REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT

HYTEC-LITTLEROCK SITE
HALO-KUNTUX LANE
LITTLEROCK, WASHINGTON

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LIST OF ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
COCs	Chemicals of concern
cPAHs	carcinogenic Polycyclic Aromatic Hydrocarbons
CSM	Conceptual Site Model
DQO	Data quality objective
Ecology	Washington State Department of Ecology
EM	Electromagnetic method
FC	Federal Candidate
FCo	Federal Species of Concern
FE	Federal Endangered
FS	Feasibility Study
FT	Federal Threatened
GC/MS	Gas Chromatography/Mass Spectrometry
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HASP	health and safety plan
HLMW	Hytec-Littlerock monitoring well
ICs	Institutional controls
Kd	soil-water partition coefficient
Koc	organic carbon partition coefficient
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter
mg/L	Milligrams per liter
MCL	Maximum contaminant level
MDL	Method detection limit
MTCA	Model Toxics Control Act
NTU	Nephelometric turbidity units
NGVD	National Geodetic Vertical Datum
NWHI	Northwest Habitat Institute
ORCAA	Olympic Region Clean Air Agency
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PID	Photo ionization detector
PLP	Potentially Liable Party
POC	Point of compliance
ppbv	Parts per billion volume
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
Qvr	Vashon glacial outwash
RAO	Remedial action objective
RI	Remedial Investigation

RL	Reporting Limit
SAIC	Science Applications International Corporation
SAP	Sampling and analysis plan
SC	State Candidate
SE	State Endangered
SIM	Selective Ion Monitoring
SHA	Site hazard assessment
SS	State Sensitive
ST	State Threatened
STL	Severn Trent Laboratories
SVOC	Semivolatile organic compound
TEC	Toxicity equivalent concentration
TEE	Terrestrial ecological evaluation
TEF	Toxicity equivalence factor
TDS	Total dissolved solids
TICs	Tentatively identified compounds
TP	Test pit
TPH	Total petroleum hydrocarbons
TPH-Dx	Total petroleum hydrocarbons – diesel range
TPH-HCID	Total petroleum hydrocarbons - hydrocarbon identification
TSS	Total suspended solids
Tv	Eocene basalt
UCL	Upper confidence limit
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VOC	Volatile organic compound
WAC	Washington Administrative Code
WADNR	Washington State Department of Natural Resources
WARM	Washington Ranking Method
WDOH	Washington Department of Health
WDFW	Washington Department of Fish and Wildlife

Remedial Investigation/Feasibility Study
Hytec-Littlerock Site

1.0 Introduction

This document presents the results of a remedial investigation/feasibility study (RI/FS) of the Hytec-Littlerock site located near Littlerock, Washington. The Washington Department of Ecology (Ecology) has issued an Agreed Order 2888 requiring the responsible parties to perform a RI/FS and to prepare a cleanup action plan for the Hytec-Littlerock site (the site). This RI/FS was prepared for the site in response to the requirements of the Agreed Order. The RI/FS was conducted by CALIBRE in accordance with the requirements of the Model Toxics Control Act (MTCA) following the procedures contained in Chapter 173-340 of the Washington Administrative Code (WAC 173-340). The draft RI/FS was submitted to Ecology in June 2007 and this final RI/FS has been revised to address comments provided by Ecology.

1.1 Site Background

The site is located southwest of Littlerock, Washington, north of Bordeaux Road, and is accessed via Halo Kuntux Lane, a gated private gravel road. The site location is shown on Figure 1-1.

The site comprises approximately 44 acres and was divided into five parcels of land in late 1998. Four of the parcels are 5-acres in size and the fifth is approximately 24 acres in size. Two of the 5-acre parcels have single-family residences and the remaining two 5-acre parcels do not have residences constructed on them. The 24-acre parcel to the east and south sides of the site is undeveloped and includes a former gravel pit along Bordeaux Road. The property boundary, parcel boundaries, and owner names are shown on Figure 1-2.

Mr. and Mrs. Lufkin (the current owners of the 24-acre parcel), and Hytec, Inc. have been named as a Potentially Liable Persons (PLPs) by Ecology in the Agreed Order. Mr. Lufkin purchased the entire 44-acre parcel in July 1975. At that time Mr. Lufkin was the President of Hytec, a company that manufactured fiberglass bathroom fixtures at facilities in Tumwater and Yelm, Washington. Hytec obtained a solid waste disposal permit from the Thurston-Mason County Health District in 1976 and used the north-central portion of the site to dispose of waste fiberglass, fiberglass trimmings, and waste polyester resin. This area is referred to as the fiberglass debris landfill in this report.

Two of the 5-acre parcels are currently owned by Mr. and Mrs. Pavlicek, one 5-acre parcel by Ms. Morgan, and one 5-acre by Mr. and Mrs. Spears. Debris associated with the fiberglass debris landfill was encountered during the construction of the northern portion (cul-de-sac area) of the Halo Kuntux Lane in the late 1990’s. Additional fiberglass debris was encountered on the Morgan property during trenching of utility lines west of Halo Kuntux Lane. A construction hold was placed on the Spears parcel by Thurston County Development Services pending the results of the RI. Phase I of the RI focused on the fiberglass debris landfill area of the site.

The site is also known to include the dump of the former Town of Bordeaux as well as minor trash/household refuse from third party disposal. These areas of the site were investigated in the Phase II of the RI.

The regional geologic/hydrogeologic setting has been investigated in multiple prior investigations (e.g., see USGS 1961, 1966, 1999). Relevant details from the regional geologic setting are shown in Figure 1-3 (adapted from USGS 1966). A key feature from the regional studies is that the property is bisected (in north-south direction) by a major geologic transition; the east side of the property is on the western edge of the geohydrologic area *Prairie Area 7C* and west side is on the eastern edge of geohydrologic area *Black Hills* (as defined in Water Supply Bulletin No. 10, USGS 1961, 1966). Geohydrologic area *Prairie Area 7C* is identified with a surface geology defined as Vashon glacial outwash (Qvr in Figure 1-3) and geohydrologic area *Black Hills* is identified with a near surface geology defined as Eocene basalt that is covered (typically) by a weathered red soil that is several feet thick (Tv in Figure 1-3).

1.2 Objectives of the RI/FS

Pursuant to the requirements of WAC 173-340-350, the objective of the RI/FS is to collect, develop, and evaluate sufficient information regarding the Hytec-Littlerock site to select a cleanup action (under WAC 173-340-360 through 173-340-390). The general objectives of the RI are to:

- Provide data needed to determine whether actions are required because of chemical concentrations detected in soil and/or groundwater at the site; and

- If actions are required, to provide data needed to select appropriate remedial actions.

The general objectives of the FS are to:

- Identify cleanup action alternatives that will meet cleanup action objectives for the site; and

- Provide information needed to select preferred cleanup action alternatives for the site that satisfy the requirements of WAC 173-340-360.

The RI was planned and implemented in accordance with a Data Quality Objectives (DQOs) process following the procedures listed in WAC 173-340-350,7,b (scoping activities). A summary of the primary decisions related to project implementation and the data required to make those decisions was developed in the approved RI Work Plan (CALIBRE 2006a). The project DQO process, summarized in Table 1-1 (from the RI Work Plan), was implemented to ensure that data collection activities are tied to specific MTCA decisions related to the site and also to collect data of sufficient quantity and quality to support those anticipated decisions.

CALIBRE implemented RI activities at the site starting in the spring of 2006. The specific actions conducted to obtain the data required to meet the RI objectives and the results of the investigations are presented in Sections 2 and 3. The overall approach was to collect data necessary to conduct a terrestrial ecological evaluation, feasibility study, and cleanup action plan for the site. To meet these objectives, the investigation approach at the site was organized into two phases with several investigative tasks as follows:

Phase I – Fiberglass Debris Landfill Area

A. Conduct initial characterization of soil and groundwater at the fiberglass debris landfill area;
B. Conduct geophysical investigations to locate subsurface features such as fill boundaries and/or drums;
C. Install test pits/trenches to locate the boundaries of fiberglass fill material, and where easy access was available investigate/remove buried drums and sample soil beneath buried drums;
D. Install monitoring wells in the vicinity of the fiberglass debris landfill area; and
E. Sample and analyze groundwater from site monitoring wells and water supply wells.

Phase II – Other Suspect Areas on the 44-Acre site

A. Characterize soil and groundwater at the Bordeaux dump area;
B. Conduct a site inspection to identify suspect areas within the 44-acre parcel and characterize soil on those suspect areas;

The sampling and analysis protocols used to collect the RI data within the 44-acre site, along with the number of samples collected, sample location, and analyses are presented in Section 3.0.

1.3 General Site Information

This section contains the following general facility information required by WAC 173-340-350(7)(c)(i):

<u>Project title</u>: Remedial Investigation and Feasibility Study for Hytec-Littlerock site

<u>Project coordinators and Telephone numbers</u>:

Mohsen Kourehdar	Ecology	360 407-6256
Tom McKeon	CALIBRE Systems	425 643-4634
John Houlihan	Houlihan Law	206 547-5052

<u>Facility location</u>: The site is located approximately 2.5 miles southwest of the town of Littlerock, Thurston County, Washington (see Figure 1-1). The site is located north of Bordeaux Road and is accessed via Halo Kuntux Lane, a gated private gravel road. The legal description

of the property is the East ½ of the NW ¼ of Section 9, Township 16 North, Range 3 West of the Willamette Meridian, lying northerly of the county road known as Bordeaux Road.

Dimensions of facility: The site comprises approximately 44 acres and was divided into five parcels of land in 1998. The dimensions of the site are approximately 1,400 feet by 1,250 feet. Four of the parcels are 5-acres in size and the fifth is approximately 24 acres in size. Two of the 5-acre parcels have single-family residences and the remaining two parcels are prepared for building, but no homes have yet been constructed. The 24-acre parcel to the east and south sides of the site is undeveloped and includes a former gravel pit along Bordeaux Road.

Present owner and operator: Two of the 5-acre parcels are currently owned by Mr. Pavlicek, one 5-acre parcel by Ms. Morgan, and one 5-acre by Mr. and Mrs. Spears. Mr. and Mrs. Lufkin own the remaining 24-acre parcel (see Figure 1-2).

Chronological listing of past owners and operators and operational history: The Lufkins purchased the entire 44-acre parcel in July 1975 from Mr. and Mrs. Conwell. Hytec obtained a solid waste disposal permit from the Thurston-Mason County Health District and Hytec used the north-central portion of the site to dispose of waste fiberglass, fiberglass trimmings, and waste polyester resin. The waste was reported to have been disposed of in two natural depressions in the north-central portion of the site. Disposal at the landfill started in mid 1976 and was discontinued sometime thereafter. After that time, Hytec waste was disposed at the Hawks Prairie Landfill in Thurston County. The approximate location of the fiberglass debris landfill (based on the land scar visible in aerial photography from 1978) is shown on Figure 1-4. The 1978 aerial photograph suggests that the fiberglass debris landfill was not operational at that date. The visible land scar area likely includes filled areas and adjacent areas (unfilled) where surface material was scraped for daily cover material. The 1978 aerial photograph also shows numerous slash burn piles from the logging operations that occurred shortly before 1975 (clusters of burnt stumps are currently present in several areas).

The Lufkin's sold the entire 44-acre parcel to Patricia and Pamela Mathews in 1995 (the Lufkin's financed the purchase). The ownership was returned to the Lufkins in 1998 through forfeiture. The 44-acre parcel was subdivided in 1998 and included four 5-acre parcels on the west side of the site. Two of the parcels were purchased by Mr. and Mrs. Pavlicek and two were purchased by Mr. and Mrs. Monte. The Monte's subsequently sold the two northern most parcels (on the west side); one to Ms. Morgan in 2002, and the most northern parcel to Mr. and Mrs. Spears in 2002.

1.4 Report Organization

The RI/FS report is organized as follows:

- Section 1.0 (this section) of the RI/FS report presents general introductory information, including background on the activities leading up to this RI/FS, the purpose of the RI/FS, and general site information required by WAC 173-340-350(7)(c)(i).

- Section 2.0 presents information on site conditions required under WAC 173-340-350(7)(c)(iii). This information includes data developed during this RI (specifically related to site geology and hydrogeology), as well as information developed during previous investigations at the site.
- Section 3.0 describes the field investigation activities completed in the RI, along with a summary of the site characterization data collected.
- Section 4.0 discusses the evaluation of human health and ecological risks.
- Section 5.0 presents conclusions with respect to the site characterization data, applicable MTCA criteria and the need for cleanup actions, and defines remedial objectives to meet the applicable MTCA criteria.
- Section 6.0 identifies general response actions based on these conclusions and objectives.
- Section 7.0 identifies specific cleanup technologies applicable to the site.
- Section 8.0 identifies cleanup action alternatives, evaluates these alternatives with respect to the requirements contained in WAC 173-340-360, and identifies the preferred cleanup actions for the site.
- Section 9.0 lists references cited throughout this RI/FS.

Additional information presented in Appendices includes the following:

Appendix A	Listing of Known Water-Supply Wells within a One-Mile Radius of Site
Appendix B	Site Boring, Well and Test Pit Logs and Well Completion Diagrams, Hytec-Littlerock Site
Appendix C	Geophysical Testing Report
Appendix D	Sample Data Sheets with Well Purging/Field Water Quality Monitoring
Appendix E	Laboratory Data Sheets from April, June, September and December 2006 Sampling
Appendix F	Summary of Chemical Properties used to Calculate MTCA Method B Leaching Parameters (Koc for organics and Kd for inorganics)
Appendix G	Anticipated Designation of Solid Waste Following Washington Dangerous Waste Regulations
Appendix H	Feasibility Study Cost Estimates for Cleanup Action Alternatives
Appendix I	Sampling Results from Gravel Pit Area

2.0 Site Conditions

This section presents descriptions of site conditions relevant to the RI/FS. Section 2.1 presents the general facility conditions identified in WAC 173-340-350(7)(c). Sections 2.2 through 2.7 address the specific characteristics identified in WAC 173-340-350(7)(c)(ii) through (iii), respectively. As appropriate, the results of investigations at the site are summarized in this section (specifically related to site hydrogeology). Where required information was not available from previous investigations, additional data were obtained from RI activities, including the field investigations described in Section 3.0.

2.1 General Site Conditions

The site is located in a rural area of Thurston County and is zoned residential. A private gated road, Halo Kuntux Lane, enters the site from Bordeaux Road and ends in a cul-de-sac on the north end. A site map showing the surface topography is shown in Figure 2-1. Figure 1-2 (presented previously) identifies property boundaries, building structures, existing supply wells and utilities.

The property on the eastern side of Halo Kuntux Lane is undeveloped and wooded except for several roads (a dirt road that was the prior site access road before the development of Halo Kuntux Lane and several roads/trails cut by a caterpillar). An old dump (generally thought to be the historic dump from the Town of Bordeaux, circa 1900-1930) is present in a wooded area next to the road in the southeastern section of the property. The location and extent of this historical dump shown on Figure 1-2 was determined using historical photographs and geotechnical studies conducted during this RI. A topographic low area exists on the eastern-central portion of the site, north of the Bordeaux dump. This low area is a natural draw/drainage area (no man-made features are visible) but no surface drainage conditions are visible. West of Halo Kuntux Lane (near Bordeaux Road to the south) another road with a locked entry exists that accesses the old gravel pit. The old gravel pit was excavated to a current depth of approximately 30 feet below the surrounding topography. The gravel pit is visible in the oldest aerial photo available (1970) and also depicted on USGS maps in the area.

The topography of the western side of Halo Kuntux Lane becomes much steeper as the Black Hills rise up in the middle of the western portion of the property up to an elevation of approximately 320 feet. A small ravine exists in the northwestern section between the 320-foot rise and a smaller approximately 25-foot rise that slopes from the north. This section of the site (the western half) has been sub-divided into four parcels. Two houses are present on the western side of the site, the Morgan home and the Pavlicek home. Groundwater wells have been installed for domestic purposes for both homes. Two wells exist on the Morgan property (only one is in use) and one well exists on the Pavlicek property. Both homes have septic drain fields. Utilities present in the area include electric and phone lines. To the south of the Pavlicek house lie a clearing, work area and trailer used for a pallet reconstruction business.

Fill material from Hytec was placed in the fiberglass debris landfill between starting in 1976 and ending before 1978. The area of the fill material was determined based on historical photos, geophysical testing and site characterization studies (described in this RI report).

2.1.1 Previous Investigations

2.1.1.1 Soil Gas and Soil Sampling Conducted in 1990

A field investigation was conducted at the site as part of a preliminary site hazard assessment (SHA) by Science Applications International Corporation (SAIC) under contract to the Washington State Department of Ecology. The first phase of the SAIC investigation, conducted on October 28 1990, was a magnetic survey covering a 350 by 400 feet area over the location of the fiberglass debris landfill (operated under a solid waste disposal permit from the Thurston-Mason County Health District). The magnetic survey was conducted on transects approximately 25 feet apart using an EG&G Geometrics G586 magnetometer. The interpretation of results indicated two magnetic anomalies, the largest at the north central portion of the grid area and a smaller anomaly located to the southwest of the larger anomaly. Several drums were noted on the surface in the area of the larger anomaly. The work summary indicated that the anomalies may arise from buried drums or other metallic material. The results of this magnetic survey were used to identify locations where soil and soil gas samples would be collected to help characterize anomalies identified in the magnetic survey and to characterize any chemical releases associated with those anomalies.

