenic orally in their diet. Arsenic was detected at a maximum concentration of 104 mg/kg in the ditch sediments. Applying the above NOEL data, an intake of soils exceeding 20 grams per day per kilogram body weight of an environmental receptor may pose a health risk. This level of intake well exceeds that estimated for ducks and turtles, and arsenic is not therefore considered to pose risks to off site terrestrial life.

### **Chromium**

As presented in Section 5.4.1, NOELs ranging from 0.089 mg/kg/day to 2.5 mg/kg-bw/day were determined for rats and dogs administered Cr VI orally, and a NOEL of 1468 mg/kg-bw/day was reported for rats administered Cr III orally.

The maximum concentration of chromium detected in the offsite ditch sediments was 25.5 mg/kg, which is less than that detected in the offsite soils. Following the logic of Section 5.4.2, it is felt that the concentration of chromium detected in the ditch sediments does not pose a risk to offsite environmental receptors.

### **Copper**

Copper was detected at a maximum concentration of 47.5 mg/kg in the ditch sediments. Although toxicological data are too limited to provide conclusive

evidence, a comparison to several animal studies referenced in the toxicological profile suggests that the copper detected in the offsite ditch sediments does not pose a risk to environmental receptors.

#### **Zinc**

NOEL values referenced in the toxicological profile ranged from 95 mg/kg/day to 188 mg/kg/day for rats and mice. Zinc was detected at a maximum concentration of 178 mg/kg in the ditch sediments. Applying the most conservative of the above NOEL data, an intake exceeding 533 grams of soil per day per kilogram body weight of an environmental receptor is necessary to pose a health risk. This level of intake by environmental receptors is not plausible, and therefore, the maximum concentration of zinc detected in the offsite ditch sediments is not expected to pose a risk to environmental receptors.

#### **5.4.3.2 Surface Water**

In addition to the information obtained from the toxicological profiles, ambient fresh water quality criteria are also provided to facilitate assessment of the environmental risks associated with the J.H. Baxter site. This data is provided in the document entitled "*Table 20 Water Quality Criteria Summary, Oregon Administrative Rules, Chapter 340, Division 41 - Department of Environmental Quality*". Table 5-3 provides a summary of the Oregon fresh water quality criteria for the retained PCOCs.

#### **PAHs**

Limited toxicological data is available for PAH toxicity in surface water to fresh water aquatic species. No fresh water acute or chronic criteria are available for total PAHs from the Oregon Water Quality Criteria Summary or the U.S. EPA. Oregon provides an acute toxicity for total PAHs of 300 ug/L for marine aquatic species. The maximum concentration of total PAHs detected in the offsite drainage ditch was 3.43 ug/L.

TABLE 3-3  
Water Quality Criteria Summary  
for the  
Retained PCOCs used for the  
Environmental Impact Assessment

