Hamilton/Labree Roads Groundwater Contamination Superfund Site

Draft Final Remedial Investigation Report

Prepared for

EPA Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Prepared by

Parametrix
5700 Kitsap Way, Suite 202
Bremerton, WA 98312-2234
360-377-0014
www.parametrix.com

June 2006 | 415-2328-007 (024) Revision 0

CITATION

Parametrix. 2006. Hamilton/Labree Roads
Groundwater Contamination Superfund Site
Draft Final Remedial Investigation Report
Revision 0. Prepared by Parametrix, Bremerton,
Washington. April 2006.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.

Prepared by Scott Elkind, P.E.

Checked by Brandon Ball, P.E.

Approved by Peter Battuello, LG, LHG

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS

AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/s	centimeters per second
COPC	chemical of potential concern
CSM	conceptual site model
cy	cubic yard
DNAPL	dense nonaqueous-phase liquid
E&E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
Farallon	Farallon Consulting, L.L.C.
FS	feasibility study
ft	foot
ft/d	feet per day
ft/ft	foot per foot
gpm	gallon per minute
HRIA	Hamilton Road Impact Area
I-5	Interstate 5
kg	kilogram
MCL	maximum contaminant level
$\mu g/m^3$	microgram per cubic meter
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
MRL	method reporting limit
MSL	mean sea level
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System

ACRONYMS (CONTINUED)

NPL	National Priorities List
PCE	tetrachloroethene
ppm-v	parts per million-volume
QA	quality assurance
QAPP	quality assurance project plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RG	remediation goal
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
SAIC	Science Applications International Corporation
START	Superfund Technical Assistance and Response Team
SVOC	semi-volatile organic compounds
TCE	trichloroethene
TEG	Transglobal Environmental Geosciences Northwest, Inc.
URS	URS Group, Inc.
VOC	volatile organic compound
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

1. INTRODUCTION

This report presents the remedial investigation (RI) completed by EPA for the Hamilton/Labree Roads Groundwater Contamination Superfund Site (Site) in Chehalis, Washington. The RI was completed under the EPA Region 10 Architect and Engineering Services (Small Business) Contract No. 68-S7-03-04.

1.1 PURPOSE

The RI was prepared by EPA Region 10 to present an interpretation of previously collected groundwater, soil, surface water, sediment and other data to assess the nature and extent of contamination, contaminant fate and transport, and potential risks to human health and the environment associated with contaminated media at the Hamilton/Labree Site.

This RI report was prepared in accordance with *Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act* [CERCLA] (Interim Final, October 1988).

1.2 REPORT ORGANIZATION

This report is divided into eight major sections including:

- Section 1: Introduction – describes Site information including site description and history and summary historical investigations.
- Section 2: Sources of Site Characterization Data – provides a chronological listing of previously completed site investigation and a general summary of results by media.
- Section 3: Physical Characteristics of the Study Area – described the physical site characteristics including geology, hydrogeology, surface water hydrology, soil and sediment, and various other site features.
- Section 4: Nature and Extent of Contamination – identifies the Site contaminants of potential concern (COPCs) and distribution of these contaminants in Site media.
- Section 5: Contaminant Fate and Transport – describes the behavior of contaminants in Site media, presents the conceptual site model (CSM), and provides a summary of groundwater modeling completed to assess future migration and potential impacts on downgradient receptors.
- Section 6: Baseline Risk Assessment – presents a summary of the results of the baseline human health and ecological risk assessment completed for the Site.
- Section 7: Summary and Conclusions – provides a summary of the finding of the RI and preliminary remedial action objectives (RAOs).
- Section 8: References

1.3 SITE BACKGROUND

This section present Site background information including a description of the Site and its history, a summary of previous investigation, the nature and extent of contamination, baseline risk assessment results, and a description of fate and transport process affecting contaminant migration.

1.3.1 Site Description and History

The Hamilton/Labree Site is located near the intersection of Hamilton Road and Labree Road, west of Interstate 5 (I-5), about 2 miles south of the city of Chehalis, Washington (Figure 1-1). The Site includes the S.C. Breen Construction Company (Breen) Property, the Hamilton Road Impact Area (HRIA), and the geographic area underlain by groundwater containing chemicals of potential concern (COPCs). This geographic area encompasses the area between and around the Breen property and the HRIA and extends to the northwest to the area of monitoring MW-25 (Figure 1-2).

The boundary between the City of Chehalis and unincorporated Lewis County bisects the Site roughly north to south along the western side of Labree Road. The HRIA and the Breen property are both within the city limits of Chehalis. This entire portion of the site within the city of Chehalis is zoned for commercial use. The portion of the site located in Lewis County is zoned rural development district, and includes agricultural uses (predominately dairy) and residential use (Farallon 2003).

The Site is located within the Newaukum River valley and has a relatively flat topography. Berwick Creek traverses the site from southeast to northwest. Overall, the site slopes to the northwest. Groundwater and surface water flow are generally northwest toward the Chehalis River (URS 2004).

Both the Breen property and the HRIA have been identified as sources of COPCs, primarily tetrachloroethene (PCE) in shallow groundwater beneath the Site. This groundwater occurs in a “shallow” aquifer occurring from roughly 5 feet to approximately 50 feet below ground surface (bgs). Regional groundwater flow in the shallow aquifer is to the northwest along the Newaukum River valley.

On October 31, 2001, an Administrative Order on Consent (AOC) between the EPA and Breen was signed on (U.S. EPA Docket No. CERCLA 10-2002-0002). In accordance with the AOC, Breen (through their consultant, Farallon Consulting) conducted remedial investigation (RI) activities under EPA oversight to investigate the chemicals of potential concern (COPCs) in the shallow aquifer at the Breen Property. COPCs were determined to be primarily PCE and associated degradation products. In addition, EPA conducted investigation within the HRIA to further evaluate contamination within Berwick Creek and the shallow aquifer.

Breen Property

The Breen Property is located in the northeast quarter of the southeast quarter of Section 9, Township 13 North, Range 2 West, Willamette Baseline and Meridian in Lewis County, Washington.

The Breen property has been previously discussed as two geographic areas: the western and eastern portions (Figure 1-3). The western portion consists of approximately 6.5 acres containing three wood-framed, steel-clad buildings with concrete floors. The Bulldog Trailer Company occupies the northern building (Building A), a building located in the center portion of the property is unoccupied (Building B), and a building located on the southern portion of the property is also unoccupied (Building C). A concrete wash-down pad approximately 24 feet by 38 feet is located southeast of Building C.