The subsequent SAIC sampling was conducted in October/November 1990 and included 25 soil gas samples and 4 soil samples. The work summary (SAIC 1990) indicates the soil gas samples were collected from a depth ranging from 1 to 3 feet below ground surface (bgs) and analyzed for volatile organic compounds (VOCs) using a Sentex Scentograph Model 101 portable gas chromatograph (GC). The “hot spots” identified from the soil gas samples were then investigated with soil borings and laboratory analysis of soil samples for VOCs. The soil gas sampling results were summarized as follows (by SAIC 1990);

> “Organic solvents detected were 1,1-dichloroethylene, methylene chloride, methyl ethyl ketone, 1,1,2-trichloroethane, and 1,1,2,2-tetrachloroethane. The maximum organic solvent concentration detected was methylene chloride at 1,110 ppbv. 1,1-dichloroethylene was detected at five of the seven sample locations which showed organic solvent contamination. Benzene, ethylbenzene, toluene, m-xylene and/or o-xylene (BTEX) were also detected at 17 of the sample locations. The maximum BTEX compound concentration was m-xylene at 1,746 ppbv. Concentrations of six of the sample locations which showed BTEX contamination were less than 10 ppbv. The results were not contoured because of the lack of obvious trends in the data. Soil boring locations were determined based partially on the soil gas data.”

A summary (prepared by SAIC) of the soil sampling results from soil borings has not been identified. A plan view map showing 2 soil boring locations labeled, HTB-02 and HTB-03, is presented (SAIC 1990). The two locations appear to be the “hot spot” locations from the soil gas survey along with four laboratory data sheets from Weyerhaeuser Laboratory. The results, as interpreted from the laboratory data sheets, are summarized in Table 2-1.

All other results from the laboratory VOC analyses are reported as non-detect at the method reporting limit (ranging from 6 to 12 ug/kg) and the laboratory data sheets note that no Tentatively Identified Compounds (TICs) are indicated.

The soil gas results identified methylene chloride in 1 sample out of the 25 collected. None of the compounds identified in the soil gas survey (based on the portable field GC results) were subsequently identified in the laboratory analysis of soil samples (at levels above the reported detection limits). Methylene chloride is a highly volatile chemical (vapor pressure of 360 mm mercury). The expected 3-phase partitioning (in vapor, soil moisture, and soil adsorbed phases) was evaluated using the general procedures presented WAC 173-340-747. The expected methylene chloride concentration in each phase (equilibrium partitioning in vapor, soil moisture, and soil adsorbed phases) are shown in Table 2-2.

This calculation (in Table 2-2) is derived from the 3-phase partitioning model used as the basis for MTCA equation 747-1 However, the measured site input parameter is not the drinking water standard, but the soil gas concentration reported by SAIC (1,110 ppbv methylene chloride).

The calculations presented in Table 2-2 are included to demonstrate that it is possible for methylene chloride to be detected in soil vapor but still be below the analytical detection limits for the soil samples and also to present the appropriate conversion units from the soil gas measurements in parts per billion volume (ppbv) reported by SAIC.

Following the site hazard assessment in 1990, Ecology ranked this site as 3 (with 1 indicating the highest relative risk and 5 the lowest) under the Washington Ranking Method (WARM). In August 1992, Ecology informed Mr. Lufkin that the WARM ranking for the site had been reduced to 4 (a lower relative risk). In July 1993, the Washington State Department of Health conducted a preliminary assessment of the potential for the site to affect public health and concluded, at that time, that the site did not present a significant hazard to public health.

2.1.1.2 Water Sampling in 2003

Groundwater samples were collected from the Morgan water supply system in June 2003. The samples were collected by the property owner and analyzed for VOCs using EPA method 8260B by Libby Environmental. The sampling quality assurance (QA) documentation includes chain-of-custody forms, method blanks, laboratory control spikes, and surrogate recovery tests. The results indicate all analytes (VOCs by Method 8260B analysis) at concentrations that are less than the instrument detection limits which are reported as 0.1 micrograms per liter (ug/L) for the sample collected (Morgan supply system). The Pavlicek water supply system may have also been sampled in the same time frame (~June 2003); however, sampling results (from the Pavlicek well) have not been identified.

2.1.1.3 Soil Sampling in 2004

Soil sampling was conducted at the site by Stemen Environmental (Stemen) in March/April 2004. Various soil samples collected by Stemen were analyzed for metals, VOCs and semi-volatile organic compounds (SVOCs). The exact locations of the samples collected by Stemen are not known based on the information that is available (no stakes are present in the ground and no map was prepared). Based on information derived by discussion with Mr. Stemen, it is believed that 3 of the samples (labeled D1-L2, D1-L1, and L1-S1) were collected in the area of the fiberglass debris landfill, near test pits located off the southeast quadrant of the present cul-de-sac area. Two additional samples (labeled SLF-1 and SLF-2) were collected from a location several hundred feet to the south. The exact location of these two soil samples (SLF-1, SLF-2) is uncertain but they may have been collected from the location of the Bordeaux dump.

The soil samples (Stemen) for metals analysis were analyzed by ESN Northwest Chemistry Laboratory as follows; lead (Pb) by EPA Method 7420, cadmium (Cd) by EPA Method 7130, chromium (Cr) by EPA Method 7190, arsenic (As) by EPA Method 7061, silver (Ag) by EPA Method 7760, barium (Ba) by EPA Method 7080, selenium (Se) by EPA Method 7741, and mercury (Hg) by EPA Method 7471. The results for arsenic, silver, barium, selenium, and mercury are all below the method detection limit in each sample. The results for the lead, cadmium and chromium analyses are shown in Table 2-3.

Some of the soil samples collected by Stemen were also analyzed by ESN Northwest Chemistry Laboratory for VOCs using EPA Method 8260 and SVOCs using EPA Method 8270. The results of these organics analyses are shown in the Table 2-4.

Because no written report accompanied the data from Stemen Environmental, it is unknown whether the samples were collected, stored, and transported in accordance with acceptable sample collection and handling methods and no confirmation of the sampling and analysis protocols has been located (Ecology 2005).

2.1.1.4 Water Sampling in 2004

Prior water quality data collected at the site includes sampling of the water supply systems from two potable wells in the immediate vicinity; the Morgan well which is in the immediate vicinity of the fiberglass debris landfill area sampled in this investigation and the Pavlicek well which is located approximately 400 feet to the south in a direction that is cross gradient/downgradient of the water level contours developed with the data collected herein. The Ecology Water Well Report (Well ID AGP372) for the Morgan well indicates that it is 200 feet deep (drilled in March 2002) with a screen interval from 140 to 200 feet bgs. The Ecology Water Well Report (Well ID AEJ746) for the Pavlicek well indicates that it is 62 feet deep (drilled in March 1999) with a screen interval from 57 to 62 feet bgs. Existing information indicates both of these wells were sampled by Stemen Environmental in March 2004 and again by Insight Geologic in December 2004 (Insight Geologic 2005). Both of the sampling events included the following analyses:

1) VOC analysis by EPA Method 8260B
2) SVOC analysis by EPA Method 8270
3) Metals analysis (various methods)

As noted previously, no written report accompanied the data from Stemen Environmental, and it is unknown whether the samples were collected, stored, and transported in accordance with acceptable sample collection and handling methods and no confirmation of the sampling and analysis protocols has been located (Ecology 2005).

The background information and conclusions presented by Insight Geologic are as follows (Insight Geologic 2005):

> "Water samples collected from the Pavlicek and Morgan residential water systems in 2004 by Stemen Environmental reportedly contained detectable concentrations of volatile and semi-volatile organic compounds (VOCs and SVOCs) and metal. The Morgan water sample contained naphthalene and 2-methylnaphthalane at concentrations of 1.09 and 0.213 microgram per liter (ug/L), respectively. The Pavlicek water sample contained trichlorofluoromethane at a concentration of 2.1 ug/L. Chromium was detected in both the Morgan and Pavlicek water samples at concentrations of 1.67 and 1.36 ug/L, respectively. Barium was detected in the Pavlicek water sample at a concentration of 5.45 ug/L.
>
> The concentrations of the compounds detected in 2004 were all less than the respective Model Toxics Control Act (MTCA) cleanup levels and appropriate Maximum Contaminant Levels (MCLs) for drinking water set by the Washington Department of Health (WDOH). The results of the initial sampling effort are suspect, however, since the VOC analyses were not performed by an Ecology-accredited laboratory and the quality assurance/quality control (QA/QC) data were out of range for the metals."
>
> "Water samples collected from the Pavlicek and Morgan wells by Insight Geologic, PLLC on December 30, 2004 were analyzed for the presence of VOCs, SVOCs and metals (arsenic, cadmium, chromium, lead and mercury). The samples were analyzed by Ecology-accredited laboratories using appropriate analytical methodology. Chromium was detected in the water sample from the Pavlicek well at a concentration of 0.024 milligram per liter (mg/L). This concentration is less than Ecology's MTCA Method A cleanup level for ground water of 0.050 mg/L (50 ug/L) and less than the WDOH MCL of 0.100 mg/L. No other metals, VOCs or SVOCs were detected in the water samples."

Table 2-5 summarizes the analytical results from these two sampling events (Insight Geologic 2005).

2.2 Regional Geology

The Hytec-Littlerock site is located on the western margin of the Puget Lowlands and adjacent to the eastern margin of the Black Hills (Township 16 North, Range 3 West, Section 9 in the east ½ of the northeast ¼ of the section). The area of the site, like most of the Puget Lowland, has been shaped by both tectonic forces and multiple glaciations. During the Pleistocene epoch, the area was repeatedly inundated by continental glaciers. The most recent advances during the Pleistocene epoch include the Fraser glaciation (maximum extent approximately 15,000 years ago) and the Possession glaciation (maximum extent approximately 80,000 years ago.) During prior advances, the farthest extent of the glacier is generally regarded to be around Grand Mound/Rochester. The Hytec-Littlerock site is on the border of the lateral extent of the Fraser glaciation. The extent of Fraser glacier is postulated to have advanced to a terminus around the site location long after the deposition of the Eocene volcanic rocks of the Black Hills.

Eocene volcanic bedrock and deposits of two or more Pleistocene glacial advances are present in the site area. The Black Hills are part of the Willapa Hills which consist of basalt of the Eocene Crescent Formation. This basalt is thought to originate as seamounts in a mid-ocean ridge system and was accreted onto the North American continent in the Juan de Fuca subduction zone during Eocene time (Walsh et al. 1987; WADNR 2001). Where the topographic highs of the Black Hills are mostly exposed bedrock, the lower slopes are covered with a thick red soil. The thickness of these soils increases with a decrease in elevation due to soil creep (USGS 1966).

Most of the surface geology of the Puget Lowland is dominated by deposits of the more recent glacial period, the Fraser glaciation. The glacier that covered the Puget Sound area originated in the Coast Range in British Columbia, the Cordilleran Ice sheet. Several lobes diverged off of the Cordilleran Ice Sheet. One of the lobes of that glacier, the Puget Lobe, covered an area that extends just south of the Olympia area. The Puget Lobe had two smaller lobes at the terminus, the Olympia Lobe and the Yelm Lobe. The Olympia Lobe covered the area of the site. The Fraser glaciation left a characteristic sediment sequence related to a glacial advance and retreat. This sequence of glacial deposits comprises the youngest deposits in the area (recent alluvial deposits not withstanding).

The regional geologic units/sequence (and common hydrostratigraphic units) are shown in Table 2-6. The following discussion of regional geologic units is adapted from USGS 1966 and USGS 1999, and also includes the geohydrologic units typically associated with each geologic unit. The youngest geologic unit in the regional area consists of alluvial and deltaic sand and gravel **(Qvr)** of the Holocene age. Alluvium is generally found on the valley bottoms of larger streams and is of limited areal extent.

The Vashon recessional outwash and Vashon end moraine **(Qvr/Qvm)** are the next youngest units. Outwash deposits are moderately well sorted melt-water stream deposits of stratified pebble, cobble, and boulder gravel. The next youngest formation in the sequence is the Vashon glacial till **(Qvt)**; this is an unsorted mix of gravel, boulders and sand in a silt/clay matrix. Till deposits are commonly referred to as hardpan in drill logs. Below the Vashon glacial till a glacial advance outwash **(Qva)** is commonly encountered. The **Qva** (described as poorly to moderately well-sorted, well-rounded gravel in a matrix of sand with some sand lenses) is the primary near-surface unit identified at the site. The glacial advance, till and recessional outwash are collectively referred to as Vashon drift.

Below the Vashon drift deposits is an interglacial deposit known as the Kitsap Formation **(Qf)**. This unit is found in some areas of the Puget Lowlands between the Vashon and older glacial sequences. Deposits of the Kitsap Formation have not been identified in the area of the Mima Prairie (USGS 1999) and this formation is not present at the Hytec-Littlerock site based on well and boring logs.

Below the Kitsap Formation (where present, or the Vashon Drift when the Kitsap is not present) is a deposit of pre-Vashon glacial origin which consists of coarse stratified sand and gravel that is commonly stained with iron oxides to a yellowish brown or reddish brown color. This older outwash deposit **(Qc)** is referred to as Salmon Springs (?) Drift in USGS 1966 and USGS 1999. Drilling logs in the Mima Prairie area indicate thick gravel sequences that have been identified as Salmon Springs(?) Drift (USGS 1999).

Beneath the Salmon Springs(?) Drift is a sequence of fine- and coarse-grained sediments extending to bedrock. These sediments are described as the "unconsolidated and undifferentiated" deposits of Quaternary and Tertiary ages **(TQu)**. Based on regional geology described by the USGS (1999), all Pleistocene unconsolidated deposits older than Salmon Springs(?) Drift in the area have been designated as undifferentiated pre-Salmon Springs(?) deposits. They are chiefly fine-grained deposits of both glacial and nonglacial origin but they also include sands and gravels. The **TQu** unit is described as blue clay by many drillers and blue clay is reported in many well logs (USGS 1966). It is generally a dark blue-gray but is also gray, brown, and buff. At only a few places the material is a pure clay, but commonly the proportion of clay is large enough to impart at least some plasticity to the deposit. It is described as virtually impermeable. An area of **TQu** is mapped by the USGS (1999) on the south side Mima Creek. This unit (dense clay that is blue, gray, brown or buff) is identified in numerous wells logs along the west side of the Mima Prairie area in contact with (or just above) underlying consolidated rocks.

The consolidated rocks that make up the bedrock **(Tb)** consist largely of Tertiary sedimentary claystone, siltstone, sandstone, and minor beds of coal. Associated with these sedimentary rocks are igneous bodies of andesite and basalt. Virtually all of the Black Hill area is mapped as Tertiary volcanic rocks underlain by Eocene age basaltic rocks of the Northcraft and Mclntosh formations.

The area has been studied on a regional level by USGS and Washington State Department of Natural Resources (WADNR) (USGS 1999, WADNR 1987). These studies confirm the site is on the edge of Eocene volcanic bedrock and the lateral extent of the last glaciation. This is consistent with all geologic data collected at the site.

2.3 Site Hydrogeology

The site setting is on a low bluff (approximately 230 feet in elevation) on the western side of the Black River valley floor, approximately 15 feet above the Mima Prairie. Just west of the site, the surface topography rises sharply into the Black Hills area. The site location is near the western edge of the geohydrologic area defined as *Prairie Area 7C* with a surface geology defined as Vashon glacial advance outwash (**Qva)**, as defined in Water Supply Bulletin No. 10, 1961, 1966). Just west of the site, the geohydrologic area changes to the *Black Hills* with a near surface geology defined as Eocene basalt **(Tb)** that is covered (typically) by a weathered red soil that is several feet thick. A gravel pit approximately 30 feet deep (historically used for mining gravel) is located along the southern boundary of the site along Bordeaux Road, several other gravel pits are identified on the United States Geological Survey (USGS) maps within about 1 mile of the site. Inspection of the exposed face on the north side of the gravel pit (approximately 30 feet high) indicates glacial outwash over the depth of the exposed face. A number of residential water supply wells are installed in the Mima Prairie area. Many well logs from the Mima Prairie area indicate a glacial outwash to a depth of approximately 120 feet.

The shallow geology observed in each of the existing site wells and new borings (completed as part of the RI) is consistent with a glacial outwash. Typically, the glacial outwash **(Qva)** is underlain by a low permeability formation **(TQu)** generally containing layers of clay and dense silt found above the underlying bedrock **(Tb)**. In some locations the clay layer transitions to interbedded layers of dense silt or silty-sand near the contact with bedrock. This conceptual model of the site hydrogeology is consistent with a location at the transition from the *Black Hills* to the *Prairie Area* (geohydrologic areas defined in Water Supply Bulletin No. 10).

Outwash gravel covers the surface of the entire site and appears to be contiguous with thick gravel deposits found on the Mima Prairie to the east. North of the property boundary (see cross sections discussed in subsequent sections), the basalt is covered only with a 15-foot outwash gravel layer (Vashon advance or recessional gravel). The thickness of the outwash gravel sequence increases moving east and south towards the Mima Prairie.

As noted above, the regional geology/hydrogeology of the area has been studied by the USGS and WADNR (USGS 1999, WADNR 1987). These regional studies have been evaluated in the development of a hydrogeologic conceptual model for the site.