| Compounds                         | Maximum Conc.<br>Detected in the<br>Drainage Ditch<br>ug/L | Maximum Concentration for<br>Protection of Fresh Water Aquatic Life |                             |
|-----------------------------------|------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------|
|                                   |                                                            | Acute<br>Criteria<br>ug/L                                           | Chronic<br>Criteria<br>ug/L |
| Polynuclear Aromatic Hydrocarbons |                                                            |                                                                     |                             |
| Non Carcinogenic PAHs             |                                                            |                                                                     |                             |
| Naphthalene                       | -                                                          | 2300 (a)                                                            | 620 (a)                     |
| Acenaphthylene                    | -                                                          | N/A                                                                 | N/A                         |
| Acenaphthene                      | -                                                          | 1700 (a)                                                            | 520 (a)                     |
| Fluorene                          | 0.481                                                      | N/A                                                                 | N/A                         |
| Phenanthrene                      | -                                                          | N/A                                                                 | N/A                         |
| Anthracene                        | -                                                          | N/A                                                                 | N/A                         |
| Fluoranthene                      | 0.416                                                      | 3,980 (a)                                                           | N/A                         |
| Pyrene                            | 0.503                                                      | N/A                                                                 | N/A                         |
| Benzo(g,h,i,)perylene             | 0.394                                                      | N/A                                                                 | N/A                         |
| Potentially Carcinogenic PAHs     |                                                            |                                                                     |                             |
| Chrysene                          | 0.273                                                      | N/A                                                                 | N/A                         |
| Benzo(a)anthracene                | 0.251                                                      | N/A                                                                 | N/A                         |
| Benzo(b)fluoranthene              | 0.528                                                      | N/A                                                                 | N/A                         |
| Benzo(k)fluoranthene              | 0.124                                                      | N/A                                                                 | N/A                         |
| Benzo(a)pyrene                    | 0.361                                                      | N/A                                                                 | N/A                         |
| Dibenzo(a,h)anthracene            | 1.12                                                       | N/A                                                                 | N/A                         |
| Indeno(1,2,3-cd)pyrene            | 0.221                                                      | N/A                                                                 | N/A                         |
| Chlorinated Phenolic Compounds    |                                                            |                                                                     |                             |
| 2-Chlorophenol                    | -                                                          | 4380 (a)                                                            | 2000 (a)                    |
| 2,4-Dichlorophenol                | -                                                          | 2020 (a)                                                            | 365 (a)                     |
| 4-Chloro-3-Methylphenol           | -                                                          | 30 (a)                                                              | N/A                         |
| 2,4,6-Trichlorophenol             | -                                                          | N/A                                                                 | 970 (a)                     |
| 2,3,5,6-Tetrachlorophenol         | 7.2                                                        | N/A                                                                 | N/A                         |
| Pentachlorophenol                 | 266                                                        | 20 (b)                                                              | 13 (b)                      |
| Nitrophenolic Compounds           |                                                            |                                                                     |                             |
| 2,4-Dinitrophenol                 | -                                                          | N/A                                                                 | N/A                         |
| 4-Nitrophenol                     | -                                                          | N/A                                                                 | N/A                         |
| 2-Methyl-4,6-Dinitrophenol        | -                                                          | N/A                                                                 | N/A                         |
| Total Nitrophenols                | -                                                          | 230 (a)                                                             | 150 (a)                     |
| Metals                            |                                                            |                                                                     |                             |
| Arsenic                           | 86.6                                                       | N/A                                                                 | N/A                         |
| Chromium                          | -                                                          | 16 (c)                                                              | 11 (c)                      |
|                                   | -                                                          | 1700 (d,e)                                                          | 210 (d,e)                   |
| Copper                            | 253                                                        | 18 (e)                                                              | 12 (e)                      |
| Zinc                              | 140                                                        | 120 (e)                                                             | 110 (e)                     |
| Volatile Compounds                |                                                            |                                                                     |                             |
| Benzene                           | -                                                          | 5300 (a)                                                            | N/A                         |
| Toluene                           | 0.6                                                        | 17500 (a)                                                           | N/A                         |
| Chlorobenzene                     | -                                                          | N/A                                                                 | N/A                         |
| Total chlorinated benzenes        | -                                                          | 250 (a)                                                             | 50 (a)                      |
| Ethylbenzene                      | 0.6                                                        | 32000 (a)                                                           | N/A                         |
| Xylenes                           | 0.9                                                        | N/A                                                                 | N/A                         |
| Styrene                           | -                                                          | N/A                                                                 | N/A                         |

Notes:

"-" not detected.

"NA" not analyzed.

"N/A" not available.

(a) = Insufficient data to develop criteria; value presented is the LOEL (Lowest Observed Effect Level).

(b) = pH dependent criteria (7.8 pH used).

(c) = Chromium VI (hexavalent)

(d) = Chromium III (trivalent)

(e) = Hardness dependent criteria (100 mg/L used).

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Of the PAH compounds detected in the ditch surface water, only fluoranthene (maximum 0.416 ug/L) has an Oregon fresh water acute criterion of 3,980 ug/L. No fresh water chronic criterion is available for fluoranthene.