The eastern portion of the Breen Property is approximately 4.5-acre and contains the Chehalis Livestock Auction. The eastern portion is no longer owned by Breen (Farallon 2003). Two buildings are located on the portion of the Property: a large wood-framed building is located on the northeast portion and a smaller wood-framed building is located along the southeastern boundary and Berwick Creek. Most of the eastern portion of the Breen Property is an unpaved parking area.

HRIA

The HRIA is located southeast of the Breen Property (see Figure 1-3). The HRIA is shown in the AOC as a roughly rectangular area approximately 3 acres in size, located immediately east of the United Rentals building and extending eastward to the western edge of I-5. This area includes a portion of the United Rentals property and small portions of properties owned by Mr. Reggie Hamilton and Mr. Willard Warren. The area is crossed in a north-south direction by Hamilton Road and Berwick Creek. The portion of the HRIA located between Hamilton Road and I-5 consists of grassy open land that includes Berwick Creek, which flows north; overhead power lines; and a wire field fence preventing access to I-5. An unnamed ditch passes underneath I-5 and discharges to Berwick Creek within the HRIA.

1.3.2 Summary of Historical Investigations

During late 1993 and early 1994, Washington State Department of Health (WDOH) sampled 18 private water-supply wells in the vicinity of the Hamilton/Labree Site as part of a routine sampling program. PCE was detected in six of the 18 water-supply wells. These six wells were screened in the shallow aquifer and contained PCE at concentrations ranging from 3.3 micrograms per liter (µg/L) to 2,165 µg/L (Ecology 1999). The maximum contaminant level (MCL) promulgated by EPA for PCE allowed in drinking water is 5 µg/L. Lewis County Public Services informed affected well owners of the sampling results and advised them to obtain alternative sources of drinking water.

In 1996, WDOH re-sampled five of the six water-supply wells that previously exhibited PCE concentrations and found that concentrations had increased slightly from those measured in 1993 and 1994. Also in 1996, Ecology learned from a confidential source that drums containing solvents might have been buried on the Breen property. Ecology initiated an investigation that included a geophysical survey by Geo-Recon International and a subsurface investigation by Science Applications International Corporation (SAIC). Between October 1997 and July 1998, Ecology performed quarterly sampling of monitoring wells installed by SAIC and some private water-supply wells. In spring 1998, Ecology contracted Transglobal Environmental Geosciences (TEG) Northwest, Inc. to conduct additional subsurface investigation.

In June 1999, Ecology installed seven additional monitoring and recovery wells within the HRIA study area and contracted GeoPotential to conduct an additional geophysical survey. In August 1999, Breen entered into an Agreed Order with Ecology and contracted for additional investigation on the Breen property. This investigation included a geophysical survey by Northwest Geophysical Associates in August 1999 and additional subsurface investigation by GeoEngineers, Inc. In September 1999, 70 drums and a number of pails and cans were removed from beneath Building B on the Breen property. PCE was detected in the contents of some drums and in water in the drum excavation (GeoEngineers 2001).

On July 27, 2000, the Hamilton/Labree Site was added to the EPA National Priorities List (NPL). The same year the EPA Superfund Technical Assistance and Response Team (START) contractor began a phased removal assessment including installing soil borings and new groundwater monitoring wells, and collecting subsurface soil and groundwater samples in and near the HRIA,. The assessment resulted in the expansion of the City of Chehalis municipal water-supply system to include those residences at the Site with contaminated water-supply wells.

Beginning in July 2002, Farallon, under contract to Breen, conducted Phase I RI activities. Farallon installed and sampled temporary borings and conducted a soil gas investigation on the Breen Property, collected surface water and stream-bed soil samples from Berwick Creek, and sampling groundwater from existing monitoring and private water supply wells within the overall Hamilton/Labree Site.

In 2003, URS began additional field investigations at the HRIA to support completion of a Engineering Evaluation/Cost Analysis (EE/CA). The purpose of the field investigations was to better define the extent of soil and groundwater contamination including defining the extent of dense non-aqueous phase liquid (DNAPL) in the Berwick Creek bed and the shallow aquifer related to a potential release or spill into Berwick Creek. URS also evaluated potential alternatives for remediation of contamination in the HRIA.

Beginning in late 2003, Farallon conducted Phase II RI sampling and analysis to better define the nature and extent of contamination at the Breen property and to determine potential sources areas on the property. This included conducting soil and groundwater sampling, monitoring well installation and sampling, surface water sampling, pump testing, and various other activities. This data was collected, but was not reported.

The history of investigations conducted at the Hamilton/Labree Site is summarized in Table 1-1.

2. SUMMARY OF HISTORICAL SITE CHARACTERIZATION DATA

Several characterization investigations were conducted at the Site between 1993 and 2004 to assess the nature and extent of PCE contamination. This section discusses these investigations and presents a summary of the results.

2.1 CHRONOLOGY OF PREVIOUS SITE INVESTIGATIONS

Table 1-1 presents a chronological list of historical characterization investigations conducted at the Site including a description of the activities conducted and key findings.

2.2 SUMMARY OF SITE CHARACTERIZATION DATA BY MEDIA

This section provides a discussion of site characterization data for the Site for each media of concern.

2.2.1 Soil

Soil samples have been collected during the various investigations conducted within the project area (Ecology 1999a, GeoEngineers 2001; SAIC 1997; EPA 2000, 2001, 2002b, Farallon 2003; URS 2004). A brief summary of soil investigations is presented below in chronological order:

- ***Washington Department of Ecology*** (March 1997 through April 1998): Ecology conducted various investigations of the project area (SAIC 1997; Ecology 1999a; Ecology 1999b) with a goal to locate the source(s) of PCE contamination. As a contractor for Ecology, SAIC (1997) collected subsurface soil samples throughout the HRIA study area. PCE concentrations from soil borings (SB-001 through SB-008) ranged from <0.004 to 0.023 milligrams per kilogram (mg/kg). Ecology (1999b) collected six soil samples near PW-9 in January of 1998 and found all non-detected concentrations of PCE (<2 mg/kg). TEG for Ecology (1999a) collected several soil samples (B21 through B27) in April 1998 near PW-3 and found PCE concentrations ranging from 0.05 to 5.24 mg/kg.
- ***GeoEngineers*** (August and September 1999): On behalf of Breen, GeoEngineers (2001) conducted subsurface investigations, drum removal, and other remedial activities on the Breen property. Soil samples were collected from stratoprobe sampling locations at various depths (SP-1 through SP-8). PCE concentrations in soil ranged from <0.05 to 0.0586 mg/kg. Soil samples were also collected at the site of drum removal (Building B) and PCE concentrations ranged from <0.05 to 190 mg/kg. The soil containing the highest PCE concentrations was removed by GeoEngineers and confirmatory soil samples collected indicated that contaminated soil beneath Building B was successfully removed.
- ***U.S. EPA START Investigations*** (June 2000 through October 2001): The EPA START contractor (Ecology and Environment) conducted four phases of investigations in the HRIA study area. Data collection efforts included soil and groundwater from temporary borings, groundwater from monitoring wells and sampling of new monitoring wells. Phase I investigations occurred during June and July 2000 and included soil subsurface soil samples (AB1 through AB-10, GP-1 through GP-4, and GP-A3 through GP-A4). PCE concentrations ranged from <0.001 to 0.013 mg/kg. Phase II assessment was conducted in August 2000 and included