2.3.1 Site Stratigraphy

Stratigraphy at the site was evaluated based on review of existing well logs from water supply wells in the vicinity of the site and from borings and monitoring wells installed at the site between April and August 2006. Figure 2-2 presents the location of selected cross-sections developed for the site. Figures 2-3, 2-4, 2-5 and 2-6 present cross-sections of the site stratigraphy developed from the boring logs. The geologic records and stratigraphy, as depicted in the cross sections, are the basis for the conceptual model regarding site geology and hydrogeology. Table 2-7 presents a range of estimated hydraulic conductivity values for the related units (based on estimation methods by the USGS from the yield of water supply wells)

The site is bordered to the north and west by bedrock consisting of Tertiary volcanics **(Tb)**. The stratigraphy overlying the volcanic bedrock formation varies slightly, but in the area of the fiberglass debris landfill, it is predominantly a low permeability unit **(TQu)** consisting of clay and dense silt layers (see exceptions noted below and also in Figures 2-3 and 2-7). In all four cross-sections, A-A', B-B', C-C' and D-D', the contact surfaces of the bedrock **(Tb)** and clay deposits **(TQu)** are shown, indicating relatively steep slopes to the underlying stratigraphic units. Eocene basalt is encountered below the glacial deposits to the north and west of the site. The predominant deposit above the basalt is a low permeability layer **(TQu)** consisting of clay with dense silt layers in some areas. This clay has been noted in the closed boring by Monte in 1999 (start card A12636), Morgan's and Spear's wells, (based on the existing well logs), and observed in RI borings B10 and B11, and RI borings for monitoring wells HLMW-02A, and HLMW-04A. The thickness of this layer **(TQu)** is estimated at approximately 40 feet in multiple logs (start card A12636, Morgan's, Spear's, and thinning to the east in borings B10 and B11). The top of this layer was identified at locations HLMW-01A and HLMW-03A where a significant transition from the outwash gravel was found.

Only a few of the RI site borings (B01, B10, B11) were advanced to the depth where bedrock **(Tb)** was encountered. However, based on regional conditions and the prior site borings where bedrock was identified (boring closed by Monte in 1999, Spears, Morgan and Riggs well logs), the site conceptual model has assumed that bedrock is present in all areas. The hydraulic conductivity of the bedrock **(Tb)**, the clay and any dense silt layers within the clay **(TQu)** are significantly lower than that of the overlying outwash gravel **(Qva)**. Figure 2-7 presents the elevation of the **TQu** surface (perching layer).   The clay within the TQu unit is of sufficiently low permeability (i.e., water perches above it) to serve as an aquitard. The low permeability layer immediately overlying the bedrock (the clay layer and silty layers within and beneath it) is very dense with blow counts typically in the 50's for less than 6-inches of penetration.

Near the northern end of the site (see borings B01 and B02 in Figure 2-3, A-A' cross section) the low permeability layer above the bedrock transitions to a series of interbedded layers of clay, sandy-clay, silt, silty-sand and sand above the bedrock. Farther north of the site, the transition zone is absent and the outwash gravel is in contact with the bedrock (see log for Riggs well in Figure 2-3).

Outwash gravel covers the surface of the entire site and is contiguous with thick gravel deposits out on the Mima Prairie to the east. Based on data reported by the USGS (USGS 1999), the Vashon outwash gravel is estimated to have a median hydraulic conductivity of about 150 feet/day.

2.3.2 Groundwater

A conceptual site model of groundwater flow direction and gradient was developed using the initial field investigations groundwater elevation measurements. This conceptual model indicates that groundwater flows predominantly on the surface of a perching layer to the southeast (SE) at a hydraulic gradient of 0.06 feet/feet (to the SE at a bearing of approximately 150 degrees clockwise from north). The water-level data collected in April 2006 are presented in Figure 2-8. The April water-level elevation contour map is based on five data points (water levels measured at temporary piezometer borings B01, B02, B05, B06, and B09). This water-level elevation contour map represents a wet-season condition (following 35 consecutive days of rain ending in mid January 2006 and additional precipitation in February and March 2006). It is expected that this figure represents higher than typical water levels.

The water-level elevation contours indicate significant influence of local recharge areas and subsurface structure influencing flow directions. The steep topographic rise on the west side of the property (a clay slope approximately 75 feet in height) and the subsurface clay structure create a southeasterly groundwater flow direction. The groundwater flow paths (based on the wet-season water-level contours) appear to generally flow from a recharge area, specifically the wetland area on the west side of the Morgan/Spears parcels (also extending much farther to the northwest), towards the topographic low area (a natural draw) on the east side of the Lufkin parcel. The wetland area on the northwest corner of the property covers at least 5 acres (extending off site to the northwest) and is the drainage outlet for a small watershed (no other surface drainage other than the wetland) covering at least 25 acres. This wetland area is expected to be a significant recharge zone for groundwater encountered at the site which subsequently flows towards the Mima Prairie.

This conceptual site model was reevaluated and revised based on data collected in August/September from the monitoring wells. The August/September data provide results that are generally consistent with the initial hydrogeologic conceptual site model. Figure 2-9 presents water-level elevation contours calculated from the September data. The September water-level elevation contour map is based primarily on three data points (water levels measured at points HLMW-01A, HLMW-02A, HLMW-03A); this map does not include a data point to the southwest near decommissioned boring B06 (when compared to the April water-level contours). The September water-level elevation contours (low-water conditions) indicate groundwater flow predominantly on the surface of the perching layer **(TQu)** to the south-southeast (SSE) at a hydraulic gradient of 0.10 feet/feet (to the SSE at a bearing of approximately 165 degrees clockwise from north). The September groundwater elevation contour surface (Figure 2-9) appears to match the slope and direction of the top of **TQu** surface structure map (Figure 2-7). The September water-level water level elevation contour map represents a dry season condition (following a dry summer) and represents low water-level groundwater flow conditions at the site. Based on shallow groundwater and typical seasonal precipitation, the lowest water levels of the year are expected in late October and the groundwater flow direction may rotate even farther to the south than observed in the early September data set.

When comparing the high water level (April) and low water level (September) elevation contours, the 220 feet elevation contour is in approximately the same position and orientation in both seasons (to the north and west of the cul-de-sac area). Downgradient from the 220 feet elevation contour, the September water levels decrease with distance approximately twice as fast as the April water levels. The calculated horizontal hydraulic gradient based on September data is 0.10 feet/feet versus 0.06 feet/feet for data collected in April). Based on available data, the groundwater flow direction experiences a change from flowing toward the SE during high water levels in April to flowing toward the SSE during low water levels in September.. This change in the groundwater flow direction is plausible with the seasonal water level changes but may also be an artifact of the different data sets used in the developing the water level elevation contours. Water level data from boring B06 are included in the April contours but not in September because the temporary piezometer was decommissioned after sampling. The B06 data point used in April drives the curve in the water level elevation contours creating a more easterly flow.

Figure 2-10 presents water-level elevation contours calculated from the December water level data. The December water-level elevation contour map is based on five data points (water levels measured at points HLMW-01A, HLMW-02A, HLMW-03A, HLMW-04A, and L1-GP located at the Bordeaux dump area). The December water-level elevation contours indicate groundwater flows predominantly to the east-southeast (ESE) at a horizontal hydraulic gradient of 0.06 feet/feet (to the ESE at a bearing of approximately 125 degrees clockwise from north). The December groundwater elevation contour surface (Figure 2-10) produces a groundwater flow pattern in a similar direction and magnitude to the April 2006 water-level elevation contour map (the prior wet-season condition). The seasonal water level change (from September 2006 to December 2006) in wells HLMW-01A, HLMW-02A, and HLMW-04A is approximately five feet (increase in December). The seasonal water level change (from September 2006 to December 2006) in well HLMW-03A is much greater at approximately 20 feet.

A summary of the results from the grain size analysis is presented in the analytical results in Section 3. Grain size data from soil samples collected at the site indicate soil conditions that are expected to have a high permeability. Data reported by the USGS (USGS 1999) indicate that the outwash gravels encountered over much of the site have an estimated median hydraulic conductivity of about 150 feet/day. The steep hydraulic gradient (0.06 to 0.10 foot/foot) combined with the apparent high permeability soil is indicative of a thin groundwater zone perched on an underlying and steeply dipping low permeability layer (clay/dense silt above bedrock). The steep groundwater gradient is created by the underlying surface slope of the perching low permeability layer. This conceptual model of the site hydrogeology is consistent with a location at the transition from the *Black Hills* to the *Prairie Area* (geohydrologic areas defined in Water Supply Bulletin No. 10). The water level data indicate a downward vertical hydraulic gradient direction from the shallow perched zone to the deeper water bearing zones in the basalt.

2.3.3 Groundwater Quality and Use in the Area

Groundwater in the immediate area of the site (and surrounding areas) is used for potable water supply. Details on the groundwater sampling and laboratory results (from this RI) are summarized in Section 3. A listing of private water supply wells identified within a 1-mile radius of the site is presented in Appendix A. Groundwater samples from monitoring wells around the fiberglass debris landfill have detected low levels of organic compounds in groundwater, all detections have been less than applicable drinking water standards (either MCLs or MTCA Method B criteria based on use as drinking water). Groundwater samples collected from water supply wells at the site (in bedrock beneath the fiberglass debris landfill) have detected low levels of organic compounds in groundwater, all detections have been less than applicable drinking water standards (either MCLs or MTCA Method B criteria based on use as drinking water).

2.4 Surface Water and Sediments

The nearest surface water bodies to the site are Mima Creek and the Black River, which are located approximately 2,000 feet to the southwest and 6,000 feet to the east of the site, respectively. Site conditions and any potential future activities at the site are not expected to result in impacts to surface water or sediments in Mima Creek or the Black River. One intermittent creek (unnamed) flows past the property at the northeast corner. Another intermittent creek (unnamed) flows over the property near the base of topographic rise on the western side (draining the wetland area, see Figure 2-10). The gravel pit (adjacent to Bordeaux Road) has been observed to contain water in times of heavy precipitation (i.e., in February 2006 after a record 30 plus days of rain in Olympia, in December 2006 after record rainfall in November 2006, and in one historical aerial photograph).

There are no observed areas of erosion or sediment deposition on site. Most precipitation falling on the site infiltrates directly into the highly permeable outwash gravels that comprise the surface topography of the site. There are approximately 30 inches a year of recharge into the soils at the site (USGS 1999). Ground water in all glacial outwash in the area moves towards major streams and marine water bodies. Specifically, water in this area moves towards the Black River which flows towards the Chehalis River and ultimately discharges to the Pacific Ocean.

2.5 Air

Hazardous substances at the site potentially impacting air quality is a pathway to be considered, if levels detected (or expected) were likely to impact to air quality. As shown in the conceptual site model (CSM), chemicals of concern (COCs) are present in soil. However, existing data (summarized in Section 3) indicate that it is unlikely that site conditions would affect the air at or surrounding the site at levels that would exceed any MTCA risk-based standard. If soil disturbing actions are conducted at the site, controls should be implemented to reduce the generation of dust.

2.6 Conceptual Site Model

A CSM identifying sources of hazardous substances, pathways for contaminant migration, and potential receptors is shown in Figure 2-11. The information used to develop this CSM, and general interpretations drawn from this CSM, are presented in the following sections.

The CSM is intended as a schematic representation of potential pathways by which receptors (humans or other ecological endpoint species) may be exposed to chemicals at or released from a source. The purposes of the CSM are to provide a framework for problem definition, to identify exposure pathways that may result in adverse effects to human health or other ecological receptors, to aid in identifying data gaps, and, if necessary, to aid in identifying applicable cleanup measures targeted at significant contaminant sources and exposure pathways. The potential exposure pathways in the conceptual site model are shown in Figure 2-11.

An exposure pathway describes a specific environmental pathway by which chemicals may be transported to human or other ecological receptors. A complete exposure pathway requires each of the following six elements:

- Source of chemicals
- Mechanism of chemical release
- Environmental transport medium
- Exposure point
- Intake route
- Human or other ecological endpoints

If one of these elements is absent, the pathway is incomplete and exposure cannot occur. Incomplete pathways, as well as negligible pathways that would not contribute to overall risk estimates, are not expected to result in adverse effects to human health or the environment. The MTCA Method B criteria (for soil and water), and ecological screening criteria have been used to identify media and pathways that are expected to exceed the MTCA risk criteria.

2.6.1 Potential Release and Transport Mechanisms

The potential sources of COCs are chemicals present in soil/fill at the site and any containers in the debris/fill area which may contain chemicals different than the bulk fill material (such as a drum with liquid). Contaminants emanating from these potential sources may migrate from shallow soil to deeper soils and have the potential to enter groundwater and eventually discharge to surface water. In addition, the COCs in soil could results in exposure via direct contact and potentially be transported as fugitive dust. The main release mechanisms for COCs to the environment include:

- Direct contact to COCs in soil
- Leaching from potentially contaminated soil into deeper soils,
- Infiltration to groundwater, and
- Stormwater runoff and wind releasing soils to down slope/downwind areas.

Stormwater and/or erosion could potentially transport contaminated soil particles to other areas or surface water bodies.

2.6.2 Potential Human Receptors

Potential human receptors include residents (on site and downgradient). The CSM includes residents that are assumed to utilize groundwater as a potable water supply and have unrestricted access to soil (unless some type of institutional controls [ICs] are implemented as part of a site cleanup action). The potential exposure mechanisms to COCs in soil consist of dermal contact, ingestion, and inhalation of on-site soil. The potential exposure mechanisms to COCs in groundwater consist of dermal contact, ingestion, and inhalation of vapors (from indoor water use).

2.6.3 Potential Ecological Receptors

The Washington Department of Fish and Wildlife and Northwest Habitat Institute have classified the site habitat as a Western Lowlands Conifer-Hardwood Forest habitat. The site is a heavily wooded area except for the areas that have been developed. Douglas fir is the dominant tree species with minor amounts of western cedars, white fir, and hemlock. The deciduous trees completing the forest canopy include alder, cottonwood and dogwood. A variety of understory is present including Oregon grape, salal brush, various berries (blackberries, huckleberries, and others) and sword fern.

Historical aerial photographs of the site have been review as part of the planning/site investigation. In the early 1970's the property is heavily forested. In a 1978 photograph most of the property has been clear-cut logged (with the exception of the steep slope on the west side of the property and approximately 4.5 acres in the northeast corner. Mr. Lufkin replanted the clear -cut area with Douglas fir after acquiring the property in 1975. The new plantings are visible in a 1985 photograph. Additional logging in the northeast corner is apparent in a 1996 photograph.

The goal of the terrestrial ecological evaluation process is the protection of terrestrial ecological receptors from exposure to contaminated soil with the potential to cause significant adverse effects. Pursuant to MTCA definitions, a significant adverse effect for species protected under the Endangered Species Act (16 U.S.C. Section 1533) or other applicable laws extending protection to individuals of a species, WAC 232-12-011(1) and 232-12-014, means an impact that would significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. For all other species (i.e., Federal Candidate, Federal Species of Concern, State Candidate, and State Sensitive: FC, FCo, SC and SS designations, respectively), significant adverse effects are effects that are expected to impact the species population through impacts on reproduction, growth or survival.

Several species of small mammals and birds reside on the site including rabbits, ground squirrels, mice, and shrews. Larger mammals such as raccoons, deer, and bears are likely to utilize the area (none have been observed, although deer tracks and abundant scat have been observed). There is potential for several special status species to be present near the site. The site is many miles from the coast and has no streams or ponds. Therefore, special status species that are pelagic, marine, or aquatic are not present. Also, plants that have not been sighted in the Thurston County since 1977 are not considered further. Table 2-6 lists the remaining species in the FE, FT, SE, or ST categories and their potential presence to the site in the area potentially impacted by project activities.

Species potentially at or near the site project activities include:

Birds; Bald Eagle

Bald Eagles typically tend to locate near large bodies of water, which are not present at the site. Neither Bald Eagles nor Bald Eagle nests have been sighted at the site but it is conceivable that they could transit the site.

Butterflys; Mardon Skipper.

While the site does not have any prime Mardon Skipper habitat, it is near the Mima Prairie, and it is conceivable that a Mardon Skipper could transit the site.

Plants; Pacific Pea, Western Wahoo, and Pine-foot.

Any areas on the site that will be impacted by remediation (if required) should be inspected for the presence of these three plants.

Table 2-9 includes species in the FC, FCo, SC, and SS categories. Species potentially at or near the site project activities include:

Plants; California Swordfern and Small-flowered Trillium, could potentially be found on the site. Remediation, if required, should be performed in manner to avoid populations of these two plants if they are found on the site.

One area on the site could be considered a wetland. However, no project activities will take place in the vicinity of that area. Table 2-10 lists those special status species whose habitat consists of wetlands.

2.7 Natural Resources and Ecology

A number of plant and vertebrate animal species that are either federally or state-listed as endangered or threatened, or are candidates for such listing, are present in Thurston County but none have been found at the site. These species are described in Section 2.6.3.

2.8 Regulatory Classifications

The property at the Hytec-Littlerock is zoned residential and groundwater represents a potable water supply. The Olympic Region Clean Air Agency (ORCAA) regulates air discharges throughput the county and presently indicates that no areas exceed the EPA non-attainment criteria (for ozone, carbon monoxide, particulate matter, oxides of nitrogen, oxides of sulfur and lead). Surface water is present intermittently at the site (ponding in the gravel pit near Bordeaux Road, and drainage along an ephemeral stream, see Figure 2-10).

3.0 Field Investigations

This section presents a summary of the data collection activities and results for the RI field work conducted at the Hytec-Littlerock Site during April 2006 through December 2006. The RI was conducted in accordance with the RI Work Plan (CALIBRE 2006a). The RI was planned and organized into two phases that each addressed specific areas of the Site. Phase I focused on the fiberglass debris landfill area and Phase II focused on all other suspect areas present within the 44-acre Site. This information section is organized as follows:

- Section 3.1 - Phase I Investigation – Fiberglass Debris Landfill Area
- Section 3.2 - Phase II Investigation – Other Suspect Areas on the 44-Acre Site
- Section 3.3 - Sample Analyses and Analytical Methods
- Section 3.4 - Analytical Results
- Section 3.5 - Summary of the Nature and Extent of Contamination

All Tables and Figures for Section 3 are presented at the end of this section.