Naphthalene and acenaphthene, which were not detected in the surface water, have Oregon fresh water acute and chronic criteria of 2,300 ug/L and 620 ug/L, and 1700 ug/L and 520 ug/L, respectively. These values are significantly higher than the concentrations of other non carcinogenic PAHs detected in the ditch surface water.

In summary, the data suggests that PAHs in the offsite drainage ditch surface water do not pose risks to environmental receptors.

#### **Chlorinated Phenolics**

2,3,5,6-Tetrachlorophenol was detected at a maximum concentration of 7.2 ug/L in the offsite ditch surface water. No fresh water quality criteria is available for 2,3,5,6-tetrachlorophenol, however, 7.2 ug/L is less than that shown to create adverse effects in aquatic species as described in the toxicological profile for chlorinated phenolics.

Pentachlorophenol was detected at a maximum concentration of 266 ug/L at sampling location SW-8. Concentrations decreased further downstream to 187 ug/L, 75 ug/L, and 26 ug/L at SW-9, SW-10, and SW-11, respectively. The fresh water acute and chronic criteria for pentachlorophenol (at pH 7.8) are 20 ug/L and 13 ug/L, respectively. Although it is expected that biodegradation and other mitigating factors may decrease the concentration of pentachlorophenol to acceptable levels prior to reaching a receiving water body, the elevated concentration of pentachlorophenol may create adverse environmental effects in the vicinity of the plant site.

#### **Arsenic**

Arsenic was detected at a maximum concentration of 86.6 ug/L in the offsite ditch surface water. No fresh water acute or chronic criteria are available for arsenic from the Oregon Water Quality Criteria Summary. Criteria derived from the U.S. EPA for acute and chronic toxicity to fresh water organisms are 360 ug/L and 190 ug/L,



respectively. Based on these criteria, arsenic in the ditch surface water does not pose a risk to aquatic life in the offsite ditch.

### **Copper**

Copper was detected at a maximum concentration of 253 ug/L at sampling location SW-9 in the offsite ditch surface water. The downstream concentration of copper decreased to 28 ug/L at SW-11. The fresh water acute and chronic criteria for copper (at 100 mg/L water hardness) are 18 ug/L and 12 ug/L, respectively. Although it is expected that cation exchange, sorption processes, and other mitigating factors may decrease the concentration of copper to acceptable levels prior to reaching a receiving water body, the elevated concentration of copper may create adverse environmental effects in the vicinity of the plant site.

### **Zinc**

Zinc was detected at a maximum concentration of 140 ug/L at location SW-9 in the offsite ditch surface water. The downstream concentration decreased to 70.5 ug/L at SW-11. The fresh water acute and chronic criteria for zinc (at 100 mg/L water hardness) are 120 ug/L and 110 ug/L, respectively. Zinc in the ditch surface water may pose a risk to aquatic life in proximity to the plant site, although downstream concentrations appear to be reduced to levels less than those shown to cause detrimental environmental effects in similar settings.

### **Volatile Compounds**

Volatile compounds in the offsite ditch surface water do not pose a risk to environmental receptors. Toluene, ethylbenzene, and xylenes were detected at maximum concentrations of 0.6 ug/L, 0.6 ug/L, and 0.9 ug/L, respectively. The fresh water acute criteria for toluene and ethylbenzene are 17,500 ug/L and 32,000 ug/L, respectively. Fresh water chronic criteria are not available for toluene and ethylbenzene. Fresh water acute and chronic criteria are not available for xylenes.

## 5.5 Ecological Survey

An ecological survey of the site was performed by a qualified and experienced ecologist to determine if endangered or threatened plant or animal species are present or likely to be present. The survey consisted of collecting information from federal and state agencies including the Oregon Natural Heritage Data Base (OHHDB). The following summarizes the Ecologist's findings.