sampling from soil borings (AB11) and monitoring wells (MW-9, MW-10, MWR-8 through MWR-11). PCE concentrations ranged from <0.06 to 53 mg/kg. Phase III investigations occurred in January and February 2001 and included the collection of several soil samples from new monitoring wells (MW-11 through MW-16). PCE was not detected in the soil samples (<71 mg/kg). Phase IV soil investigations were conducted to assist in the evaluation of a proposed water supply piping route. Ninety soil borings were installed (GP-102 through GP-191) and samples collected every 50 feet along Hamilton Road North to the intersection with Labree Road. PCE concentrations ranged from 0.001 to 0.11 mg/kg.

- ***Farallon*** (June 2002 through June 2004): Breen contracted with Farallon (2004) to conduct remedial investigations of the Breen property. Two phases of field data collections were conducted during these investigations and soil samples were collected in June through September 2002 and April 2004. Soil samples were collected at reconnaissance points (RS-1, RS-2, RS-5, RS-8, RS-9, RS-12, RS-16) and monitoring wells (MW-18, MW-19, MW-12, MW-23, MW-24, and MW-25) on the Breen property. PCE concentrations ranged from <0.001 to 0.35 mg/kg.
- ***URS Group, Inc.*** (August 2003 through January 2004): URS conducted an engineering evaluation and cost analysis report for the EPA (URS 2004). This document examined various removal alternatives for the HRIA study area. During this investigation soil samples were collected from beneath Berwick creek (39 samples) and at various locations around Berwick Creek using a Geoprobe or hollow-stem auger sampling methods (359 samples). The average concentration of PCE in all creek bed soil samples was 195 mg/kg and the average for discrete samples was 23.7 mg/kg.

2.2.2 Groundwater

Groundwater samples have been collected periodically from permanent monitoring wells and private wells from 1993 through 2004 (Ecology 1999a, 1999b, 2000; SAIC 1997; EPA 2000, 2001, 2002b, Farallon 2003; URS 2004). In addition, groundwater samples from shallow and deep zones have been collected from temporary soil borings located on the Breen Property and HRIA (Ecology 1999a; SAIC 1997; GeoEngineers 2001; EPA 2000, 2001, 2002b; URS 2004). Farallon (2003) conducted additional groundwater monitoring from reconnaissance samples located downgradient from the Breen and HRIA sites to examine groundwater and contaminant flow. A brief summary of the groundwater investigations is presented below in chronological order:

- ***Washington Department of Health*** (Fall 1993 through June 1996): In 1993 and 1994, eighteen private water supply wells (PW-1 through PW-18) were sampled for volatile organic compounds (Ecology 1999a, 1999b). PCE was detected at six of these wells (PW-2, PW-3, PW-4, PW-5, PW-7, PW-9) ranging from 3.3 to 2,165 micrograms per liter (µg/L). Five of these wells were re-sampled (PW-2, PW-3, PW-4, PW-5, PW-9) in June of 1996 and PCE concentrations ranged from 5.75 to 3,009 µg/L.
- ***Washington Department of Ecology*** (March 1997 through September 2000): Ecology conducted various investigations of the project area (SAIC 1997; Ecology 1999a; Ecology 1999b; Ecology 2000; Ecology 2001). Ecology began investigations in 1997 through the installation of several monitoring wells and sampling of private wells (SAIC 1997). PCE was detected in monitoring wells (MW-1 through MW-8) at concentrations ranging from 3 to 1,500 µg/L and in private wells (PW-2, PW-3,

PW-4, PW-5, PW-7, PW-9) at concentrations ranging from 7 to 2,700 µg/L. In March and April of 1998, Ecology contracted Transglobal Environmental Geosciences Northwest, Inc (TEG) to conduct additional site investigation. TEG collected shallow and deep groundwater samples from temporary borings (B1 through B27) near the intersection of Hamilton and Labree roads (Ecology 2000). PCE concentrations from groundwater ranged from 1 to 60,000 µg/L. Ecology continued quarterly monitoring of permanent monitoring wells (MW-1 through MW-9), monitoring and recovery wells (MWR-1 through MWR-7), and private wells (PW-2 through PW-22) from October 1997 to September 2000. PCE concentrations generally remained stable or decreased over this time period.

- ***GeoEngineers*** (August and September 1999): On behalf of Breen, GeoEngineers (2001) conducted subsurface investigations, drum removal and other remedial activities on the Breen property. Groundwater samples were collected from stratoprobe sampling locations at depths of 15 and 40 feet (SP-1 through SP-8). PCE concentrations ranged from <1.0 to 941 µg/L. The highest concentrations were found near the equipment cleaning area.
- ***U.S. EPA START Investigations*** (June 2000 through October 2001): The EPA START contractor (Ecology and Environment, Inc.) conducted four phases of investigations in the vicinity of the HRIA study area. Data collection efforts included soil and groundwater from temporary borings, groundwater from monitoring wells and sampling of new monitoring wells. Phase I investigations occurred during June through July 2000 and included groundwater samples collected from subsurface boreholes (AB-1 through AB-10, GP-1 through GP-3, and GP-A3 through GP-A4). PCE concentrations ranged from <1 to 190,000 µg/L. Phase II assessment was conducted in August 2000 and included sampling of existing monitoring (MW-1 through MW-10, MWR-1 through MWR-7) and private wells (PW-2, PW-9, and PW-14) and newly installed monitoring wells (MWR-8 through MWR-11). PCE concentrations ranged from <1 to 44,000 µg/L. Phase III investigations occurred in January and February 2001 and included the collection of soil borings and sampling of monitoring and private groundwater wells. PCE concentrations in monitoring wells (MW-1 through MW-16), monitoring/recovery wells (MWR-1 through MWR-11), and private wells (PW-2, PW-6, PW-9 and PW-20) ranged from <1 to 56,000 µg/L. Two additional rounds of groundwater monitoring were conducted as part of Phase IV investigations during May and October of 2001. In May, PCE concentrations from private wells (PW-4, PW-6, PW-16, PW-17, PW-21, and PW-22) ranged from <1 to 710 µg/L. In October, PCE concentrations from monitoring wells (MW-1 through MW-10), monitoring/recovery wells (MWR-1 through MWR-11), and private wells (PW-1, PW-3 through PW-9, PW-16, PW-17, and PW-21 through PW 37) ranged from <1 to 61,000 µg/L.
- ***Farallon*** (June 2002 through June 2004): Breen contracted with Farallon Consulting (Farallon) to conduct remedial investigations of the Breen property. Two phases of field data collections were conducted during these investigations. Groundwater monitoring occurred during June/July 2002, November 2002, August/September 2003, November 2003, April 2004, and June 2004. Samples were collected from existing and new monitoring wells (MW-1 through MW-25, MWR-1 through MWR-11), private wells (PW-7, PW-21) and reconnaissance groundwater stations on or downgradient of the Breen property (RS-1 through RS-24). Concentrations from existing wells were comparable or less than previous investigations (e.g., Ecology or