3.1 Phase I Investigation – Fiberglass Debris Landfill Area

The RI Phase I Investigation was implemented for soil and groundwater characterization around the area of the fiberglass debris landfill. Tasks conducted during the Phase I activities and the respective subsection numbers are as follows:

- Section 3.1.1 - Direct-Push Subsurface Sampling
- Section 3.1.2 - Geophysical Survey
- Section 3.1.3 - Test Pits/Trenches and Interim Remedial Actions
- Section 3.1.4 - Monitoring Well Installation
- Section 3.1.5 - Monitoring and Private Well Sampling

3.1.1 Direct-Push Subsurface Sampling

The objective of the initial direct-push sampling task was to determine Site geology/stratigraphy, depth to groundwater, groundwater flow direction, characterization of subsurface soil, and water quality near the water table to determine appropriate placement of groundwater monitoring wells near the fiberglass fill area. The first task of the Phase I investigation included reviewing all readily-available existing geologic data, performing direct-push probe sampling to assess the approximate groundwater elevation, and collecting subsurface soil and groundwater samples for characterization of soil and water quality in the immediate landfill area.

Direct-push (Geoprobe) sampling methods were used to collect subsurface soil and groundwater samples at the Site from April 11 – 13, 2006. Nine direct-push borings, designated as B01 through B09, were installed at locations around the fiberglass fill area. Soil sampling was conducted from boring locations B02, B03, B04, B05, B06, and B07. A core-barrel sampling device was used with the direct-push rods to collect soil samples in accordance with the procedures presented in the Work Plan. All of the soil samples were analyzed for VOCs, SVOCs (Selective Ion Monitoring , SIM), and metals. In addition, five of the borings had soil samples collected for grain size analysis. Locations for each of the nine borings, borings B01 through B09, are presented in Figure 3-1. The depths at which soil samples were collected from each boring are shown in Table 3-1. Boring logs are presented in Appendix B.

Temporary piezometers were installed in selected borings to collect groundwater data (depth to water and water quality). Groundwater sampling was conducted at boring locations B01, B02, B-05, B-06, and B-09. The samples were collected with a foot valve attached to the base of a sampling tube. Depth-to-water measurements and samples for chemical analyses were collected 24 hours after installation of the temporary piezometers to allow for equilibration. Table 3-1 shows the screen interval in the temporary piezometers where the samples were collected. Table 3-2 presents the sample identifiers for the groundwater samples. All of the groundwater samples were analyzed for VOCs, SVOCs (SIM), metals (total and dissolved), and total suspended solids (TSS). For the dissolved metal analysis, the groundwater samples were filtered in the field. All analytical methods and results are presented in Section 3.3 and 3.4, respectively.

These borings provided data on soil and groundwater quality, geologic structure and groundwater flow direction in the area. The depths of each boring, coordinates, and ground surface elevation at each of the borings is presented in Table 3-1. Table 3-2 shows the sample numbers of the groundwater samples collected from temporary piezometers.

In general the direct-push sampling task was implemented in accordance with the Work Plan with the following exceptions:

- Sampling location B-04 did not yield water at the refusal depth; therefore, no groundwater sample was collected. A soil sample was collected at this location.

- A photo ionization detector (PID) was not on site on April 11, 2006, an extra soil sample was collected and stored until the next day.

- The PID readings collected on April 12, 2006 are considered suspect because a field check of the instrument (conducted in the afternoon) failed to show a response by the instrument. The PID was recalibrated.

- The laboratory analysis of soil and groundwater samples for semi-volatile organic compounds (SVOCs) used EPA Method 8270 SIM rather than Method 8270C. Both methods use Gas Chromatography/Mass Spectrometry (GC/MS); however, the SIM analysis has lower detection limits and a shorter analyte list.

3.1.2 Geophysical Survey

The objectives of the geophysical survey were to assist in determining the boundaries of the fiberglass debris landfill and to determine the location and depth of subsurface metal anomalies (e.g., drums). The geophysical survey/mapping was subcontracted to Golder Associates based on their expertise in geophysical testing. The geophysical survey and mapping work was conducted the week of May 1, 2006. The summary report from Golder Associates is included as Appendix C. The site geophysical investigation used the following testing instruments: Geonics EM-31 Conductivity Meter, Geometrics 858 Magnetometer, Grainger Fluxgate Magnetometer, Ground Penetrating Radar (GPR) and a CSI Max Differential Global Positioning System (GPS). The use and objectives of these instruments is as follows:

- The electromagnetic method (EM) measures subsurface electrical properties (using EM induction) and is used to identify conductivity differences in soil types, water content, disturbed soil/fill and differences in magnetic susceptibility caused by the presence of metallic debris. As used at this site, the EM-31 has an effective depth of penetration of about 18 feet along each transect.

- The magnetometers are used to measure the gradient in the earth's magnetic field with a focus on local distortions/anomalies caused by ferrous objects or minerals.

- The GPR directs electromagnetic pulses (radar) into the ground from an antenna and measures the reflection of the pulses caused by subsurface features. Typically, buried drums and areas that have been excavated and in-filled can be good reflectors of the radar signal. The GPR system is also used to estimate the approximate depth for each of the objects identified. As used at this site, the GPR has an effective depth of penetration of about 15 feet along each transect.

- The GPS is used to record the spatial position of the readings from the other instruments (as appropriate).

The results of the geophysical survey/mapping are summarized below. The geophysical testing results are graphically presented in Figure 3-2.

The northern portion (~ 350N to 375N in the site grid) of the area investigated indicates a zone of buried debris, interpreted to be fiberglass debris and metal. The subsurface metal objects appear concentrated in the northern portion of this area over a zone approximately 100 feet wide in an east-west direction (~ 150E to 250E). The GPR measurements suggest that the top of the metal debris ranges from 0 to 5 feet bgs but cannot be used to identify the debris thickness or base of the filled zone. In locations where non-metallic debris is present, the results indicate a fill that is approximately 3-8 feet thick in this northern area. A smaller area of metallic debris, interpreted to be a lower density of metallic objects, extends to the south (near grid 125E, from 250N to 375N). Surface drums are visible in this area. These two areas noted above are located to the north and west of the present cul-de-sac on the site.

Another area of fill is located to the southwest of the cul-de-sac. The fill in this area appears to be approximately 2-5 feet thick. A number of smaller metallic objects (12) were identified in this area. Each item was flagged and marked with the estimated depth ranging from 0.5 to 1.5

feet bgs to the top of the metallic object.

A third area of fill is located to the southeast of the cul-de-sac. One metallic object (top of object) is mapped in this area at a depth of one foot bgs. Existing test pits in this area indicate fiberglass debris with a thickness of about three feet.

A fourth smaller area of fill is located to the southeast of the cul-de-sac (approximately 160 feet to the SE, grid 300E, 75N). This smaller area was interpreted to be about two feet thick and no metallic objects were noted.

These geophysical testing results (from May 2006) are similar to the results from SAIC (from 1990) in the northern portion of the fiberglass debris landfill. The testing equipment and data interpretation software for virtually all geophysical testing methods has improved significantly in the last 15 years.

3.1.3 Test Pits/Trenches and Interim Removal Actions

The objectives of the test pits/trenches and interim removal actions were to:

- Confirm the results of the geophysical testing with test pits used to field verify the fill boundaries and depths.

- Identify and remove specific metal objects detected during the geophysical survey (specifically shallow metal objects identified in the geophysical testing).

- Collect samples of the fill material and soil below drums for laboratory analysis.

The test pits/trenches task was completed on June 13, 2006. An excavator was used for all larger test pits and a small backhoe was used to dig and remove the shallow metal objects. The completed work included excavation of 14 test pits to verify the boundaries of the filled areas (based on the maps derived from the geophysical testing), excavation/removal of 17 shallow metallic objects to determine if they were buried drums, and collection of samples of the soil/fill material from 10 locations.

The location of all test pits/trenches, areas of anomaly excavations, and the locations of samples collected are shown in Figure 3-3. Visual observation of the test pits was used to determine the presence of fill (fiberglass debris is obvious when present). Following the project Work Plan, soil samples were collected beneath each location where a drum was excavated (10 locations included drum removal). A total of 11 soil samples (10 plus one duplicate) were collected below drums during excavation of shallow anomalies, 2 soil samples from test pits, and one liquid sample of residual found in one drum. All soil/fill material samples were analyzed for VOCs, SVOCs, and metals. Analytical methods and results are presented in Section 3.3 and 3.4, respectively.

One of the drums excavated from the location of test pit 3 (TP-3) contained a small quantity of liquid (estimated at less than one gallon). The drum was placed in an over-pack container. The drum was crushed (not flattened) and contained multiple open holes (one was a six-inch gap in the side of the drum). A sample of the liquid (designated as HL-TP3-D1) was submitted for total petroleum hydrocarbon (TPH-HCID) analysis.

The visual results from the test pits (i.e., fiberglass debris or native soil) are depicted in Figure 3-3. Test pits depicted in blue were observed to contain native soil with no fill; test pits depicted in red indicate the presence of fill (at least at one end of the trench). The visual observations from the test pits are consistent with the fill boundaries identified in the geophysical testing. A summary of the observations from each of the test pits/trenches and excavation of anomalies is shown in Table 3-3.

3.1.4 Monitoring Well Installation

This task included the installation of four monitoring wells and two deep borings (advanced to bedrock). The objectives of this task included installation of monitoring wells for determining groundwater quality, determining groundwater elevations and gradients, and acquiring additional data for geologic characterization.

Four groundwater monitoring wells, HLMW-01A, HLMW-02A, HLMW-03A and HLMW-04A, and two boreholes, B10 and B11, were installed between August 14 and 17, 2006. The borings were drilled using a hollow-stem-auger drill rig. Lithological data were collected using an 18-inch by 3-inch diameter split-spoon sampler (Dames and Moore Sampler). Lithological data are presented in the boring and well construction logs in Appendix B. Locations of the monitoring wells, HLMW-01A through HLMW-04A, and borings, B10 and B11, installed in August are presented in Figure 3-1. Monitoring well construction details and depths to groundwater are presented in Table 3-4.

The drilling included two borings advanced until the underlying bedrock was reached (basalt at a depth of 75 feet and 40 feet in boreholes B10 and B11, respectively). Boreholes B10 and B11 were backfilled with bentonite following completion.

The groundwater monitoring wells were constructed using 2-inch PVC with 10-slot screens ranging from 10 - 15 feet in length. The well screens were installed at the base of the first water bearing zone just above the perching geologic layer. Sand filter-pack was placed from the base of the borehole upward to 1.5 feet above the screened interval. Bentonite chips were placed above the filter-pack sand upward to 2 feet below ground surface. The wells were completed with an above-ground steel monument (set in concrete) with locking cap and protective bollards. The monitoring well construction diagrams are presented in Appendix B.

All groundwater monitoring wells were initially developed with a bailer to remove the heavy sediments and followed with additional development using a surge and pump method. A total of 75 gallons of water were purged from the monitoring wells (all wells combined). All purge water was placed in a drum for each individual well. Well HLMW-02A was purged dry. Proper well development was difficult due to the thin saturated thickness associated with the late summer low water levels. Well development was continued in December 2006 in wells HLMW-02A and HLMW-03A when the water bearing zone was recharged. Sampling of wells is discussed in the following section.

After well construction was complete, all wells and borings were surveyed. The survey established northing and easting locations, ground surface elevations, and top of casing elevations for all monitoring wells (and the same information except top of casing for all borings). The surveying was performed by Butler Surveying, a licensed Washington surveyor. All elevations are based on the National Geodetic Vertical Datum 1929 (NGVD 29); all spatial coordinates are based on the Washington State Plane South Zone. All relevant survey information is presented in Tables 3-1 and 3-4.

3.1.5 Monitoring and Private Well Sampling

Groundwater sampling of monitoring wells and two private wells was conducted to evaluate water quality in the area of the fiberglass debris landfill and in private wells located in the vicinity of the fill area. Groundwater sampling of the four monitoring wells (HLMW-01A, HLMW-02A, HLMW-03A and HLMW-04A) was conducted on September 1, 2006 (two weeks after well development). Two weeks later (September 14, 2006) two private water-supply wells were sampled.

The depth to water was measured for each monitoring well prior to sampling using a depth-to-water probe. Water-level measurements for the September 2006 sampling are shown in Table 3-4. Groundwater monitoring parameters collected during the purging of each well are presented in the individual sample data sheets in Appendix D. All monitoring wells were purged and sampled using a low-flow sampling technique.

Four samples (one from each monitoring well) and one duplicate sample were collected and submitted to the laboratory for VOCs, SVOCs, and total metal analyses. The duplicate was collected from monitoring well HLMW-04A. All analytical methods and analytical results are presented in Section 3.3 and 3.4, respectively. An Ecology representative also collected a field-split sample for VOC and SVOC analyses from well HLMW-01A at the same time this sampling was completed. The sample collected by Ecology was submitted to the Manchester Environmental Laboratory for analysis (lab results are included in Appendix E).

On September 14, 2006 sampling, two private water-supply wells were sampled; Morgan's well, and Pavlicek's well. An attempt was made to sample Spears' well, but this was not possible with the existing pump and wiring in the well. The well logs indicate the total depth of Morgan's well is 200 feet deep, Pavlicek's well is 59 feet deep, and Spears' well is 180 feet deep. Depth to water was measured in the Spears' well at 56 feet before Morgan's well was purged. This corresponds with a water table elevation of 174.86 feet NGVD for the water table in bedrock. Comparing this with the water table elevation in monitoring well HLMW-04 (205.9

feet NGVD) indicates a downward vertical gradient between the shallow monitoring wells and the deeper private supply wells. The depth to water in Spears' well increased by 15 feet (the piezometric surface dropped) during the purging of Morgan's well, indicating that there is a hydraulic connection between the two wells.

More than three well volumes of water were purged from each well prior to sampling and water quality parameters were measured during purging (see Appendix D). A garden hose was used to direct the water away from each residence. All purge water from the water-supply wells was discharged to ground. Prior to sample collection, the flow rate was reduced and the samples were collected from the hose used for purging. The samples were inadvertently collected from the end of the garden hose rather than directly at the tap. These samples are therefore suspect because of the potential for chemical adsorption or desorption from the hose.

Two samples (one from each well) and one duplicate sample from Morgan's well were collected and submitted to the laboratory for VOCs, SVOCs, and total metals analyses. All analytical methods and analytical results are presented in Section 3.3 and 3.4, respectively.

3.2 Phase II Investigation – Other Suspect Areas on the 44-Acre Site

The RI Phase II Investigation was implemented for soil and groundwater characterization of all other suspect areas on the 44-acre Site. The Phase II investigations were intended to include soil/ groundwater investigations to characterize the potential impacts derived from other suspect areas of the Site not investigated during the Phase I investigation activities. Phase II activities were conducted in accordance with the Addendum to the RI Work Plan (CALIBRE 2006b).

CALIBRE staff, in conjunction with Ecology staff, walked the site several times (February, July and August 2006) to identify specific suspect areas that require further investigation in the Phase II RI. Based on those site inspections, the following suspect locations/areas were identified:

- Historical Dump from Town of Bordeaux (designated area L-1 in the Work Plan)
- Other Suspect Areas
  - Area of a rusted drum on the ground surface (located just south of the Bordeaux dump, designated area L-2 in the Work Plan) ,
  - Area with observed surface glass debris (located in front of the Pavlicek's yard, designated area L-3 in the Work Plan)
  - Base of gravel pit (designated area L-4 in the Work Plan).

Results of investigation activities conducted during Phase II are discussed in subsections as follows:

- Section 3.2.1 - Bordeaux Dump Area
- Section 3.2.2 – Other Suspect Areas

3.2.1 Bordeaux Dump Area

The historical town of Bordeaux used an area on the Site as a dump site in the early 1900's. The area of the suspected dump is shown on Figure 3-4. Metal and glass waste, along with burned debris, are apparent in the dump that covers an area of approximately 100 feet in diameter. The Bordeaux dump was investigated to determine if hazardous substances are present in the fill material above MTCA criteria, to sample groundwater beneath the fill area, and to provide sufficient data on the fill boundaries to support a remedial action decision if hazardous substances are present.

A geophysical survey of the Bordeaux Dump area was completed in May 2006 when a geophysical survey contractor was on-site for the Phase 1 investigation. The visual site inspection, photogrammetric mapping (from 1970 aerial photo, presented in the Work Plan (CALIBRE 2006a, CALIBRE 2006b), and geophysical survey provide a reasonable initial estimate of the bounds of the Bordeaux dump (the geophysical survey results indicated a bowl shaped fill area). The results of the geophysical survey are presented in Appendix C.

Test pits and soil sampling were conducted on December 5, 2006 at the Bordeaux dump area. Eight test pits were dug in and around the dump area to characterize the waste material and to assist in determining the boundaries of waste material and the depth of the fill. In addition, an existing test pit from prior investigations to the north of the dump was inspected and logged.