The OHHDB provided information that the site has no known occurrences of any threatened or endangered species, and no known occurrences of any species of concern. Bradshaw's lomatium (*lomatium bradshawii*) which is a federally listed endangered specie is known to occur in the Eugene area. It is a small, herbaceous perennial with yellow flowers, and until recently had only been observed in the southern Willamette Valley. However, a population has recently been discovered in Clark County, Washington. It occurs in flat bottomlands, usually in tufted hairgrass (*deschampsia cespitosa*) communities, with heavy clay soils. It is usually found in depressions and seasonal channels and rarely in vernal pools.

Several species of concern such as; white-topped aster (*aster curtus*), tall bugbane (*cimicifuga elata*), Willamette Valley daisy (*erigeron decumbens*), Kincaid's lupine (*lupinus sulphureus* spp *kincaidii*), Howell's montia (*montia howelli*), shaggy horkelia (*horkelia congesta*) and Timwort (*microcala quadrangularis*) are present in the Eugene area. In addition, both the northwestern pond turtle (*clemmys marmorata marmorata*) and Fender's blue butterfly (*icarioides fenderi*) have been found in the vicinity.

White-top aster has a federal candidate 2 and state sensitive 2 listing. Tall bugbane also has a federal candidate 2 and state sensitive 2 listing. These listings indicate that the species is of concern, but is not protected.

The Willamette Daisy is listed as a federal candidate 1 and a state sensitive 1 species. These categories indicate that there is enough information to list the specie as threatened or endangered, but it has not been listed. Kincaid's lupine, like the white-



top aster and tall bugbane has a federal candidate 2 and state sensitive 2 listing. Howell's montia has a federal candidate 2 state sensitive 1 listing. Since it is not listed as threatened or endangered, they are not protected, but are a species of concern. Shaggy horkelia has a federal category 2 listing, and does not have a state listing.

Fender's blue butterfly is associated with Kincaid's lupine since it feeds on the lupines leaves and flowers. It has a federal candidate 2 listing and has been dropped from the state's list. The northwestern pond turtle is found throughout western Oregon and Washington, and is found along slow moving streams and ponds. It has a federal candidate 2 and a state critical listing. A state critical listing indicates that the species may soon have endangered status, but is not listed currently.

A site visit was conducted to determine if there was any suitable habitat present on the site for any of the rare, threatened or endangered species listed above. Except for a small area in the southwest corner of the site there is no suitable habitat for any of the species listed above. The southwest corner of the site is dominated by Himilayan blackberry. Below the blackberry there is a band of reed canary grass. Beggar tick dominates the bottom of the pond.

Due to the industrial nature of the site there is little to no suitable habitat for Bradshaw's lomatium, which is the only species discussed above protected by law. The rest of the species are not protected by either state or federal laws.

## 5.6 Conclusions

Pentachlorophenol and other chlorinated phenolics, chromium, zinc, benzene, toluene, chlorobenzene, ethylbenzene, xylenes, and styrene were not considered to be present at levels in the on site surface soils which would create environmental risks. Based on an assessment of its maximum and arithmetic mean concentration, total PAH detected in the onsite surface may pose potential risks to environmental receptors at the J.H. Baxter site. The geometric mean arsenic concentration is not considered to pose a risk. Based on an assessment of maximum site concentrations, arsenic and dioxins/furans detected in the onsite surface soils may pose potential

risks to environmental receptors at the J.H. Baxter site. However, the arithmetic mean concentrations are not considered to pose risks. Toxicological data for nitrophenolics and copper are too limited to provide a specific conclusion, although an environmental risk may be present for the maximum concentration of copper detected at the site.

Contaminant species detected in the offsite surface soils were not present at levels which would pose risks to environmental receptors.

Only the maximum concentration of PAHs detected in the ditch sediment approaches the lower threshold of concentrations that have been shown to cause biological effects. Other contaminant species detected in the ditch sediments were not present at levels which would pose risks.

Arsenic, PAHs, chlorinated phenolics compounds other than pentachlorophenol, toluene, ethylbenzene, and xylenes detected in the surface water of the offsite drainage ditch were not considered to be present at levels which would create environmental risks. The concentration of pentachlorophenol, copper, and zinc in the immediate vicinity of the plant site only, may present health risks to environmental receptors.