START). PCE concentrations from reconnaissance samples ranged from <0.2 to 2,400 µg/L.

- ***URS Group, Inc.*** (August 2004 through January 2004): URS completed an engineering evaluation and cost analysis report for the EPA (URS 2004). This document examined various removal alternatives for the HRIA study area. During this investigation groundwater samples were collected from new monitoring wells and from geoprobe/auger samples. The sampling event targeted the projected PCE source area north of Hamilton Road around Berwick Creek. PCE concentrations from new wells (MW-600 through MW-608) ranged from 55 to 83,500 µg/L. PCE concentrations for groundwater samples collected geoprobe and auger boring installation had a mean concentration of 302,000 µg/L and a maximum concentration of 2,720,000 µg/L.

These investigations have been used to identify the nature and extent (i.e., vertical and horizontal distribution) of contamination.

2.2.3 Surface Water

Surface water samples have been collected from Berwick Creek by Ecology (1999a, 1999b) and Farallon (2004). Ten locations have been periodically sampled from April 1998 to February 2003. PCE concentrations over the sampling period have ranged from <0.2 to 40 µg/L. The surface water stations are primarily located near the Breen property or in the vicinity of the HRIA study area. PCE concentrations have been decreasing or are remaining stable over the period of study.

2.2.4 Creek Sediment

Creek channel samples CC-1 through CC-9 were collected by Farallon (2003) during Phase II RI/FS sampling. The samples were collected from various locations along Berwick Creek south of the Breen Property. The samples were collected from the creek bed sediments at approximately 1-foot bgs. No PCE was detected above laboratory detection limits in any of the samples collected.

A total of 39 bed and bank sediment samples from Berwick Creek and unnamed ditch were collected by URS (2004) at various depths (0 to12 ft bgs) to aid in source area identification and delineation. The maximum PCE concentration detected in the samples was 5,220 mg/kg. The average PCE concentration of all 39 stream bed and bank samples was 195 mg/kg. The results of the sampling provided strong evidence of a release to Berwick Creek just upstream of the unnamed ditch.

2.2.5 Soil Gas

Soil gas samples have been collected from limited areas on the Breen Property (Farallon 2003) and in the HRIA study area (URS 2004). Farallon conducted a qualitative soil gas survey in November 2002 at two areas (RS-1, RS-2 and RS-7) to better define potential PCE sources. None of the soil gas samples detected PCE above the detection limit and these areas were determined to not contain a PCE source.

URS (2004) collected 38 soil gas samples from the vicinity of Berwick Creek and I-5 north of the HRIA. PCE concentrations from these samples were generally non-detectable to low (<3.2 parts per million). The results of the URS investigation showed that the Berwick Creek contamination at the HRIA was likely not related to a release or spill from I-5.

2.3 DATA USABILITY ASSESSMENT

Data quality evaluations for the identified historical Site investigations were reviewed and summarized to assess the usability of this data for completing an RI for the Site (Parametrix 2006). These reviews did not constitute an attempt to re-validate any of the third-party data.

While varying sampling methods and laboratory methods have been employed during sampling, the data have generally met EPA quality assurance standards and are acceptable for use in characterizing the nature and extent of contamination at the Site, and development of potential remedial alternatives. Several instances of rejected data were identified and these results were excluded from further evaluation.

A technical memorandum summarizing the results of the data usability assessment is included in Appendix A.

3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section includes descriptions of the Hamilton/Labree Site and regional geology, hydrogeology, surface water hydrology, topography and drainage.

3.1 TOPOGRAPHY, DRAINAGE, AND CLIMATE

The Hamilton/Labree Site and surrounding area lies within the Newaukum Prairie, a relatively flat area formed by the Newaukum River. Hills bound the Prairie to the west and east, rising to elevations on the order of 400 to 700 feet above mean sea level (MSL). Site topography ranges from about 195 to 210 feet MSL, with drainage to the north and northwest (towards Berwick Creek) and to the Newaukum River west of the Site. The regional topography and drainage are shown in Figure 3-1.

The Site is located in the valley of the Newaukum River, which flows northwesterly towards confluence with the Chehalis River about 5 miles northwest of the Site. Berwick Creek is a small stream that flows through the Site in a general northwest direction and joins Dillenbaugh Creek within approximately 1,500 feet from the Site boundary (see Figure 1-2). Dillenbaugh Creek flow to the northwest and eventually discharges to the Chehalis River.

Average annual precipitation in the Chehalis area is approximately 47 inches, with December being the wettest month (Western Regional Climate Center 2006). An estimated three-quarters of the annual precipitation falls during October through March. The climate of the region includes wet winters and moderately warm, dry summers. Mean average annual temperature for the Chehalis area is about 50 degrees F.

3.2 GEOLOGY

The overall soil-type distribution at the Site consists of low permeability silt and clay layer underlain by 45 to feet of water-bearing sand and gravel, underlain by a silt and clay aquitard. These soil types are consistent with regional geologic mapping by Weigle and Foxworthy (1962) and a regional study for the Chehalis Generation Facility (Dames and Moore 1994). These regional studies classify the upper 50 feet of soil in the area of the site as recent alluvium and glaciofluvial sediments. The aquitard found at approximately 50 feet bgs is widespread, is often described as blue-gray, clayey silt, and is reported to be more than 100 feet thick (Dames and Moore 1994).