The test pits were identified as TP-19 through TP-26. Relatively shallow samples in the dump/fill material (1-2 feet bgs) and deeper soil samples (2-3 feet bgs) were collected from three test pits (TP-21,-22, and -23). The deeper samples were collected from native soil present below the fill material. A total of 7 subsurface soil samples were collected in the Bordeaux dump area (3 test pits with shallow and deep samples and a duplicate). In addition, one multi-incremental sample (L1-SC) of the fill material was collected from 20 grab locations. All subsurface soil samples and one duplicate sample were analyzed for VOCs, SVOCs, metals, polychlorinated biphenyls (PCBs), TPH-Dx, and TPH-HCID. The multi-incremental surface sample was analyzed for metals only. Soil and waste materials at the dump were field screened using a PID and observations of odor, staining, and ash/burn areas were noted.

Soil samples were not collected from five other test pits because the objective (defined in the Work Plan) was to visually confirm the boundaries of the Bordeaux dump area. The location of the test pits and samples collected are shown on Figure 3-4. Logs and descriptions of soil or other material encountered in the test pits are presented in Table 3-5.

Direct-push sampling methods were used to collect a groundwater sample from below the center of the dump area (see Figure 3-4). The direct-push boring, labeled L1-GP, encountered groundwater at approximately 26.7 feet bgs, the groundwater sample was collected over an interval from 31-36 feet bgs. The groundwater sample (L1-GW-27-36) was analyzed for VOCs, SVOCs, metals (total and dissolved), PCBs, and other water quality parameters (see analytical methods in Section 3.3). Section 3.4 presents the analytical results of all sampling at the Bordeaux dump.

3.2.2 Other Suspect Areas

Other suspect areas identified on the Site included an area with a rusted drum on the ground surface, area with observed surface glass debris (broken jars and other glassware), and the base of the gravel pit that exists on the southern portion of the Site. Investigations of these suspect areas were planned to determine if hazardous substances are present in these areas above MTCA criteria. Locations of these suspect areas are presented on Figure 3-4.

Investigations of the drum area and broken glass area were conducted on December 5, 2006. Due to standing water in the gravel pit, investigation of the gravel pit area was delayed until February 20, 2007. Investigations completed in these areas are discussed below.

Area of Rusted Drum. The investigation at this area included digging test pits and collecting a soil sample. One test was dug at the location of the drum to determine if subsurface debris was present at this location. Prior to digging the test pit, the empty and rusted drum was removed and stored at the Bordeaux dump. One soil sample (L2-TP17-0.5) was collected at a depth of approximately six inches from the sidewall of the test pit (TP-17) below the spot where the drum had rested. The soil sample was analyzed for VOCs, SVOCs, metals, PCBs, TPH-Dx, and TPH-HCID. Analytical methods and results of the soil sample are presented in Sections 3.3 and 3.4, respectively.

A second test pit, test pit 18 (TP-18), was dug approximately 10 feet southwest of TP-17 where a minor amount of debris (shells from either clams or oysters) were observed on the surface. No subsurface debris or staining was observed in either test pit and subsurface materials appeared to consist of native soil. Because neither test pit indicated subsurface debris that would indicate a waste disposal or dump area, no further investigation of the rusted drum area was conducted. Figure 3-4 shows the location of the test pits and soil sample collected. Logs and descriptions of soil or other material encountered in the test pits are presented in Appendix B.

Area of Surface Glass Debris. A relatively limited area (approximately 100 feet by 200 feet) south of the Pavlicek house contained an area of broken glass/bottles on the ground surface (see Figure 3-4). To determine if this was a fill area and/or part of the Bordeaux dump, this area was investigated. In addition, sampling was conducted to determine if hazardous substances are present in the area above MTCA criteria.

The investigation of this area was conducted on December 5, 2006. Two test pits (TP-27 and TP-28) were excavated using a pick and shovel to a depth of 2 feet. Two shallow soil samples (~6 inches in depth) were collected from the sidewalls of the two test pits and submitted for VOCs, SVOCs, PCBs, and metals analyses. Analytical methods and results of the soil sample are presented in Sections 3.3 and 3.4, respectively. Logs and descriptions of soil or other material encountered in the test pits are presented in Table 3-5.

No evidence of subsurface debris or waste disposal was observed in the test pits. Since it appeared glass observed on the property was limited to the surface, no additional investigation was conducted in the area.

Gravel Pit. The investigation conducted at the gravel pit included sampling and analyses of shallow soil samples from eight locations in the base of the gravel pit. The data were evaluated to determine if soil was impacted at levels that exceed MTCA screening criteria. Eight soil samples were analyzed for metals and TPH, three soil samples (a subset of the eight) were analyzed for VOCs, SVOCs, and PCBs.

3.3 Sample Analyses

This section presents the laboratory analytical results for all RI samples and the analytical methods used. The locations and descriptions of samples collected during RI investigations were described in the previous sections. Table 3-6 presents specific information on the RI Phase, task, matrix (soil, groundwater), number of samples, analyses, and laboratory analytical method performed on all RI samples.

Along with analyses conducted on site characterization samples, several quality assurance/quality control (QA/QC) samples were also collected and analyzed in accordance with the project Work Plan. The QA/QC samples included trip blanks, duplicate samples, and extra sample volumes for laboratory matrix spike/matrix spike duplicate analyses. A total of 4 trip blanks and 10 duplicate samples were collected and submitted for analyses during RI activities. Results of all QA/QC samples are presented in Section 3.4.

All groundwater and soil samples were collected using the specified bottles/ preservatives and placed in an ice chest (cooled to ~ 4° C), as per the Work Plan. The samples were sealed under chain-of-custody and delivered to Severn Trent Laboratories (STL) in Tacoma, Washington for laboratory analyses.

3.4 Analytical Results

The laboratory analytical results for analyses conducted on samples collected during the RI are presented in this section. The results are summarized by RI Phase, Phase Task, and media analyzed. The summary of analytical results only presents detected compounds or analytes (metals) and/or analytical results that exceed MTCA screening levels. The applicable MTCA screening level is described on the summary tables. Complete analytical results, including all sample results below laboratory reporting limits (non-detect) and/or screening levels are presented in Appendix E.

3.4.1 Phase I – Fiberglass Debris Landfill Soil Results

Direct-Push Soil Sampling Direct-push subsurface soil sampling was conducted from boring locations B02, B03, B04, B05, B06, and B07. All of the soil samples were analyzed for VOCs, SVOCs (SIM), and metals. In addition, five of the borings had soil samples collected for grain size analysis. Six soil samples and one duplicate soil sample were collected.

The highest concentrations for each analyte detected in all of the soil samples collected in April 2006 are shown in Table 3-7. Summary tables presenting all analytes detected (i.e., above the laboratory detection limits) from the April direct-push soil sampling are included at the end of Chapter 3 (Table 3-28). The complete laboratory data package (including all analytes detected and all analytes below detection limits) is included in Appendix E.

The highest concentrations are compared with MTCA screening criteria. The following criteria are used for comparison:

- Naturally occurring background values of inorganic compounds for Puget Sound (90^{th} percentile of background range following WAC 173-340-709, as presented in Ecology 1994);
- MTCA Method B standards for residential use (WAC 173-340-740);
- MTCA Method B standards for leaching impacts to groundwater (WAC 173-340-747), the parameters used for soil-water partitioning calculations (Koc for organics and Kd for inoganics) are presented in Appendix F.
- MTCA Screening Criteria for Ecological Impacts (Table 749-2 WAC 173-340-7490).

The MTCA Method A criteria are also included in the tables (where applicable/available) but are not used specifically for comparisons pursuant to the requirements of WAC 173-340-704 (Method A criteria do not exist for all constituents). The comparison to these criteria are used as a screening level to determine if the soil data indicate a release to the environment at levels of potential concern (as per the project data quality objectives, DQOs, and Work Plan). Use of these criteria for comparative screening is not intended to establish Site cleanup levels; if applicable, other additional steps under MTCA are necessary to establish cleanup levels.

The data from the Phase I soil borings represent samples collected from locations immediately adjacent to and beneath the area with fiberglass debris fill. Sample locations B02, B03, B04, and B07 are from locations beneath and/or immediately adjacent to the fill area. The objective of this Phase I soil sampling was to determine if a release from fill material to soil had occurred through comparison of sample data with applicable MTCA criteria. The maximum concentrations of all VOCs, SVOCs, and metals detected in samples collected from these soil borings were present at concentrations below MTCA Method B screening criteria (see Table 3-7). One metal, chromium, exceeded an ecological screening level in one sample but was within the 90% of naturally occurring background values. Table 3-8 presents a summary of the grain size data from subsurface samples collected from five boreholes during direct-push sampling in April 2006.

Test Pits/Trenches Soil Results

A total of 11 soil samples (10 plus one duplicate) were collected below drums during excavation of shallow anomalies (metal objects), 2 fill/soil samples were collected from other test pits, and one liquid sample was collected of residual found in one drum. Sample identifiers and locations are presented on Table 3-3. All soil/fill material samples were analyzed for VOCs, SVOCs, and metals. The liquid sample was analyzed for TPH-HCID. The highest concentrations for each analyte detected in all of the soil samples collected in test pits/trenches in June 2006 are shown in Table 3-9. Summary tables presenting all laboratory detections from the June test pit sampling are included at the end of Chapter 3 (Table 3-29). The complete laboratory data package (including all analytes detected and all analytes below the detection limits) is included in Appendix E.

The analytical testing of the fill material samples detected metals and a number of volatile and semi-volatile organic compounds present in the fill. The compounds detected were compared against MTCA Method B screening criteria. The results of that comparison are presented in Table 3-9 for each compound which exceeds the Method B screening criteria. In all cases, the lowest criterion is for potential impacts from chemicals in soil leaching to groundwater (following MTCA guidelines for the specific chemicals identified and listed in Table 3-9).

As shown on Table 3-9, a total of 1 metal and 10 different organic compounds were detected at concentrations above the MTCA Method B screening criteria in samples collected from the fill. The most prevalent compounds detected included styrene, trichlorofluoromethane, dimethyl phthalate, and pentachlorophenol. Based on visual observations of the fill (fiberglass debris mixed with soil), the laboratory results from the test pit samples are considered a reasonable representative characterization of the bulk fill material present at the Site.

The Total Toxicity Equivalent Concentration (TTEC) for carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) are calculated based on the measured concentration (of individual cPAH compounds) adjusted by Toxicity Equivalency Factors (TEFs, from Cal EPA 1994) and summed to represent the TTEC cPAH level for comparison with a benzo(a)pyrene criteria (0.1 ug/L in water and 0.1 mg/Kg in soil). The TEF factors used are listed below.

	TEF (MTCA factors, from CAL EPA 1994)
Benzo(a)pyrene	1.0
Benzo(a) anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenzo(a,h)anthracene	0.4
Indeno(1,2,3-cd)pyrene	0.1

Some low levels of specific compounds were detected in the method blanks and trip blanks; these detections are likely the result of cross contamination at the laboratory. For all of the analytes, the low levels detected in the method blanks/trip blank are below the applicable MTCA criteria for screening. For any Site samples that have an analyte that was detected in the blanks, the results are reported with a “B” flag as a data qualifier.

3.4.2 Phase I Groundwater Results

Phase I groundwater results include analytical results from temporary wells constructed in April 2006 in boring locations B01, B02, B05, B06, and B09; and results of sampling four Site monitoring wells and two private water supply wells in September 2006. In addition, a second round of monitoring well sampling was conducted in December 2006. All groundwater samples were analyzed for VOCs, SVOCs, and metals. The temporary wells were analyzed for total and dissolved metals, while the September 2006 sampling of monitoring wells and private wells were analyzed only for total metals. Monitoring well sampling conducted in December 2006 included analyses for total and dissolved metals, along with VOCs and SVOCs. The locations of the temporary wells, monitoring wells, and private wells are shown on Figure 3-1.

The highest concentrations for each analyte detected in temporary wells during April 2006 are shown in Table 3-10. The highest concentrations are compared with MTCA Method B criteria. These data were used to assist in determining the locations of Site monitoring wells. As shown on Table 3-10 and discussed below, several VOCs, SVOCs, and metals were detected in the samples. Only five total metal results (nickel, lead, beryllium, chromium, and copper) exceeded MTCA Method B screening criteria. Dissolved metal analyses were all below screening criteria for all analytes. Summary tables presenting all analytes detected (i.e., above the laboratory detection limits) from the April groundwater sampling are included at the end of Chapter 3 (Table 3-28). The complete laboratory data package (including all analytes detected and all analytes below detection limits) is included in Appendix E.

The results of the monitoring well sampling conducted in September 2006 are presented in Table 3-11. All analytes detected are presented on the table and are compared with MTCA Method B criteria. The results of the second round of monitoring well sampling conducted in December 2006 are presented in Table 3-12. All analytes detected are presented on the table and are compared with MTCA Method B criteria. As shown on Tables 3-11 and 3-12 and discussed below, several VOCs, SVOCs, and metals were detected in the samples.

The analytical results for private wells are presented in Table 3-13 for the Morgan well and Table 3-14 for the Pavlicek well. All analytes detected are presented on the tables and are compared with MTCA Method B criteria. As shown on Table 3-13 and Table 3-14 and discussed below, a limited number of VOCs, SVOCs, and metals were detected in the samples.

Similar to the soil sample results, low levels of specific compounds were detected in the method blanks and trip blanks associated with the above groundwater sampling results. Considering all groundwater samples through September 2006 for volatile and semi-volatile organic compounds, all but one compound detected in one sample were below the MTCA Method B screening criteria. Bis (2-ethylhexyl) phthalate was detected at 13 ug/L in monitoring well HLMW-04A (and at 11 ug/L in the duplicate sample); this value is an estimated value below the reporting limit (RL of 15 ug/L) but above the method detection limit (MDL). It was also detected in the method blank at 1.1 ug/L and bis (2-ethylhexyl) phthalate is a common laboratory contaminant.

These data are presented on Table 3-11.

During the second round of monitoring well sampling in December 2006 no VOCs or SVOCs were detected above MTCA Method B screening criteria (see Table 3-12). Bis (2-ethylhexyl) phthalate was not detected in the regular sample from well HLMW-04A, but was detected at 1.1 ug/L in the duplicate sample from the same well. This concentration is below the Method B screening criteria of 6 ug/L. Based on the VOCs and SVOCs analyses, the groundwater sampling has not identified organic chemicals in groundwater at the Site that are above MTCA Method B standards (based on drinking water). One compound, trichlorofluoromethane, has been detected frequently in groundwater samples from monitoring wells typically in the range of 5 to 10 ug/L. The MTCA Method B standard for trichlorofluoromethane (based on drinking water) is several orders of magnitude higher at 2,400 ug/L.

Several of the samples collected in both April and September 2006 were very turbid. The total metals analysis for one sample from the April sampling from temporary wells had elevated levels of metals above MTCA Method B criteria; specifically for the single sample that also had the highest TSS level, at 170,000 mg/L. All of the dissolved metals analyses for this same sample were below applicable MTCA criteria (see Table 3-10).

In September, the samples collected from monitoring wells HLMW-01A and HLMW-02A were also very turbid. As shown on Table 3-11, lead and chromium were detected in the turbid samples from these wells at levels that exceeded the MTCA Method B criteria for screening (note that well HLMW-01A is the upgradient well). Lead was detected at 0.075 mg/L and 0.12 mg/L from HLMW-01A and HLMW-02A, respectively. Chromium was detected at 0.39 mg/L and 0.58 mg/L from HLMW-01A and HLMW-02A, respectively. While TSS analysis was not conducted on these samples, the field turbidity readings exceeded the range of the instrument at > 999 NTU. Using total metals analysis for highly turbid samples does not meet the MTCA requirement to collect samples that provide a representative measure of groundwater quality. In order to provide more suitable data for metals analyses (based on the turbid samples from these wells), the December 2006 sampling of monitoring wells included analyses for dissolved metals.

Monitoring well sampling during December 2006 included total and dissolved metal analyses as presented on Table 3-12. Except for total arsenic in one sample, all total and dissolved metal concentrations were below MTCA Method B screening criteria. In sample HLMW-03A, total arsenic was detected at 0.011 mg/L which is above the Method B screening criteria of 0.010 mg/L. The corresponding dissolved arsenic concentration in this sample was 0.00057 mg/L, below Method B screening criteria. The infrequent detections of total metals in some samples at concentrations that exceed Method B screening criteria are the result of turbid groundwater samples that include soil particles that contain naturally occurring metals. Based on the metals analyses, the groundwater sampling has not identified metals of concern in groundwater at the Site (above MTCA Method B standards based on drinking water).

The analytical results from the private well sampling indicated that there were no analytes detected above MTCA Method B screening criteria. All analytes detected were at relatively low concentrations and the values reported were estimated (J flagged) because the concentrations were below laboratory reporting limits and/or were also found in the associated blank sample (B flagged). The private well data indicating all detected analytes are presented in Tables 3-13 and 3-14.

3.4.3 Phase II Soil Results

Phase II soil sampling and analyses included soil sampling at the Bordeaux dump, area of the rusted drum, and in the area of broken glass debris on the ground surface. The following presents the results of the soil sampling in these areas.

Bordeaux Dump Area A total of six subsurface soil samples (and one duplicate) were collected in the dump area. In addition, one multi-incremental sample (L1-SC) of the surface fill material was collected. All subsurface soil samples were analyzed for VOCs, SVOCs, metals, PCBs, TPH-Dx, and TPH-HCID. The multi-incremental surface sample of the fill area was analyzed for metals only. Analytical results for detected analytes are presented in Table 3-15 (VOCs), Table 3-16 (SVOCs), and Table 3-17 (metals), and Table 3-18 (TPH). No PCBs were detected in any of the samples.