The surface water retention pond, its outfall, and the receiving ditch were evaluated in the Phase I RI report. Seven surface water samples were obtained; three from the pond, one from the outfall, and three from the receiving ditch. The conclusions of the Phase I report are summarized in the following paragraphs.

The maximum concentrations of phenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol detected in all of the surface water samples were below the freshwater acute and chronic criteria set for these compounds.

Pentachlorophenol was detected in all surface water samples except for the sample collected upgradient in the ditch. Samples from the retention pond as well as the outfall from the pond were found at concentrations exceeding the acute and chronic criteria for freshwater aquatic organisms. Pentachlorophenol was detected in two

out of three samples collected from the ditch, of which one sample exceeded both the chronic and acute criteria and the other exceeded the chronic criteria.

PAH compounds were detected in all surface water samples, except for one ditch sample that was collected upgradient to the site. The detected levels were not considered to have posed environmental risks.

All surface water samples obtained from the pond exceeded the acute and chronic toxicity criteria for arsenic, chromium, copper and zinc, except for one out of the three chromium samples. In this and further chromium analyses, the concentrations were conservatively compared to the criteria for chromium (VI), the most toxic form of chromium.

The sample from the outfall from the pond and a sample from the drainage ditch, downgradient from the pond, had arsenic concentrations exceeding both the acute and chronic criteria. Copper was detected above both the chronic toxicity value and the acute toxicity value in all but one sampling location. Chromium was detected above acute and chronic criteria at the outfall sampling location only. Zinc was detected at concentrations exceeding chronic values in all but one sample and above acute values in the sample from the outfall and a downgradient sample from the drainage ditch.

An ecological survey found that only one species which occurs in the Eugene area, Bradshaw's lomatium, is protected by law. However, no known occurrences of this species has been reported at the site according to the Oregon Natural Heritage Data Base and the site conditions do not provide an environment conducive to its presence.

The Phase I environmental impact assessment determined that concentrations of arsenic, chromium and zinc exceeded ambient water quality criteria in the onsite ditch water and pentachlorophenol concentrations at some locations in the surface water retention pond and onsite ditch exceeded chronic and/or acute criteria.

### 5.7 Sources of Uncertainties

Receptor species and characteristics have not been quantitatively evaluated and generic data has been referenced from available sources. The environmental impact of PCOCs from the site was qualitatively assessed. At times, only crude comparisons could be made between the concentrations of PCOCs detected at the J.H. Baxter site and laboratory or field toxicological studies. Maximum onsite and offsite concentrations of PCOCs in surface soils, sediments, and surface water were compared to relevant criteria and toxicological information. This may not be applicable to actual intakes by environmental receptors. Where appropriate, arithmetic and geometric mean concentrations of PCOCs in site surface soils and water quality at downstream surface water sampling locations were referenced. In addition to the J.H. Baxter site there are other potential sources for offsite surface soil contamination.

The environmental assessment is also affected by uncertainties identified in Section 4.10.4 for environmental fate and transport processes.

## **6.0 SUMMARY AND CONCLUSIONS**

The Phase II Remedial Investigation (RI) was performed by Keystone Environmental Ltd. on behalf of J.H. Baxter & Company for the Oregon Department of Environmental Quality (DEQ) to assess the offsite extent of potential constituents of concern (PCOCs) identified in the Phase I RI report (dated August 1991). The extent of PCOCs in the onsite soils was also investigated as part of the Phase II RI. The Phase II RI data was used to refine the original public health and environmental risk assessments performed in the Phase I RI.

To accomplish the Phase II RI, the following investigative program was conducted between November 1991 and January 1994.

- o The installation and sampling of nine monitoring wells,
- o The collection and analysis of four offsite ditch sediment and surface water samples,
- o The collection and analysis of nine offsite surface soil samples, and
- o The drilling of thirty-two onsite soil boreholes and the collection and analysis of 64 soil samples from the boreholes.