The low permeability silt layer above the aquifer was found to be continuous within the Site, ranging in thickness from less than 1 foot beneath Berwick Creek to 15 feet at the Breen Property. The silt cap creates locally confined groundwater conditions in the shallow aquifer. In some cases, the silt grades to a silty sand or silty gravel at its contact with the underlying sand and gravel of the shallow aquifer.

The sand and gravel of the shallow aquifer underlies the low permeability silt layer has a thickness of about 45 to 50 feet. Soil types within the sand and gravel typically range from fine-grained, poorly sorted sand to coarse gravel, with cobbles prevalent. The silt content of the sands and gravels varies substantially throughout the shallow aquifer, with some zones classified as silty sands and silty gravels and other zones classified as clean sands or gravels. The degree of correlation in soil types between nearby borings is poor, indicating a high degree of grain size and silt content variation within the shallow aquifer. In general, laterally continuous beds or zones of particular grain sizes or silt content are not apparent. A somewhat laterally extensive bed of poorly sorted sand was identified in borings beneath and around Berwick Creek at a depth of about 30 feet bgs. However, this bed does not appear to be a substantial barrier to downward contaminant migration. Silt lenses have been reported within the sand and gravel shallow aquifer by previous investigators.

The silt and clay aquitard that forms the base of the shallow aquifer was present at all sampling locations drilled sufficiently deep. The aquitard appears to be continuous beneath the Site, which is consistent with regional geologic information (Ecology 2005).

Cross-sections illustrating the distribution and thickness of the geologic units encountered beneath the Site were prepared by Farallon (2003) and URS (2004). An additional cross section was also completed between the HRIA and Breen Property along the approximately groundwater flow directed. New and previously completed site cross-sections are shown in Appendix B.

3.3 HYDROGEOLOGY

The groundwater flow direction beneath the HRIA source area/Berwick Creek is to the west/northwest, but becomes northwesterly downgradient of the Breen Property and on a regional scale (Figures 3-2 and 3-3).

Regional investigations conducted by others (Dames and Moore 1994 and Ecology 2005) have categorized the shallow aquifer in the area as an unconfined aquifer or semi-confined. However, in the HRIA the shallow aquifer exhibits the characteristics of a confined or semi-confined aquifer, primarily due to the silt cap immediately above the aquifer. The mean vertical hydraulic conductivity of the silt capping the shallow aquifer was measured as 6.3×10^{-7} centimeters per second (cm/s). The silt cap of the shallow aquifer exhibits vertical hydraulic conductivities less than the 8×10^{-6} cm/s rule-of-thumb value published as representative of confining layers (Fetter 1980).

Short-term aquifer pumping tests were conducted at monitoring wells MWR-10 and MWR-11 by START (EPA 2000). Both of these monitoring wells are screened over the interval from 19 to 49 feet bgs. START estimated the horizontal hydraulic conductivity in the HRIA area at 4.4×10^{-2} cm/s or 125 feet per day (ft/d) with a flow rate of 14 gallons per minute (gpm) for each well. The horizontal hydraulic conductivity estimated based on long-term pumping tests were completed in the HRIA area during the EE/CA (URS 2004). The tests were conducted in wells MW-602 and MW-605 at constant sustainable flow rates of 25 and 6 gpm, respectively. Calculated hydraulic conductivity ranged from 1.7×10^{-3} to 4.9×10^{-2} cm/s (4.8 to 135 ft/d). The average hydraulic conductivity was calculated at 4.9×10^{-3} cm/s (13.5 ft/d). Calculated hydraulic conductivity for pump testing completed at the Breen property showed a value between 5.1×10^{-3} to 6.4×10^{-3} cm/s (14.5 and 18 ft/d).

The overall groundwater gradient beneath the HRIA is 0.0063 foot per foot (ft/ft) (URS 2004). A localized steeper gradient (approximately 0.016 ft/ft) is apparent immediately downgradient of Hamilton Road. START previously calculated an average groundwater gradient of 0.0032 ft/ft for entire Site (EPA 2001). Average regional gradient in the area of the Site is 0.0055 ft/ft (Ecology 2005).

The groundwater flow rate, or seepage velocity, beneath the Site can be calculated based on the hydraulic conductivity, the average regional groundwater gradient, and the mean effective porosity of the aquifer material (Fetter 1980). The formula for seepage velocity is as follows:

$$v_s = (k)(i)/n_e$$

Where:
v_s - seepage velocity (ft/d)
k - hydraulic conductivity (ft/d)
i - groundwater gradient (ft/ft)
n_e - effective porosity

Using the horizontal hydraulic conductivity of 4.8 to 135 ft/d, an average regional gradient of 0.0055 ft/ft, and an average effective porosity of 0.25, the seepage velocity would range from approximately 0.11 to 2.97 ft/d. Using the average hydraulic conductivity of 13.5 ft/d produces a seepage velocity of 0.30 ft/d.

3.3.1 Shallow Groundwater Use

Groundwater is used at local residences and farms for water supply, including drinking, irrigation, and stock watering. Approximately 250 private water wells are located within 4 miles of the Site (Farallon 2003). The following six wells are located within 1,000 feet of the Hamilton/Labree Site and are completed within the shallow aquifer:

- Well PW-2, located at 269 Hamilton Road, southeast of the United Rentals building. Well PW-2 is also referred to as the Hamilton Well in previous reports and is owned by Mr. Reggie Hamilton. PW-2 has been replaced by Well PW-23 installed in the deep aquifer by Mr. Hamilton.
- Well PW-3, located on the United Rentals Property, south of the paint shop building.
- Well PW-4, located approximately 750 feet south-southeast of the intersection of Hamilton and Labree Roads. This well, along with wells PW-5 through PW-8, is owned by Mr. Hank Doelman.
- Wells PW-5 located approximately 1,000 feet south of the intersection of Hamilton and Labree Roads.
- Wells PW-7 located approximately 100 feet west of the intersection of Hamilton and Labree Roads.
- Well PW-9 located approximately 100 feet southeast of the intersection of Hamilton and Labree Roads. This private water-supply well provided water to the Thurman residence.

Pursuant to the discovery of PCE in groundwater on and downgradient of the Site, Ecology arranged for delivery of bottled water to residences, farms, and businesses whose wells had been affected by the contamination. In November 2002, installation of a public water supply line was completed on behalf of EPA to service the locations of private wells impacted by PCE in groundwater and those location potential affected by migration of the PCE plume. The location of the water supply line is shown in Figure 3-4.