Relatively low concentrations of VOCs and SVOCs (all below MTCA screening criteria) were detected in the shallow fill material at the Bordeaux dump (see Tables 3-15 and 3-16). Soil samples from native soil below the fill (2 – 3 feet bgs) had no detections of VOCs or SVOCs except for detections of di n butyl phthalate that also was detected at similar levels in the method blanks (B flagged in Table 3-16). The di n butyl phthalate concentrations are estimated because it was below the reporting limit.

Antimony, arsenic, cadmium, copper, lead, selenium, and zinc were detected in fill material at concentrations that exceeded at least one MTCA criteria on Table 3-17. The soil samples in native soil below these samples contained no metals that exceeded MTCA Method B screening criteria, only selenium exceeded the ecological screening criteria (J flagged samples) but all values are below a level representing 90% of naturally occurring background values. Fuel compounds (#2 diesel and motor oil) were detected in shallow fill material at the dump at concentrations below MTCA screening criteria shown on Table 3-18. Soil samples in native soil (2.5 – 3 feet bgs) were all non-detect for fuel compounds. The data indicate that impacted soils are limited to shallow fill materials at the dump from the ground surface to 1- 2 feet in depth.

Area of Rusted Drum One soil sample (L2-TP17-0.5) was collected at a depth of approximately six inches from the sidewall of the test pit (TP-17) below where the drum had rested. The soil sample was analyzed for VOCs, SVOCs, metals, PCBs, TPH-Dx, and TPH-HCID. Analytical results for detected analytes are presented in Table 3-19 (SVOCs), Table 3-20 (metals), Table 3-21 (PCBs), and Table 3-22 (TPH). No VOCs were detected in any of the samples from this area.

Several SVOCs were detected in the shallow soil sample (0.5 feet bgs), all below MTCA screening criteria on Table 3-19. Arsenic exceeded the MTCA Method B criteria but is below a level of 90% of background value and zinc exceeded the ecological screening criteria. One PCB arochlor was also detected as shown on Table 3-21, but the concentration was well below screening criteria and the low concentration was estimated (J flagged). Petroleum hydrocarbons (motor oil and #2 diesel) were detected at concentrations below screening criteria on Table 3-22.

Area of Surface Glass Debris Two shallow soil samples (~6 inches in depth) were collected from the sidewalls of the two test pits and submitted for VOCs, SVOCs, PCBs, and metals analyses. Analytical results for detected analytes are presented in Table 3-23 (SVOCs) and Table 3-24 (metals). No VOCs or PCBs were detected in any of the samples from this area.

Three SVOCs were detected at relatively low concentrations and below all screening criteria on Table 3-23. Several metals were detected, but concentrations were either below MTCA screening criteria or below background values on Table 3-24. No analytes were detected in the surface glass area at concentrations that are a concern.

Gravel Pit All samples from the gravel pit area (Metals, VOCs, SVOCs, PCBs and TPH) were below applicable MTCA criteria and are summarized in Appendix I.

3.4.4 Phase II Groundwater Results

One groundwater sample was collected from direct-push boring, L1-GP, in approximately the center of the Bordeaux dump. The groundwater sample (L1-GW-27-36) was analyzed for VOCs, SVOCs, metals (total and dissolved), PCBs, and water quality parameters (ammonia, nitrogen/nitrates, chloride, sulfate, total organic carbon (TOC), and total dissolved solids (TDS)). Analytical results for detected analytes are presented in Table 3-25 (VOCs and SVOCs), Table 3-26 (total and dissolved metals), and Table 3-27 (water quality parameters).

Several VOCs and SVOCs were detected at low levels (all J flagged and under 1 ug/L) in the groundwater sample. Indeno(1,2,3-cd)pyrene estimated at 0.15 ug/L (J flagged) exceeded Method B screening criteria (0.12 ug/L) and benzo(a)pyrene estimated at 0.17 ug/L (J flagged) exceeded Method A screening criteria (0.1 ug/L) (see Table 3-25). The sum of Total Toxicity Equivalent Concentration (TTEC) for carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) was calculated to be 0.25 µg/l which is above the Method A groundwater cleanup level of 0.1 µg/l for benzo(a)pyrene TTEC. Neither of these compounds detected in the groundwater sample (indeno(1,2,3-cd)pyrene or benzo(a)pyrene, both J flagged) were detected in any of the soil samples from the Bordeaux dump area (samples from the fill or in native soil beneath the fill, a total of seven samples).

Total chromium was the only metal to exceed MTCA Method B screening criteria on Table 3-26. Chromium was not detected in the associated dissolved chromium analyses. Water quality parameters for the groundwater sample from the Bordeaux dump are presented in Table 3-27. The other water quality parameters (total dissolved solids, chloride, nitrogen-nitrate, sulfate, ammonia, total organic carbon) appear to represent background levels.

3.5 Summary of the Nature and Extent of Contamination

This section discusses the nature and extent of contamination at the Site. The contaminants detected above screening levels and MTCA cleanup levels are described along with the location and estimated volume of impacted media. The chemicals of concern and nature/extent of impacted areas are discussed separately in the following sections. The compounds detected at the fiberglass debris landfill are consistent with the known use of the area (as specified in the Landfill permit). The compounds detected at the Bordeaux dump are different that the fiberglass debris landfill and are generally consistent with use as a very old municipal dump.

3.5.1 Phase I – Fiberglass Debris Landfill Area

A summary of the contamination detected in Phase I soil and groundwater sampling at the fiberglass debris landfill area of the Site are presented in the following sections.

3.5.1.1 Soil Contamination

The concentrations of all VOCs, SVOCs, and metals detected in samples collected from soil borings around and beneath the fiberglass debris area were present at concentrations below MTCA Method B screening criteria (see Table 3-7). One metal (chromium) in one sample exceeded an ecological screening level but was at or below the 90% of background values.

As shown on Table 3-9, 1 metal and 10 different organic compounds were detected in test pits/trenches in the fiberglass debris area at concentrations above the MTCA Method B screening criteria from the soil/fill samples. The most prevalent compounds detected included styrene, trichlorofluoromethane, dimethyl phthalate, and pentachlorophenol.

Based on the soil sampling and analyses in the fiberglass debris area, the material located in the fill areas (as depicted on Figure 3-3) is impacted with organic compounds and/or metals at concentrations exceeding MTCA screening criteria. Based on these findings, the fill materials contain chemicals of concern. In contrast, soil sampling around and beneath the fill (April 2006 sampling implemented to identify migration from the fill) did not identify any samples that exceeded MTCA screening criteria for any constituent (in soil or groundwater).

3.5.1.2 Groundwater Contamination

Groundwater samples from temporary piezometers and monitoring wells indicate groundwater has been impacted by the VOC trichlorofluoromethane. The maximum concentration of trichlorofluoromethane detected was 56 ug/L which is below the MTCA Method B screening criteria of 2,400 ug/L. No organic compounds have been detected above MTCA Method A or Method B screening criteria in groundwater near the area of the fiberglass debris landfill.

Based on the metal analyses of groundwater from temporary wells and monitoring wells, the data indicate there are no metals of concern in groundwater at the Site. The infrequent detections of total metals in some samples at concentrations that exceed Method B screening criteria are the result of turbid groundwater samples which include soil particles that contain naturally occurring metals. Based on the metals data, there are no metals of concern in groundwater at the Site.

Private well sampling of two wells detected relatively low concentrations of organic compounds and metals, but not at concentrations of concern. All detections were at concentrations below the laboratory reporting limits (J flagged as estimated values) and none exceeded MTCA Method A or B screening criteria.

The results of the Phase I geologic investigation and groundwater sampling provide sufficient data for a consistent conceptual model of the site geologic structure and hydrogeologic conditions. Water quality sampling has identified low levels of organic compounds in the immediate vicinity of the fiberglass fill area (groundwater samples from well HLMW-04A, and boring B02). Sampling of downgradient wells (HLMW-02A and HLMW-03A) has identified the same compound (trichlorofluoromethane) at lower levels (providing a positive tracer indication of the predominant downgradient flow path within groundwater).

3.5.2 Phase II – Other Suspect Areas

A summary of the contamination detected in Phase II soil and groundwater sampling at the Bordeaux dump, area of rusted drum, and area of broken glass at the Site are presented in the following sections.

3.5.2.1 Soil Contamination

Bordeaux Dump Fill material in the shallow dump are impacted with several metals (antimony, arsenic, cadmium, copper, lead, selenium, and zinc) at concentrations that exceed at least one MTCA criteria on Table 3-17. The soil samples in native soil below these samples contained no metals that exceeded MTCA Method B screening criteria. The data indicate that impacted soils are limited to shallow fill materials at the dump from the ground surface to 1- 2 feet in depth.

Area of Rusted Drum Zinc from the soil sample in this area exceeded the ecological screening criteria. No other analytes (VOCs, SVOCs, PCBs, and other metals) exceeded applicable MTCA criteria.

Area of Surface Glass Debris Two shallow soil samples (~6 inches in depth) were collected from the sidewalls of the two test pits and submitted for VOCs, SVOCs, PCBs, and metals analyses. Analytical results for detected analytes are presented in Table 3-23 (SVOCs) and Table 3-24 (metals). No VOCs or PCBs were detected in any of the samples from this area.

No analytes were detected in the surface glass debris area at concentrations that are a concern when compared to the applicable MTCA criteria.

Gravel Pit No analytes were detected in samples from the gravel pit area at concentrations that are a concern when compared to the applicable MTCA screening criteria.

3.5.2.2 Groundwater Contamination

Several VOCs and SVOCs were detected at relatively low concentrations in the groundwater sample from below the area of the Bordeaux dump. Indeno(1,2,3-cd) pyrene and benzo(a)pyrene exceeded Method B screening criteria and the results are estimated (J flagged) because the values reported are below laboratory reporting limits (see Table 3-25). Total chromium was the only metal to exceed MTCA Method B screening criteria as shown on Table 3-26. Chromium was not detected in the associated dissolved chromium analyses.

The primary organic compounds detected (polycyclic aromatic hydrocarbons, PAHs) are reported at trace levels near or above the MTCA Method A/B criteria; indeno(1,2,3-cd)pyrene reported at 0.15(J) ug/L versus the Method B screening criteria of 1 ug/L and benzo(a)pyrene reported at 0.17(J) ug/L versus the Method A criteria of 0.1 ug/L. The sum of Total Toxicity Equivalent Concentration (TTEC) for carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) was calculated to be 0.25 µg/l which is above the Method A groundwater cleanup level of 0.1 µg/l for benzo(a)pyrene TTEC.

None of the soil samples from the Bordeaux dump (in the fill and beneath the fill) identified either of these compounds in any of the soil samples (at levels above the method detection limits, MDLs). Both of these compounds adsorb strongly to soil (the Koc for indeno(1,2,3-cd)pyrene is 3.5E6 L/kg, an estimated Kd of 3,500 L/kg, and a MTCA criteria to protect groundwater of 70,000 ug/kg; the Koc for benzo(a)pyrene is 9.7E5 L/kg, an estimated Kd of 970 L/kg, and a MTCA criteria to protect groundwater of 1,938 ug/kg). The MDLs for these two compounds (in soil samples from the Bordeaux dump) is typically in the range of 9 to 18 ug/kg (see lab sheets in Appendix E). The MDLs are approximately 100 times lower than the MTCA criteria to protect groundwater and there were no detections for indeno(1,2,3-cd)pyrene and benzo(a)pyrene at the MDLs.

Although PAHs are not considered naturally occurring (per MTCA definitions) they have been found to be ubiquitous in the environment at trace levels, formed naturally by forest fires, volcanoes, plants, fungi/bacteria, or from anthropogenic sources such as incomplete combustion of fossil fuels (ATSDR 1995, USGS 2005, WAC 173-340-708).

The other water quality parameters (total dissolved solids, chloride, nitrogen-nitrate, sulfate, ammonia, total organic carbon) appear to represent background levels. Groundwater data from the area beneath the Bordeaux dump do not indicate that groundwater quality is impacted from the fill.

4.0 Evaluation of Site Risks, Cleanup Levels, and Cleanup Standards

Selecting a cleanup action under MTCA requires that:

1) An unacceptable risk/impact to human health or ecological receptors exists which requires a cleanup action.
2) A determination that each of the requirements specified in WAC 173-340-360 is met, including the requirement that the cleanup action is protective of human health and the environment [WAC 173-340-357(2)].

The MTCA determination that unacceptable risk/impact to receptors exists is based on comparison of site data with cleanup levels. The MTCA uses three related terms; Cleanup Levels, Cleanup Standards, and Cleanup Actions that are interrelated but are intended to have different meaning within the MTCA RI/FS process. A specific definition (from WAC 173-340-700) is useful to define the intent (and distinction between the terms):

> Cleanup Levels are the concentration of a hazardous substance in soil, water, air or sediment that is determined to be protective of human health and the environment under specified exposure conditions. Cleanup levels are used in the FS, typically in combination with specific points of compliance, to define the area or volume of impacted media (soil, water, or sediment) at a site that must be addressed by the cleanup action.
>
> Cleanup Standards consist of the following:
> (a) Cleanup levels for hazardous substances present at the site;
> (b) The location where these cleanup levels must be met (point of compliance); and
> (c) Other regulatory requirements that apply to the site because of the type of action and/or location of the site.
>
> Cleanup Actions are the specific remedial technologies (or combination of technologies/approaches) that may be used to comply with cleanup standards at a site. This may include establishing remediation levels (i.e., the concentration of a hazardous substance above which a particular cleanup technology will be applied). If a cleanup action involves containment of a media with hazardous substances above cleanup levels (typically soil), the cleanup action may be determined to comply with cleanup standards, provided that institutional controls and a compliance monitoring program are designed to ensure the long-term compliance of the cleanup action.

4.1 Cleanup Levels for Human Health Risk

The MTCA Method B cleanup levels for residential land use have been developed and established (by Ecology) for protection of human health. As a result, a quantitative human health risk assessment is not required if the Method B cleanup levels (for residential land use) are used. The chemicals of concern (COCs) identified at the site were developed based on comparison with applicable MTCA criteria (per the project DQOs and Work Plan). The COCs and their respective cleanup levels are shown in Table 4-1. As shown in Table 4-1, several of the COCs exceed the MTCA Method B criteria, therefore human health risks exist which exceed the MTCA thresholds. The cleanup actions considered in the FS will include alternatives that meet the MTCA Method B criteria, as described in Section 5.0. Therefore, the cleanup actions considered will be protective of human health based on the use of Method B cleanup levels.

4.2 Cleanup Levels for Ecological Receptors

WAC 173-340-7490 specifies the terrestrial ecological evaluation (TEE) procedures for sites where a release of a hazardous substance has occurred. The potential impact to terrestrial ecological receptors at and near the site was evaluated using the simplified TEE procedures defined in the MTCA (WAC 173-340-7492). As defined under MTCA, the simplified TEE process is intended to identify those sites which do not pose a threat of significant adverse effects to terrestrial ecological receptors, and thus may be removed from further ecological consideration during the remedial investigation and cleanup process. The simplified TEE procedures are organized to focus on three steps in evaluating ecological risk;

1) the extent of potential exposure
2) exposure pathways
3) site-specific contaminants.

The MTCA simplified TEE procedures specify that any one of the steps may be used to determine that no further evaluation is necessary to conclude that a site does not pose a substantial threat of significant adverse effects to terrestrial ecological receptors. If none of the simplified TEE screening step conditions are met, the ecological evaluation may use the chemical concentration values listed in MTCA Table 749-2 as cleanup levels, or conduct a site-specific TEE.

The simplified TEE for the Hytec-Littlerock site considered the following factors:

<u>Exposure analysis potential</u>: The land use of the surrounding area includes forests (with wildlife exposure potential) and the total area of fill/impacted soil is more than 350 square feet.

<u>Pathways analysis</u>: No man-made physical barriers presently exist; therefore, potential exposure pathways from soil contamination to soil biota, plants and wildlife are present.

<u>Contaminants analysis</u>: The site-specific contaminants detected in soil were compared with the hazardous substances listed in MTCA Table 749-2. Considering the highest concentrations for each analyte detected from all samples, four compounds were detected at levels above the values listed in MTCA Table 749-2 (copper, lead, selenium and zinc). The four samples which contain at least one of these four compounds (above the MTCA Table 749-2 screening criteria) are from fill samples collected from the Bordeaux dump. The

deeper samples collected from each test pit (from native soil approximately 1 foot deeper at about 2.5 to 3 feet bgs) are all below the background levels and applicable ecological screening criteria. These same soil samples also exceed the residential cleanup standard for lead indicating a need for some type of remedial action to reduce or limit human exposure to soil in the Bordeaux dump (the upper soil layer containing visible fill with an approximate thickness of 1.5 to 2.5 ft).

Based on the simplified TEE described above, an ecological exposure pathway exists and contaminants present in soil in a limited area (the Bordeaux dump) exceed the ecological screening criteria.

Following the guidance provided in WAC 173-340-7492,2,c,i and the expectation that remedial actions will be implemented to address the human exposure potential to the exact same area, the potential ecological impacts will be fully addressed by remedial actions to address human health risks. The ecological standards will need to be considered in the compliance monitoring associated with any remedial action in the Bordeaux dump area (following the considerations listed in WAC 173-340-7492,1,d; the TEE may use the chemical concentration numbers listed in Table 749-2 as cleanup levels).

4.3 Cleanup Standards

As noted in the MTCA definitions, the site Cleanup Standard(s) consist of three parts: 1) Cleanup Levels for hazardous substances present at the site, 2) the location where these cleanup levels must be met (point of compliance), and 3) other regulatory requirements that apply to the site because of the type of action and/or location of the site.