### **6.1 Site Geology and Hydrogeology**

The Phase II investigation expanded the geologic knowledge of the area, particularly offsite. The offsite well installation revealed that the lower confining aquitard, which consisted of clay approximately 20 feet thick onsite, thinned to the north. At well W-17B, the northernmost offsite well, a layer approximately 3 feet thick of clayey gravels was present. The deep aquifer which was below this aquitard on the site appears to become integrated with the shallow aquifer, north of the J.H. Baxter property.

The shallow onsite soil investigation confirmed that the plant site is generally covered with a layer of silty clay with gravels intermixed. At most locations the silty clay graded to a sandy clay at depth (approximately 6 feet below grade).

The water table was approximately 5 to 6 feet below grade during the onsite soil investigation in January of 1994. The direction of groundwater flow in the shallow aquifer was confirmed to be to the northwest. A slight groundwater mound is present immediately north of Roosevelt Boulevard. The mound may be the result of infiltrating water from the floodway channel and/or the soil ridge present on the north side of the floodway channel. The hydraulic gradient within the shallow aquifer was estimated at 0.003 ft/ft in May of 1992.

## **6.2 Nature and Extent of Contamination**

PCOCs were detected in the onsite and offsite soils, offsite sediments, surface waters and groundwater. Generally, PCOCs were not present in the offsite surface soils at concentrations of concern.

PCOCs were present in the offsite ditch sediments and surface waters. Pentachlorophenol (PCP) was detected in the surface water at the furthest offsite sampling location (SW-11) at a concentration exceeding the Oregon Water Quality Criteria for protection of aquatic life. Arsenic was also detected in the offsite ditch waters. The arsenic concentration exceeded its maximum contaminant level (MCL) at the two nearest sampling locations to the site (SW-8 and SW-9). PAH was detected in the offsite ditch sediments and surface waters at low concentrations (ie. maximum total PAH concentrations are 3.43 ug/L and 1.9 ug/g). Concentrations of PAH at the furthest downstream location, SW-11/SD-11, were only 0.17 ug/L and 0.045 ug/g, respectively. The source of PAH in the offsite sediments and surface water may be associated with the adjacent railway or local industries other than J.H. Baxter.

The onsite soils contain PCOCs at various locations on the site. The highest concentration of PCOCs occurs in the immediate vicinity of the chemical storage tank farm. The treated wood and pole storage areas west and east of the treatment



facility also contain PCOCs in the soil. Generally, PCOC concentrations decrease with soil depth on the site.

Offsite groundwater samples do contain some PCOCs, but they are at low concentrations. Pentachlorophenol was only detected in a duplicate sample from well W-17A in January 1992. Pentachlorophenol has not been detected since in the offsite wells. PAHs have been detected at low concentrations in several offsite wells from January of 1992 to June of 1994. However, the concentrations are sporadic and inconsistent, which indicates the PAHs in the offsite groundwater may be not be associated with associated with the J.H. Baxter site contamination. Volatile aromatic compounds have not been detected in the offsite groundwaters.

Onsite groundwaters are contaminated with pentachlorophenol, PAHs, volatile aromatics and to a lesser extent metals. The highest concentrations of PCOCs was found at well locations W-7S, W-8S and W-2S. W-7S is located immediately downgradient of the treatment and chemical storage tank area. Well W-8S is located on the edge of the former burn pit in the southern section of the site. Well W-2S is positioned just downgradient of the surface water retention pond in the southwest portion of the site which is the probable source for PCOCs observed in W-2S.

Wells W-13I and W-13S, which are located along the northern property line, contained approximately 1 mg/L of pentachlorophenol in 1992. However, with the recent implementation of a groundwater pump and treat system, which pumps from these two wells and well W-20, pentachlorophenol concentrations have decreased significantly in the two wells. The groundwater pump and treat system has also been able to recover PCOCs which had migrated offsite and serves to maintain a hydraulic barrier preventing potential further offsite migration of PCOCs.