3.4 SURFACE WATER HYDROLOGY

There are three surface water features in the immediate vicinity of the release: Berwick Creek and two unnamed ditches that flow into Berwick Creek. Both ditches pass under Interstate 5, with flow from east to west. Both ditches are intermittent drainages, and discharge and frequency data are not available. Berwick Creek drains into Dillenbaugh Creek, which flows into the Chehalis River.

Surface water monitoring on Berwick Creek was completed as part of the site-wide RI/FS investigation (Farallon 2003). The flow measurements collected during September and November 2002 at each station were compared to assess if Berwick Creek was losing or gaining water over the reach covered by the surface water monitoring stations. Measurements collected in September 2002, at the end of the dry season, measured little to no flow at the majority of the stations with the exception of station SW-8, where a flow of approximately 500 gpm, was measured. No estimate of creek gaining or losing was possible for this event. Measurements collected in November 2002 showed flow of 1,400 gpm at station SW-8, and 1,250 gpm at station SW-9, indicating a minor loss in the reach between these stations located downstream of the HRIA and upstream of LaBree Road.

A comparison of surface water and groundwater elevations for corresponding monitoring points measured in September and November 2002 indicated that surface water elevations were at or above the potentiometric surface of the shallow aquifer during both events (Farallon 2003). These data indicate that there is a potential for surface water to seasonally discharge to groundwater in areas where the creek bed is permeable. Surface water monitoring results are shown in Table 3-1.

Within the HRIA during the EE/CA investigation, groundwater elevations in monitoring wells adjacent to Berwick Creek were above the approximate surface water elevation. This indicates a potential for groundwater to seasonally discharge to surface water in this reach of Berwick Creek. However, at all exploration locations near the creek, the silt cap of the shallow aquifer was found to be present between surface water and groundwater. The low vertical hydraulic conductivity (6.3 x 10^{-7} cm/s) of the silt cap probably minimizes the groundwater and surface water interaction within the HRIA

.

4. NATURE AND EXTENT OF CONTAMINATION

This section provides an explanation of nature and extent of contamination at the Site, including a description of known and potential contaminant source areas. Historical sampling results used to assess the nature and extent of contamination at the Site are included in Appendix C, Table C-1 through C-11. The locations of all sampling points are shown on Plates 1 and 2. Sampling point at and adjacent to the Breen Property and HRIA are also shown on Figures 4-1 and 4-2, respectively.

4.1 CONTAMINANTS OF CONCERN AND SOURCES

The primary contaminant of potential concern (COPC) is PCE. Degradation products including trichloroethylene (TCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and vinyl chloride have been detected in soil and groundwater samples collected at the Site, but less frequently and at much lower concentrations than PCE. Therefore, for the purpose of discussing the nature and extent of contamination at the Site, PCE will be considered the contaminant of concern. Appendix C, Tables C-1 through C-5 contain the analytical results for PCE, TCE and cis-1,2-DCE. Analytical results for other volatile organic compounds (VOCs) and other analytes are contained in Appendix C, Table C-6 through C-11.

4.1.1 Breen Property

Two potential source areas have been identified on the Breen Property: the former location of buried drums beneath Building B (see Figure 1-2) and possibly a former wash-down pad located near the southeast corner of the property (Farallon 2003).

In September 1999, sixty-six 55-gallon drums, four 30-gallon drums, and a number of pails and cans were removed from beneath Building B on the Breen property. PCE was detected in the contents of the drums sampled and in water in the drum excavation. In addition, approximately 600 tons of PCE and petroleum contaminated soil were removed from the drum excavation. Confirmation sampling results for samples collected from the final excavation were either non-detect or contained contamination below Ecology's Model Toxics Control Act (MTCA) Method A and/or Method B cleanup levels (GeoEngineers 2001).

A concrete wash-down pad located in the south portion of the Breen Property was used for steam cleaning heavy equipment. Runoff and sediment from the steam cleaning operation was apparently collected in an approximately 5-foot deep pit excavated adjacent to the concrete pad. Steam cleaning was reportedly conducted with water or water and detergent, but PCE may have also been used for cleaning equipment in the wash-down pad area (Farallon 2003). The exact location of the 5-foot earthen collection pit has not been identified during site investigations. However, others have assumed that the wash-down pad was historically a contaminant source based on increased PCE concentration in shallow groundwater in the area of the pad (Jewett 2005).

4.1.2 HRIA

The primary contaminant source area in the HRIA is an apparent spill or dumping of PCE into Berwick Creek in the vicinity of sampling location MW-602 (see Figure 4-2) sometime before 1990. The data point strongly to a single release at this location, but multiple releases may have occurred along a 300-foot reach of Berwick Creek. The estimated volume of the release is between 100 and 700 gallons (URS 2004). The contaminant at the HRIA is PCE, and there is no evidence of the PCE being mixed with any other contaminant. Some breakdown compounds of PCE are present, including TCE and cis-1,2-DCE, but at much lower concentrations than PCE and with a much lower frequency of detection. PCE has contaminated a silt layer in the bed of the Creek and has contaminated the soil and groundwater of the shallow aquifer.

4.2 SOILS

Concentration of PCE in soils can be divided into two categories: surface/near surface and subsurface. In general, surface soils at this site are defined as 0 to 12 feet bgs. Subsurface soils exist at depths greater than 12 feet and are typically below the silt/shallow aquifer contact. Surface/near surface and subsurface soil sampling results are presented in Appendix C, Table C-1.

4.2.1 Surface/Near Surface Soils

Currently, the only identified surface/near surface soil source for PCE concentrations to groundwater is creek bed sediments/soil in the HRIA. Only minor surface soil contamination has been identified at the Breen Property and in areas downgradient of the HRIA/Berwick Creek source area in the HRIA.

Breen Property

Limited surface (0 to 5 bgs) or near surface (5 to 10 feet bgs) soil data was collected on the Breen Property (Jewett 2005). The majority of the chemical data collected at the Breen Property was related to groundwater. Soil data was sometimes collected during installation of reconnaissance borings and groundwater monitoring wells, but appears to be mostly subsurface (greater than 10 feet bgs).

PCE contamination at the two source areas at the Breen Property may be primarily related to subsurface sources (i.e., buried drums at Building B and the collection pit at the wash-down area). Available surface and near surface soil data collected in the area of Building B and the wash-down pad showed little to no PCE or other VOCs detected above laboratory detection limits or practical quantitation limits (PQLs). In general, the laboratory detection limits were below applicable MTCA Method A and B cleanup levels. However, the laboratory detection limit for PCE for Building B confirmation samples, and the SP and TP samples collected at Building B and the wash-down pad were above the MTCA Method A cleanup level of 0.05 mg/kg for residential and industrial sites. In addition, much of this data was collected at greater than 10 feet bgs. Only one sample, which was collected near the wash-down pad, was actually collected at the surface.