The prior sections define Cleanup Levels (and corresponding MTCA basis) for applicable COCs present at the site. This section is intended to define the applicable points of compliance and an initial list of other regulatory requirements (potentially Applicable or Relevant and Appropriate Requirements, ARARs).

4.3.1 Points of Compliance

For soil cleanup levels based on the protection of ground water (i.e., leaching from soil to impact groundwater) the standard point of compliance (POC) is soils throughout the site (presumable to the depth at which groundwater is encountered).

For soil cleanup levels based on human exposure via direct contact and ecological receptors (i.e., contact with the soil is required to complete the pathway) the standard POC is the soil throughout the site from the ground surface to 15 feet below the ground surface. This is intended to represent a reasonable estimate of the depth of soil that could be excavated through site development.

A conditional POC compliance may also be set for sites with ICs established to prevent excavation of deeper soil. A specific example is a soil cap to cover soil which exceeds a MTCA Cleanup Level. The soil cap prevents future human and ecological exposure risk (with appropriate design) but would also require ICs to maintain the cap in the future.

The following points of compliance are considered (for the purpose of this FS and developing Cleanup Actions) for the two impacted areas at the site:

Fiberglass debris landfill:

A standard POC would be from the ground surface to a depth of 15 feet. The criteria would apply to all COCs that exceed MTCA Method B criteria and ecological risks.

A conditional POC would include an engineered cover over some or all of the impacted area to prevent future exposure to COCs above applicable criteria (human and ecological receptors). Use of a Cleanup Action with a conditional POC would require ICs to maintain the cover and demonstration that any residuals that remain do not exceed criteria related to leaching impacts to groundwater.

Bordeaux Dump Area:

Existing site data (soil data) are below MTCA criteria for leaching impacts to groundwater (WAC 173-340-747). A standard POC would be from the ground surface to a depth of 15 feet. The criteria would apply to all COCs that exceed MTCA Method B criteria and ecological risks.

A conditional POC would include an engineered cover over some or all of the impacted area to prevent future exposure to COCs above applicable criteria (human and ecological receptors). Use of a Cleanup Action with a conditional POC would require ICs to maintain the cover.

4.3.2 Potentially Applicable or Relevant and Appropriate Requirements

This section identifies and evaluates federal and state requirements that are potentially applicable or relevant and appropriate requirements (ARARs) for remedial actions at the site. The ARAR identification process is based on criteria presented in WAC 173-340-710. Final ARARs will be determined by Ecology in accordance with the MTCA requirements.

WAC 173-340-360(2) and 173-340-710(1)(a) require that cleanup actions conducted under the MTCA comply with applicable federal and state laws. Applicable laws are defined as those requirements that are legally applicable, as well as those that Ecology determines to be both relevant and appropriate.

In order to be defined as a “legally applicable” requirement, the requirement must be promulgated under state or federal law and must specifically address a hazardous substance, cleanup action, location or other circumstance at the site. “Relevant and appropriate” requirements are limited to those requirements promulgated under state and federal laws that, while not legally applicable, are determined by Ecology to address circumstances sufficiently similar to those encountered at the site such that the use of the requirements is well suited to particular site conditions. WAC 173-340-710(3) also includes a limited number of regulations which are automatically considered to be relevant and appropriate requirements.

Identification of ARARs must be made on a site-specific basis and involves a two-part analysis: first, a determination is made whether a given promulgated requirement is applicable; then, if it is not applicable, a determination is made whether it is both relevant and appropriate. A requirement may be either "applicable" or "relevant and appropriate," but not both.

The list of potential ARARs is presented and discussed in Tables 4-2 and 4-3. The specific regulatory limits (i.e., MTCA cleanup levels for applicable COCs are presented in Table 4-1).

This list of potential ARARs is intended to be a relatively complete list in order to meet the MTCA requirements. Based on a review of the site and plausible remedial actions, several of the potential ARARs are not likely to apply. In Table 4-2, this includes:

1) *Archeological and Historic Preservation Act Title 16 USC 469a*; No archaeological sites have been found at the site.
3) *Clean Water Act of 1977 Title 33 USC 1251, Section 404 40 CFR 230.10*; No actions at the site would include filling of wetlands.
7) *National Historic Preservation Act of 1966 Title 16 USC 470*; There are no listed historically significant properties at or near the site.

In Table 4-3, this includes (potential ARARs that are not likely to apply);

5) *Shoreline Management Act Guidelines WAC 173-16;* The nearest navigable body is more than 200 feet from the site (minimum distance required).

Pursuant to WAC 173-340-710, this RI/FS has presented applicable state and federal laws and Ecology will make the final interpretation on whether these requirements have been correctly identified and are legally applicable or relevant and appropriate.

5.0 Cleanup Action Objectives

This section presents conclusions concerning the need for and objectives of cleanup actions at the site. Based on results of RI, the following conclusions are drawn with respect to contamination at the site:

- Several organic compounds are present in soil in the area of the fiberglass debris landfill at concentrations above the MTCA Method B criteria to protect groundwater.
- Lead is present in surface/near-surface soil in the area of the Bordeaux dump at concentrations above the MTCA residential cleanup standards. The same soil samples from the Bordeaux dump also contain copper, zinc and selenium above ecological screening criteria.
- The ability of natural attenuation/degradation mechanisms to reduce contaminant concentrations in soil to cleanup standards is unlikely (materials have been present at the site for approximately 30 years, the organic compounds include SVOCs that are comparatively persistent, and inorganic elements which do not degrade).

Based on the RI results summarized in Table 5-1 (details are presented in previous sections), identification and evaluation of cleanup actions for the site is appropriate.

Cleanup actions at the site would have the following remedial action objectives (RAOs):

- Prevent the potential exposure of contaminants in soil to human and ecological receptors at concentrations greater than cleanup levels.

Potential ecological receptors include plants and wildlife that may use affected areas.

MTCA requires the soil cleanup levels be based on estimates of the reasonable maximum exposure expected under both current and future site use conditions. The site is used for residential land use. Future uses for the site are expected to remain similar to the present residential use. The MTCA Method B cleanup levels applicable to soils at the site are shown on Table 4-1. The property is zoned residential, therefore the additional cleanup requirements listed in WAC 173-340-360, 2, d apply. This additional MTCA consideration requires that soil with hazardous substance concentrations that exceed soil cleanup levels for current (or potential future) residential areas must be treated, removed, or contained.

Based on the MTCA requirements, the approach for cleanup must comply with the following:

1. The 95^{th} percentile upper confidence limit (UCL) on the mean COC concentrations remaining after remediation from any impacted area must be less than the cleanup criteria.

2. No sample concentrations after remediation can exceed two times the levels listed in Table 4-1.

3. Less than 10% of the chemical concentrations (for any analyte) remaining after remediation from of the site can exceed the levels listed in Table 4-1.

The sampling approaches implemented in this RI have been biased sampling that has been intentionally targeted at (and around) known or suspect impacted areas. As a result, the three criteria listed above do not apply to the RI data and comparison with cleanup levels. The three criteria will apply to confirmation monitoring associated with any remedial actions (as appropriate).

6.0 General Response Actions

This section describes the first phase of the FS, which is to identify general response actions that may be implemented at the site to meet cleanup objectives. The FS is focused on approaches known to be effective with the contaminants, media, and conditions at the site. The estimated soil volume above cleanup levels at the site is estimated at approximately 4,000 cubic yards and covers an area of approximately 1 acre (see Appendix H). Including an excavation contingency results in an estimated volume of approximately 5,000 cubic yards.

As described in Section 5.0, the cleanup objective is to prevent potential receptors to exposure to soils containing contaminants at concentrations above cleanup levels. The following general response actions are being considered and will be developed and evaluated further in the FS:

- No action
- Institutional controls
- Containment (capping)
- Treatment to remove or immobilize the contaminants present
- Excavation and off-site disposal or recycling

An additional response action initially considered was consolidation and containment (capping). This remedial action would be technically feasible; however, the residential zoning of the area combined with the specific compounds detected in the RI (some at levels above the WAC dangerous waste criteria) would make this option challenging; and regulatory approval and public acceptance is uncertain. In addition, the containment option (listed above) provides sufficient evaluation of this type of option to support the FS.

7.0 Identification of Cleanup Technologies

This section identifies specific cleanup technologies that can be used to implement the general response actions specified in Section 6.0. As noted in WAC 173-340-350(8)(b), in some cases it is necessary to perform an initial screening of alternatives to reduce the number for detailed evaluation. With the FS being prepared for this site however, appropriate technologies can readily be identified and screening is not necessary. The following sections describe technologies considered for the site. The discussion for each technology contains a brief description of the technology, expected effectiveness in meeting the RAOs and operational concerns.

No Action The no action alternative assesses the consequences of leaving a site in its current state.

Institutional Controls Institutional controls refer to a broad category of measures that can be used to limit or prevent contact with affected soils. These controls might include deed restrictions, permitting requirements, and other use restrictions. Controls that may be applicable include signs, access restrictions (fences), and land use restrictions.

Containment (Capping) Containment for soil refers to a physical barrier (soil cap) intended to restrict direct contact with the soil. If required to meet the RAOs, capping may also be designed to reduce infiltration of rainwater through the underlying contaminated soil. Capping would involve placing a clean soil cover over the contaminated soil and leaving the contaminated soil in place. An impermeable cap of asphalt, concrete, or geomembrane, also satisfies the basic requirements of physical barriers described above and would reduce the potential for infiltration of rainwater (if required to meet the RAOs).

Treatment to Remove or Immobilize the Contaminants Treatment refers to specific technologies to remove contaminants or to stabilize inorganic compounds. Different treatment technologies may be completed either in-situ or ex situ.

A typical example of in-situ treatment for volatile organic compounds is soil vapor extraction. The permeable soils at the site would make SVE feasible and effective.

A typical example of treatment for semi-volatile organic compounds is enhanced bioremediation where indigenous or inoculated micro-organisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) the compounds present in soil converting them to innocuous end products. Nutrients, oxygen, or other amendments may be used to enhance the bioremediation process.

A typical example of treatment for inorganic compounds is addition of a stabilization agent to immobilize or reduce the toxicity of specific inorganic compounds.

All of the technologies may be applied either in-situ or ex-situ to soils. Soil vapor extraction and enhanced bioremediation are more commonly applied in-situ and stabilization of inorganic compounds is more commonly applied ex-situ.

Excavation and Off-site Disposal This alternative refers to excavating soil with contaminant concentrations exceeding a specified action level and hauling the soil to an off-site facility for disposal or recycling. This alternative may also include physical sorting/screening to remove rocks and possibly large debris items (metals or other recyclable materials). Excavated soils need to be tested using approved methods/procedures to determine if soils meet the landfill-specific acceptance criteria.

If required as a result of the waste-acceptance criteria for a landfill, the soil may require treatment using one or more of the treatment technologies previously discussed (SVE, bioremediation, stabilization).

Offsite disposal may include recycling of some material and landfill disposal of other materials (Subtitle C or D based on the waste designation processes/criteria defined in WAC 173-303). An initial evaluation of the potential waste designation criteria is presented in Appendix G (based on the soil sampling data from test pits in the fiberglass debris landfill). A review of the soil sampling data from the Bordeaux dump indicates that soil from that area would not be regulated (pursuant to WAC 173-303) and would be suitable for disposal in a Subtitle D landfill. Actual designation would need to be based on sampling from soil stockpiles and specific evaluation by the landfill to accept the waste.

8.0 Development of Cleanup Actions and Evaluation/Ranking

This section identifies cleanup actions comprised of selected technologies described in Section 7.0 and presents an evaluation of these actions with respect to the selection criteria contained in WAC 173-340-360. This evaluation is designed to provide a basis from which a preferred cleanup action can be selected.

The criteria used for evaluating and ranking the alternatives are established under MTCA (WAC 173-340-360(2)(a)). The MTCA criteria include the following threshold factors:

1) Protection of human health and the environment,
2) Compliance with cleanup standards,
3) Compliance with applicable state and federal laws, and
4) Provision for compliance monitoring.

The other requirements for the selected alternative (contained in WAC 173-340-360, 3) consist of:

5) Use of permanent solutions to the maximum extent practicable,
6) Attaining cleanup in a reasonable time frame, and
7) Considering public concerns.

Additional criteria are contained in WAC 173-340-360(3)(f) for determining whether a cleanup action is permanent to the maximum extent practicable. These additional ranking criteria are intended to compare cleanup action alternatives with a disproportionate cost analysis used to determine whether a cleanup action meets the MTCA definition of "permanent to the maximum extent practicable". The additional criteria (all a subset of item 5 above) are:

a. Protectiveness,
b. Permanence,
c. Cost,
d. Effectiveness over the long term,
e. Management of short-term risks (risks to human health and the environment associated with the alternative during construction and implementation),
f. Technical and administrative implementability, and
g. Consideration of public concerns.

8.1 Identification of Cleanup Action Alternatives

Based on evaluation of the candidate technologies presented in Section 7.0, five cleanup action alternatives were identified for the Site. These alternatives consist of the following:

- Alternative 1 - No Action
- Alternative 2 - Institutional Controls

- Alternative 3 - Containment (Capping)
- Alternative 4 - Treatment of soil to remove, degrade or stabilize contaminants
- Alternative 5 - Excavation and Off-site Disposal

8.2 Detailed Evaluation of Cleanup Action Alternatives

This section presents a detailed evaluation of the five cleanup action alternatives identified in Section 8.1. The following sections present descriptions of each alternative and an evaluation of the alternative with respect to the requirements contained in WAC 173-34-360 (2) and (3). A summary of the FS evaluation of the alternatives is presented in Tables 8-1 and 8-2 for the fiberglass debris landfill and Bordeaux dump, respectively. The summary tables provide a relative score/ranking of the alternatives.

8.2.1 Alternative 1 – No Action

Description of Alternative The no action alternative is used to establish the risk levels and site conditions if no remedial actions are implemented. Under the no action alternative, site conditions and risk levels would remain as they currently exist. No changes or restrictions would be made that would affect activities at the site. No engineering or institutional controls would be emplaced and no remedial actions would be initiated to reduce hazard levels at the site. Land development, site maintenance, and site improvements would continue in accordance with prevailing practices.

Threshold Requirements The threshold requirements contained in WAC 173-340-360(2) consist of protection of human health and the environment, compliance with cleanup standards, compliance with applicable laws, and provision for compliance monitoring.

Protection of Human Health and the Environment Under the no action alternative, affected areas of the site would remain as they currently are with no reduction in toxicity, mobility, or volume of impacted soils. No additional protection would be afforded potential human and ecological receptors to reduce the opportunities for ingestion or dermal contact in affected areas.

Compliance with Cleanup Standards The no action alternative does not meet MTCA cleanup standards because concentrations of contaminants in soil above cleanup levels would remain on site at points where human and ecological receptors could be exposed.

Compliance with Applicable Laws Implementation of this alternative would not trigger compliance with other laws and regulations related to waste management or air discharges, but would not satisfy the requirements of MTCA.

Provision of Compliance Monitoring The no action alternative would not include compliance monitoring.

Other Requirements The other requirements contained in WAC 173-340-360(3) consist of use of permanent solutions to the maximum extent practicable, attaining cleanup in a reasonable time frame, and public concerns.

Permanent Solutions to the Maximum Extent Practicable This cleanup action would not result in permanent reduction in the toxicity, mobility, or volume of hazardous substance at the site. The no action alternative would not provide permanent solutions to the maximum extent practicable.

Attaining Cleanup in a Reasonable Time The no action alternative does not attain cleanup of the site in a reasonable time. Due to the nature of the contaminants present (degradation processes have not eliminated the compounds over the last 30 years), the no action alternative does not cleanup the site in a reasonable time period.

Public Concerns Public concerns would be addressed after receipt of public comments on the proposed cleanup action.

8.2.2 Alternative 2 – Institutional Controls

Description of Alternative The institutional controls alternative refers to establishing access restrictions, legal restrictions, and educational procedures and rules to reduce the potential for adverse impacts. Specifically, access restrictions that included fences and signage would be implemented to limit human access to areas at the site exceeding cleanup levels. The potential human exposure pathway would therefore be reduced. As with the no action alternative, this alternative would not treat or additionally contain affected soil and existing potential exposure routes for ecological receptors would remain.

This alternative would include minimum standards for fences and locating signs in affected areas to warn residents of the potential for exposure associated with contact with and/or disturbance of the soil.

Deed restrictions would be recorded to advise potential owners of the property of the hazards and use limitations associated with the specific affected areas. Grading or excavation in the affected areas would not be allowed without appropriate safety consideration. Zoning and other permit restriction would be implemented to limit site uses to avoid potential exposure. Periodic site inspections would be required to verify the condition of fences and signs and to evaluate the effectiveness of this alternative.

Threshold Requirements The threshold requirements contained in WAC 173-340-360(2) consist of protection of human health and the environment, compliance with cleanup standards, compliance with applicable laws, and provision for compliance monitoring.

Protection of Human Health and the Environment Under the institutional control alternative, affected areas of the site would remain as they currently are with no reduction in toxicity, mobility, or volume of impacted soils. Instead ICs, with access restrictions and warning signs would be used to reduce the potential opportunities for ingestion or dermal contact by human receptors in affected areas. Fences may limit large mammals from access to the affected areas; however, plants, birds, and small mammals would not be prevented from having access to the impacted areas.

Compliance with Cleanup Standards The alternative would meet MTCA cleanup standard using a point of compliance for human health as the access restriction (fence). This alternative would not eliminate ecological exposure risk and further evaluation of the site's ecological risk would be necessary.