### **6.3 Public Health and Environmental Risk Assessment**

A quantitative Public Health Risk Assessment (PHRA) was performed integrating Phase II analytical results. The Phase II PHRA addressed some additional exposure pathways the Phase I PHRA did not include. These were ingestion of ditch sediments and surface waters by a child, dermal contact and ingestion of offsite soils

by adult and child residents and dermal contact of offsite groundwater while lawn watering. Scenarios which were assessed in the Phase I PHRA but were not in the Phase II PHRA were ingestion of groundwater by residents, inhalation of groundwater VOCs while showering and dermal contact with groundwater while bathing. These were not assessed in the Phase II PHRA because residents are no longer using well water as a source of drinking and bathing water.

The Phase I PHRA identified risks above the EPA target range of  $10^{-4}$  to  $10^{-6}$  through ingestion of groundwater for adult and child future residents and dermal exposure to groundwater for adult residents. However, since the Phase I PHRA was conducted, the approach for determining the exposure point concentrations for PCOCs has been revised. The 95th percentile upper confidence limit (UCL) of the arithmetic mean concentration is now to be used instead of the maximum PCOC concentration for each media sampled. Only when the 95th UCL of the arithmetic mean exceeds the maximum PCOC concentration, is it then permissible to use the maximum concentration.

The Phase II PHRA identified carcinogenic risks to onsite workers which exceed the acceptable target values recommended by the U.S. EPA. The risk to onsite workers is from potential ingestion of onsite surface soils. The risk level for the onsite worker from potential ingestion of onsite surface soils is  $1.43 \times 10^{-4}$ . However, the hazard index for the same scenario is less than 1.0 which indicates that noncarcinogenic chronic effects are not anticipated from ingestion of onsite soils by workers. Human health risks were within the U.S. EPA target range for the remaining exposure scenarios assessed in the PHRA. Although, DEQ does not necessarily use the EPA target risk range, since they prefer to cleanup a site to background levels, unless the solution is technically unfeasible or not cost effective, it has been used for comparative purposes in the report.

The standard or deterministic approach to performing risk assessments can overestimate risk. A probabilistic or stochastic approach is now being used by many jurisdictions to provide a more realistic estimate of risk and to provide a quantitative evaluation of uncertainty. Keystone performed a stochastic risk assessment on exposure scenarios where the total receptor risk was greater than  $10^{-6}$  and exposure



factor probability distributions were available. These exposure scenarios included ingestion of onsite soils, ingestion of offsite soils and inhalation of soil particulates, onsite and offsite. J.H. Baxter plant employee records were reviewed to determine actual exposure duration data for workers at the plant and incorporated into the stochastic risk assessment.

The stochastic risk assessment results produced comparable risks when the 95th percentile risk is compared to the risks determined using the standard approach. However, the mean and mode risk values were significantly less than the standard approach risks. The mode risk represents the most probable risk. For example, the ingestion of soils by workers produced a risk of  $1.43 \times 10^{-4}$  using the standard risk approach. The 95th percentile risk from the stochastic approach was comparable at  $2.6 \times 10^{-4}$  but the mean and mode risks were approximately  $5 \times 10^{-5}$  and  $3 \times 10^{-6}$ , respectively.

The Phase II qualitative Environmental Impact Assessment (EIA) identified potential risks to offsite receptors. PAH, dioxin/furan, arsenic, chromium and copper concentrations detected in the onsite surface soils suggest a potential risk to environmental receptors. The concentration of arsenic in the offsite ditch sediments also poses a potential risk to environmental receptors. Additionally, it was determined that PCP, arsenic, copper and zinc detected in the offsite ditch waters provide a potential risk to environmental receptors. However, it is important to recognize that maximum PCOC concentrations were used to evaluate the environmental risks.

The Phase I EIA identified several PCOCs in the water in the onsite ditch which exceeded Ambient Water Quality Criteria for freshwater aquatic life. These constituents included arsenic, chromium, and zinc.

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