The technical memorandum presenting the surface soil summary for the Breen Property is contained in Appendix A.

HRIA

In general, no surface soil (0 to 5 feet bgs) contamination was detected at the HRIA. Near surface soil concentrations within the HRIA were observed primarily between 8 to 10 feet bgs. Typically, concentrations increase in depth. The highest concentration was detected at GP-501 at 858 mg/kg, which is in the area of the highest PCE concentrations in groundwater.

Other Areas

No surface soil samples collected outside the Breen Property or HRIA had detectable PCE concentrations.

4.2.2 Subsurface Soils

Breen Property

Only minor subsurface concentrations of PCE have been detected in subsurface soils at the Breen Property. Soil contamination related to the leakage from drums buried beneath Building B was removed during remedial action to remove the drums in 2001.

Two previous investigations conducted by SAIC (1997) and Farallon (2003) examined contamination at depths between 10 and 50 feet. Results indicate that soil contamination at the Site was minimal. Concentrations at more than half of the sampling locations were non-detect. The highest concentration was recorded at RS-16 (0.16 mg/kg), located along the western property line, at a depth 43 feet bgs.

HRIA

A total of 359 discrete soil samples were collected during the EE/CA and analyzed for PCE. Results for these samples showed a mean concentration of 23.7 mg/kg and a maximum concentration of 3,220 mg/kg. The highest concentrations appear to be directly related to PCE DNAPL, which has been observed in aquifer soils beneath the apparent PCE release in Berwick Creek. The highest soil concentration was detected at GP-502 at a depth of 28 feet bgs. The highest concentrations were from soil collected at MW-9, MW-602, GP-502, GP-503, and AB-650 located along the banks of Berwick Creek and from MWR-10 located crossgradient and the southwest of the main release area.

Other Areas

No subsurface soil samples collected outside the Breen Property or HRIA had detectable concentration of PCE.

4.2.3 Extent of PCE in Soil at the HRIA

Soil isoconcentration contour maps were produced based on sampling completed at the HRIA during EE/CA investigations (URS 2004). These maps show the concentration of PCE in soil with depth between elevations 210 feet (surface) and 155 feet (near the aquitard).

The isoconcentration maps show that no PCE occurs in the upper 5 feet of soil. PCE as DNAPL is present is soil to a depth of approximately 55 feet bgs and are located beneath Berwick Creek at the apparent release location.

Copies of the isoconcentration maps are included in Appendix B.

4.2.4 Other Analyses

Soil samples collected during the EE/CA investigations were analyzed for a variety of physical characteristics. The results of these analyses are shown in Table 4-1.

Metals analysis was conducted on several samples collected during the EE/CA investigations. These samples were collected for use during remedial design. The results of metals analyses conducted during the EE/CA investigations are presented in Table 4-2.

4.3 GROUNDWATER

This section discusses the nature and extent of PCE in groundwater at the HRIA, Breen Property, and other areas of concern. Groundwater sampling results are presented in Appendix C, Table C-2.

4.3.1 Breen Property

The results of groundwater sampling conducted at the Breen Property indicate the presence of a confirmed source at the Building B former drum area and two potential source areas:

- A former wash-down pad area.
- An area between the southeast corner of Building C and the Torpedo Tube (see Figure 4-1).

Groundwater sampling conducted in July 2002 in areas downgradient of the former drum cache source area at RS-8, RS-13, and RS-14 detected PCE concentrations and concentrations of degradation products, including cis-1,2-DCE (see Figure 4-1). Similar VOCs were detected in groundwater samples collected from monitoring well pair MW-17/MW-18, located directly downgradient of the former drum cache area during the 2002 and 2003 monitoring events. Concentrations of PCE at these sampling locations showed a maximum concentration of 75 µg/L, indicating that the former drum area is only a minor contributor of PCE to shallow aquifer.

Historically, groundwater samples collected from RS-7 and SG2-15, located near the wash-down pad, contained PCE concentrations of 2,400 µg/L and 1,500 µg/L, respectively. Groundwater samples collected during February and November 2003 sampling events from monitoring well MW-8 and monitoring well pair MW-20/MW-21 detected concentrations of PCE ranging from 1,400 µg/L to 1,800 µg/L. These data indicate a suspected source of PCE to groundwater at or upgradient of the wash-down pad area (Farallon 2003). Groundwater samples collected from MW-30 and MW-34, located upgradient of the wash-down pad, had detected concentrations of PCE during 2003 and 2004 sampling events. MW-30 contained PCE ranging from 1,300 µg/L to 1,700 µg/L during fall 2003 sampling events. MW-34 contained a PCE concentration of 1,700 µg/L in April 2004. These results also indicate a potential PCE source upgradient of the wash-down pad. However, the PCE source for this groundwater contamination has not been identified, if still present.

Groundwater samples collected from sampling points located in the suspected source area between the southeast corner of Building C and the Torpedo Tube (GA-4 on Figure 4-1) indicate a potential source of PCE to groundwater. Groundwater samples collected from monitoring well MW-19, which is located downgradient of this area, detected elevated concentrations of PCE ranging from 1,300 µg/L to 1,600 µg/L between August and November 2002. Concentrations of 1,400 µg/L were detected in samples from MW-19 in February and November 2003. These concentrations are higher than the PCE concentrations detected at the RS-16 located crossgradient of MW-19. Concentrations of PCE at RS-16 ranged from 420 µg/L to 620 µg/L in the groundwater sample collected in 2002. Monitoring well MW-27, which is located north of the northeast corner of Building C and upgradient of RS-16 contained PCE concentrations ranging from 1,300 µg/L to 1,500 µg/L during September and November 2003 sampling events. These results indicate a potential localized PCE source somewhere between Building C and the Torpedo Tube. However, the PCE source for this groundwater contamination has not been identified, if still present.

4.3.2 HRIA

The groundwater sampling results indicate that there are two distinct source areas within the HRIA. For the purposes of this discussion, these areas are referred to as the southeastern hotspot and northwestern hotspot.

The southeastern hotspot at the HRIA is located in the area of monitoring wells MW-600 through 604 (Figure 4-2). This hotspot is located beneath the assumed PCE release location into Berwick Creek. PCE concentrations in groundwater have been detected up to 2,720,000 µg/L at MW-602. PCE concentration indicative of DNAPL has been detected in groundwater and aquifers soils from just beneath the silt layer in the bed of Berwick Creek to 30 feet bgs.