Compliance with Applicable Laws Implementation of this alternative would not involve compliance with laws and regulations related to waste management or air discharges. Implementation of this alternative would not trigger compliance related issues with these laws and regulations, but would not satisfy the requirements of MTCA. This alternative would not meet the requirements listed in WAC 173-340-360(2), (soils with hazardous substance concentrations that exceed soil cleanup levels for residential areas must be treated, removed, or contained).

Deed restrictions and zoning changes would have to be implemented in accordance with local, county, and state laws and regulations. Construction of fences and signs would require construction to applicable standards.

Provision of Compliance Monitoring The institutional controls alternative would include one of the three types of compliance monitoring, that is, confirmation monitoring. Access restrictions, such as fences and signs, would be placed around the outside of affected areas and would not disturb areas of contamination above the cleanup levels. Confirmation monitoring of the condition of institutional controls would be required to confirm the condition and effectiveness of the control measures.

Other Requirements The other requirements contained in WAC 173-340-360(3) consist of use of permanent solutions to the maximum extent practicable, attaining cleanup in a reasonable time frame, and public concerns.

Permanent Solutions to the Maximum Extent Practicable This cleanup action would not result in permanent reduction in the toxicity, mobility, or volume of hazardous substance at the site. Therefore, the institutional controls alternative would not provide a permanent solution to the maximum extent practicable.

Attaining Cleanup in a Reasonable Time The institutional control alternative does not attain cleanup of the site in a reasonable time, it does however mitigate risk in a reasonable time.

Public Concerns Public concerns would be addressed after receipt of public comments on the proposed cleanup action.

8.2.3 Alternative 3 – Containment (Capping)

Description of Alternative The containment alternative refers to capping over areas where chemical concentrations in soil exceed cleanup levels. The intent of the action would be to prevent dermal contact or ingestion of the affected soil by residents and ecological receptors. Depending on the material used for the cap, the action may also minimize chemical transport to groundwater by infiltration. This alternative would contain the affected soil through placement of a cap over the affected areas. The cap would limit the potential exposure routes for human and ecological receptors. Some burrowing animals and plants with deep roots may remain potential receptors. A cap would be constructed of soil or more impermeable materials such as asphalt.

Deed restrictions would be recorded to advise potential owners of the property of the hazards and use limitations associated with the specific affected areas. Zoning and other permit restrictions would be required to limit future site uses to avoid potential exposure. Periodic site inspections would be required to verify the condition of a cap, and if required, maintenance of the cap would be conducted.

Threshold Requirements The threshold requirements contained in WAC 173-340-360(2) consist of protection of human health and the environment, compliance with cleanup standards, compliance with applicable laws, and provision for compliance monitoring.

Protection of Human Health and the Environment Under the containment alternative, affected areas of the site would remain as they currently are with no reduction in toxicity or volume of impacted soils, but the cap would be implemented to limit future potential exposure. The mobility of the contaminated soils would be reduced because the cap would act as a barrier for infiltration and also minimize the potential for dermal contact or ingestion.

Compliance with Cleanup Standards The alternative would meet the MTCA cleanup standards if all conditions in WAC 340-740(6)(f) are satisfied. Chemical present in soil above cleanup levels would be left on site; however, the soils would be contained to significantly reduce or eliminate the potential for exposure. A disproportionate cost analysis is required to determine if this alternative meets the requirement of being permanent to the maximum extent practicable (i.e., does the capping alternative provide an equivalent benefit, reduction in exposure risk, for a lower cost than other comparable alternatives).

Compliance with Applicable Laws Implementation of this alternative would involve compliance with laws and regulations related to wastewater discharges, air discharges, or waste management. Deed restrictions and zoning changes would have to be implemented in accordance with local, county, and state laws and regulations. The waste designation of the existing fill material is an important consideration in evaluating this ranking criteria. Fill material designated as dangerous waste under WAC 173-303 would not meet this ARAR in a capping alternative. Fill material that is not designated as dangerous waste under WAC 173-303 would be able to meet this ARAR in a capping alternative

Provision of Compliance Monitoring The containment alternative would include protection monitoring during construction to confirm human health and the environment are adequately protected. Performance monitoring would be required during cap construction to confirm the cap meets suitable design and construction specifications. Confirmation monitoring of the condition of the cap would be required to confirm the long-term condition and effectiveness.

Other Requirements The other requirements contained in WAC 173-340-360(3) consist of use of permanent solutions to the maximum extent practicable, attaining cleanup in a reasonable time frame, and public concerns.

Permanent Solutions to the Maximum Extent Practicable This cleanup action would not result in permanent reduction in the toxicity or volume of hazardous substance at the site. Therefore, this alternative may, or may not, meet the requirements of MTCA because it is possible to implement a more permanent cleanup action for all or a portion of the site (dependant upon the disproportionate cost analysis).

Attaining Cleanup in a Reasonable Time The containment alternative could reduce exposure to contaminated soil in a reasonable time; however, construction of a cap would not remove all contaminated soil from the site and ICs would be required in the future.

Public Concerns Public concerns would be addressed after receipt of public comments on the proposed cleanup action.

8.2.4 Alternative 4 – Treatment to Remove, Degrade or Stabilize COCs in Soil

Description of Alternative The alternative would use treatment technologies to remove contaminants (organic compounds) or stabilize inorganic compounds. The preferred treatment technology for volatile organic compounds is soil vapor extraction (SVE). The semi-volatile organic compounds may potentially be treated using bioremediation approaches, although performance data are limited for several of the SVOCs present. A typical treatment approach for inorganic compounds is stabilization to immobilize or reduce the toxicity of specific inorganic compounds (e.g., addition of phosphate compounds or cement to stabilize lead). These technologies may be applied either in-situ or ex-situ. The specific implementation approaches for these treatment technologies would be developed in design of a cleanup action.

Threshold Requirements The threshold requirements contained in WAC 173-340-360(2) consist of protection of human health and the environment, compliance with cleanup standards, compliance with applicable laws, and provision for compliance monitoring.

Protection of Human Health and the Environment Under this alternative soil with COCs above the cleanup standards would be treated to remove the COCs (or stabilize the inorganic compounds). As a result, this cleanup action would result in permanent reduction in the toxicity, mobility, and volume of hazardous substance at the site.

Compliance with Cleanup Standards The alternative would likely meet the MTCA cleanup standards for VOCs and SVOCs. Soil with inorganic concentrations above cleanup levels would be left on site after stabilization. However, the soils would be treated/stabilized to significantly reduce the potential for exposure. This alternative meets the requirement of being permanent to the maximum extent practicable.

Compliance with Applicable Laws Implementation of this alternative would involve compliance with laws and regulations related to wastewater discharges, air discharges, or dangerous waste management.

Provision of Compliance Monitoring The treatment alternative would include protection monitoring during construction to confirm human health and the environment are adequately protected. Performance monitoring would be required during treatment operation. Confirmation monitoring at the conclusion of treatment /processing would be required to confirm the effectiveness.

<u>Other Requirements</u> The other requirements contained in WAC 173-340-360(3) consist of use of permanent solutions to the maximum extent practicable, attaining cleanup in a reasonable time frame, and public concerns.

Permanent Solutions to the Maximum Extent Practicable This cleanup action would result in permanent reduction in the toxicity, mobility, and volume of hazardous substance at the site.

Attaining Cleanup in a Reasonable Time This alternative would reduce exposure to contaminated soil in a reasonable time. Enhanced bioremediation of SVOCs may take one or more seasons, but the potential exposure risk during the treatment period is low. The inorganic compounds would remain in site soil but in a stabilized form that reduces potential exposure/mobility.

Public Concerns Public concerns would be addressed after receipt of public comments on the proposed cleanup action.

8.2.5 Alternative 5 – Excavation and Off-Site Disposal

<u>Description of Alternative</u> The excavation and off-site disposal or recycling alternative includes excavation of all soils above cleanup standards and disposing or recycling of the soils off site. The intent of the action would be to eliminate the potential for dermal contact or ingestion of the affected soil by residents and to eliminate the potential exposure to ecological receptors. Contaminated soils would be excavated and soils above cleanup standards would be hauled off site for disposal or recycling.

The excavated material would be sampled and profiled for proper disposal at an appropriate landfill based on the waste designation following the procedures define in WAC 173-303.

This alternative would include minimum standards for excavation, stockpiling, transporting, and disposal of contaminated soil with concentrations exceeding the cleanup standard. This alternative would require clearing and grubbing of affected areas prior to excavation. Excavated soils would be sampled and analyzed to determine the appropriate disposition of the soil (hazardous or non-hazardous). Soils below cleanup standards would remain on site and be used as fill material in areas where excavations were conducted. Backfill soil (sampled to verify that it is not contaminated) would have to be imported (or moved from another non-impacted area of the site) to fill the excavated areas.

Threshold Requirements The threshold requirements contained in WAC 173-340-360(2) consist of protection of human health and the environment, compliance with cleanup standards, compliance with applicable laws, and provision for compliance monitoring.

Protection of Human Health and the Environment Under the excavation and off-site disposal or recycling alternative, affected areas of the site would be removed from the site. This cleanup action would result in permanent reduction in the toxicity, mobility, and volume of hazardous substance at the site. If excavated soils were determined to be hazardous, the soil would be disposed in a RCRA approved landfill, with treatment or stabilization if necessary. Therefore, the excavation and off-site disposal alternative would provide a permanent solution to the maximum extent practicable.

Compliance with Cleanup Standards The alternative would meet MTCA cleanup standards because soil above cleanup standards would be removed from the site.

Compliance with Applicable Laws Implementation of this alternative would involve compliance with laws and regulations related to waste management and Thurston County Codes related to excavation/construction work.

Provision of Compliance Monitoring The excavation and off-site disposal or recycling alternative would include protection monitoring during construction to confirm human health and the environment are adequately protected. Performance monitoring would be required during excavation to confirm soils remaining meet cleanup standards. Confirmation monitoring would be combined with performance monitoring to confirm the effectiveness of the removal action.

<u>Other Requirements</u> The other requirements contained in WAC 173-340-360(3) consist of use of permanent solutions to the maximum extent practicable, attaining cleanup in a reasonable time frame, and public concerns.

Permanent Solutions to the Maximum Extent Practicable This cleanup action would result in permanent reduction in the toxicity, mobility, and volume of hazardous substance at the site (the material would be transferred to another landfill location). This alternative meets the requirements of MTCA because it implements a permanent cleanup action for the site.

Attaining Cleanup in a Reasonable Time The alternative could attain cleanup standards in a reasonable time period. Implementation of the alternative would be most successful if the excavation/handling of soil were completed when conditions are dry. Therefore, the alternative may be limited to the summer season, but still could be attained in a reasonable time.

Public Concerns Public concerns would be addressed after receipt of public comments on the proposed cleanup action.

8.3 Disproportionate Cost Analysis for Alternatives 3, 4 and 5

As noted in the introduction, MTCA provides additional ranking criteria that are intended to compare cleanup action alternatives with a disproportionate cost analysis used to determine whether a cleanup action meets the MTCA definition of "permanent to the maximum extent practicable". These additional criteria are only necessary for alternatives that meet all of the prior evaluation criteria (threshold and other criteria).

The initial ranking for the fiberglass debris area (Table 8-1) indicates Alternative 5 (Excavation and off-site disposal) ranks the highest. Alternative 4 ranks similar to Alternative 5 but is expected to cost more. Alternative 3 (Capping) may only marginally meet the ARARs (specifically WAC 173-303).

For the Bordeaux dump area, the initial ranking (Table 8-2) indicates Alternatives 3, 4, and 5 rank at an approximate equivalent level and all meet the MTCA requirements. The added criteria are intended to provide a cost-benefit evaluation of alternatives that are considered equivalent in meeting the MTCA cleanup action goals (meet cleanup standards to reduce risk, meet ARARS, and provide for monitoring). These additional criteria (specifically applied to the Bordeaux dump area) are described below and summarized in Table 8-3.

Protectiveness
Alternatives 3, 4 and 5 (Capping, Treatment, and Excavation with Offsite disposal, respectively) all meet the MTCA cleanup standards and are considered essentially equivalent.

Permanence
Alternatives 3, 4 and 5 are all considered permanent. Alternative 5 is ranked slightly higher because all material is removed from this site (but placed at another landfill, most likely with no treatment). Alternatives 3 and 4 are ranked slightly lower because actions in the future are required to maintain their effectiveness (monitoring, inspections and/or ICs).

Cost
The estimated costs from the cleanup action alternatives are presented in Appendix H. The costs include capital costs and a present worth evaluation (based on 30 years) of future costs (inspection, maintenance/repair). Alternative 3, at $37,000 is the lower cost of the alternatives considered (versus Alternative 5 at $125,000).

Effectiveness over the long term
Alternatives 3, 4 and 5 are all considered effective over the long term. The distinction between these alternatives (ICs required for Alternatives 3 and 4) is reflected in the permanence criteria.

Management of short-term risks
Short-term risks to human health and the environment are associated with the Alternatives during construction and implementation. Potential site risks during construction activities can be managed with Health and Safety procedures (for all the Alternatives). Capping (Alternative 3) has the least potential short-term risk because it does not include handling and/or disturbance of contaminated soil/debris. Excavation and Off-site disposal (Alternative 5) has the highest short term risk due to unavoidable risks incurred in the transport of materials to an off-site location.

Technical and administrative implementability
Alternatives 3 and 5 are all considered equivalent regarding technical and administrative implementability. Alternative 4 is ranked slightly lower because of technical issues related to biodegradation of some compounds present.

Consideration of public concerns
A public participation plan has been prepared for this project and public comments/ concerns would be solicited under that program. Consideration of the public concerns would be addressed after receipt of comments on the proposed cleanup action.

8.4 Feasibility Study Summary

Fiberglass debris landfill
The FS has evaluated cleanup action alternatives for the fiberglass debris landfill following the MTCA evaluation criteria. Based on that evaluation, the preferred cleanup action for soil exceeding the cleanup levels (in the fiberglass debris landfill) is Alternative 5 (Excavation and off-site disposal). Specific elements of the Alternative 4 (Treatment) may be appropriate (or required) to meet the waste-acceptance criteria at a designated off-site landfill. The site groundwater monitoring data have been compared to applicable MTCA criteria. Based on the existing data (i.e., all data collected in the RI and historical data collected previously), the

concentrations of substances detected in groundwater have not exceeded the MTCA cleanup levels at a standard point of compliance (based on use as a drinking water source). In order to provide further groundwater monitoring, Ecology has required two additional bedrock wells be installed in the area expected to be down gradient of the fiberglass debris landfill (near existing wells HLMW02A and HLMW03A). These two new wells (in bedrock), along with other selected site monitoring wells will be monitored for over a wet and dry season after the remedial action at the fiberglass debris landfill is implemented to verify that groundwater does not contain constituents of concern above MTCA cleanup levels.

Bordeaux Dump

The FS has evaluated cleanup action alternatives for the Bordeaux dump area following the MTCA evaluation criteria. In the draft FS for this area, the initial ranking indicated Alternatives 3 (Capping), 4 (Treatment), and 5 (Excavation and off-site disposal) rank at an approximate equivalent level and meet the MTCA requirements. A disproportionate cost analysis was used to determine whether a cleanup action meets the MTCA definition of permanent to the maximum extent practicable. The comparison of benefits and costs is semi-quantitative as is necessary based on the discrete remedial options, baseline risks and relative comparison of alternatives. The comparison of benefits and costs includes use of best professional judgment. In the draft FS, the initial screening and disproportionate cost analysis indicated a preferred cleanup action for soil exceeding the cleanup levels at the Bordeaux dump as Alternative 3 (Capping).

Upon review of the draft FS, Ecology provided the following information and interpretation (as written comments and in discussion);

1) WAC 173-340-440 (6) states, "Cleanup actions shall not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup actions for all or a portion of the site."

2) In this case, in the Bordeaux dump area, the soil contamination is in open land and it is not located under a building foundation, therefore it is technically possible to excavate and dispose of the contaminated soil from the Bordeaux dump area.

3) Ecology's interpretation of a capping remedy for the Bordeaux dump area is that it would rely primarily on institutional controls and would therefore not meet the requirements of WAC 173-340-440 (6) ("Cleanup actions shall not rely primarily on institutional controls and monitoring where it is technically possible...").

Based on Ecology's interpretation (noted above), its preferred cleanup action for soil exceeding the cleanup levels in the Bordeaux dump area is Alternative 5 (Excavation and off-site disposal). Specific elements of the Alternative 4 (Treatment) may be appropriate (or required) to meet the waste-acceptance criteria at a designated off-site landfill.

The site groundwater monitoring data have been compared to applicable MTCA criteria (one

Geoprobe sample). Based on the existing data, trace levels of cPAHs have been detected in groundwater which exceed the MTCA cleanup levels at a standard point of compliance (based on use as a drinking water source). The cPAHs detected (indeno(1,2,3-cd)pyrene estimated at 0.15 ug/L and benzo(a)pyrene estimated at 0.17 ug/L) are not considered naturally occurring (pursuant to MTCA definitions), but they have been found to be ubiquitous in the environment at trace levels, formed naturally by forest fires, volcanoes, plants, fungi/bacteria, or from anthropogenic sources such as incomplete combustion of fossil fuels (ATSDR 1995, USGS 2005, WAC 173-340-708). These compounds were not detected in any of the soil samples from the Bordeaux dump area (samples from the fill or in native soil beneath the fill).

In order to provide further groundwater monitoring, Ecology has required one additional well be installed in the area near the Bordeaux dump. This new well, along with other selected site monitoring wells, will be monitored over a wet and dry season after the remedial action at the Bordeaux dump is implemented to verify that groundwater does not contain constituents of concern above MTCA cleanup levels.

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