Dissolved PCE in groundwater at concentrations greater than 1,000 µg/L does not appear to have migrated southwest of the United Rentals building. PCE dissolved at concentrations less than 1,000 µg/L has migrated substantially farther downgradient of this area and has commingled with the PCE plume originating from the Breen property. PCE migrating downgradient beyond the United Rentals property is typically found at the highest concentrations at an intermediate depth in the shallow aquifer of approximately 30 to 35 feet bgs.

The northwestern hotspot is centered on monitoring well MWR-4 (see Figure 4-2), where PCE concentrations of 5,300 µg/l and 8,800 µg/l were detected in groundwater samples collected during February and November 2003 sampling events, respectively. Dissolved PCE in groundwater appears to have migrated northwest of the northwestern hotspot based the most recent data collected by Farallon. A groundwater sample MW-33, located west of the northwestern hotspot, contained a PCE concentration of 1,100 µg/L during April 2004 sampling.

Both the northwestern and southeastern hotspots show a distinct stratification of PCE in groundwater within the shallow aquifer that is characterized by higher concentrations of PCE in those monitoring wells screened in the upper portion of the shallow aquifer (Farallon 2003). Monitoring wells MWR-10 and MWR-11 are located immediately downgradient of the southeastern hotspot. Monitoring well MWR-10 is screened in the lower portion of the Shallow Aquifer and monitoring well MWR-11 is a fully penetrating well. Groundwater samples collected from the lower portion of the aquifer screened in these wells demonstrate significant decreases in PCE concentrations relative to wells screened in the upper portion of the shallow aquifer even though these monitoring wells are located on a direct flow line downgradient of the southeastern hotspot.

Multi-level groundwater sampling was conducted in November 2002 (Farallon 2003) at monitoring wells MWR-8 and MWR-11, both of which are fully penetrating wells within the aquifer. Multi-level sampling was conducted to qualitatively assess the potential stratification of the PCE plume in groundwater at the southeastern hotspot and the area immediately downgradient. Results of the groundwater sampling at monitoring well MWR-8 show a significant increase in PCE concentrations, from 360 µg/l in the groundwater sample collected from the lower zone at 48.5 feet bgs to 4,700 µg/l in the groundwater sample collected from the upper zone at 15 feet bgs (Table 4-3). Results of the multi-level sampling in monitoring well MWR-11 did not indicate a significant variation in PCE concentration in groundwater samples collected from the lower to the upper zones.

4.3.3 Area South of Breen Property

This area is located downgradient of HRIA and crossgradient (south) of Breen Property and includes the Thurman Property (see Figure 4-1). Private well PW-9, located on the Thurman Property, showed PCE concentrations of 2,100 ug/L and 2,500 ug/L during the February and November 2003 sampling events, respectively. Historically, concentrations in PW-9 have ranged from 1,460 ug/L in June 1999 to 3,350 ug/L in June 2000. The nearest upgradient wells and sampling locations MW-22/MW-23, MW-24, and RS-19/19A have shown PCE concentration up to a maximum of 700 ug/L. PCE isoconcentration contour maps completed for the Site (see Section 4.3.4) show the 1,000 ug/L PCE contour from the HRIA does not extend to PW-9. This would indicate a potential local source area upgradient of PW-9.

Additional monitoring wells and sampling points were installed upgradient of PW-9 in 2003 (Farallon 2004, unreported). These sampling points (RS-30, -31, and -33, and MW-31 and -32) were located primarily along Berwick Creek south of the Breen Property (see Figures 4-1 and 4-2). Groundwater samples collected from these location contained PCE concentration ranging from 1,500 ug/L to 2,300 ug/L in shallow and intermediate groundwater (0 to 35 feet bgs) and 980 ug/L to 1,300 ug/L in deeper groundwater. The highest concentrations were detected in samples from MW-31 (2,300 ug/L) and MW-32 (2,100 ug/L) located adjacent top Berwick Creek just off of where the Creek crosses North Hamilton Road. These concentrations may be associated with an additional PCE release to Berwick Creek south of the Breen Property. However, the PCE source for this groundwater contamination has not been identified, if still present.

4.3.4 Extent of Groundwater PCE Contamination

Isoconcentration contour maps were prepared to illustrate the extent of the PCE plume throughout the Site. Groundwater sampling data collected in November 2003 during Phase II RI/FS sampling (Farallon 2004, unreported) and the EE/CA investigation (URS 2004) were used to generate the contour maps. This included primarily groundwater analytical data from monitoring wells, but additional data from discrete sampling points were also used to fill data gaps in areas without monitoring wells. The isoconcentration maps are presented in Appendix B.

Cross-sections, which included the vertical extent and concentration of PCE in groundwater were prepared for the Breen Property (Farallon 2003) and HRIA (URS 2004) and are included in Appendix B. These cross-sections indicate that the PCE DNAPL at the HRIA may have migrated vertically through the aquifer roughly 30 to 35 feet, but has not reached the silt aquitard beneath the shallow aquifer.

4.3.5 Non-VOC Analyses

Additional analyses have been conducted on a limited number of groundwater samples at the Site.

Three groundwater samples were analyzed for gasoline-range or diesel-range petroleum hydrocarbons using NWTPH-gx and NWTPH-dx. Gasoline analysis was conducted on groundwater samples from GP-1 and GP-3 during the START investigation in 2000. A concentration of 4,200 µg/L was detected at GP-1 and non-detect at a method reporting limit (MRL) of 100 µg/L at GP-3. Diesel analysis was conducted on a sample collected from PW-21 also during the START investigations in 2000. Diesel was non-detect at a MRL of 16 µg/L in this sample.

Two samples collected from private wells (PW-5 and PW-21) were analyzed for semi-volatile organic compounds (SVOCs) using EPA Method 8270 during the Ecology investigations in 1999. In addition, pesticides analysis was conducted on a sample collected from PW-5. No SVOC or pesticides were detected above laboratory detection limits.

Conventional analyses were conducted on samples collected from a number of wells within the HRIA during the EE/CA investigations (URS 2004). The results of these analyses are shown in Table 4-4.

4.4 SURFACE WATER

Surface water samples were collected from Berwick Creek in 1998 (by Ecology) and in 2002 and 2003 (Farallon). These samples were analyzed for volatile organic compounds (VOCs) and the results for PCE, TCE, and cis-1,2-DCE are summarized in Table 4-5. Samples were collected from a total of 10 stations, four established by Ecology in 1998 (SW-1 through SW-4) and six established by Farallon in 2002 (SW-5 through SW-10). Five of the 10 stations are located within the HRIA study area (SW-3 through SW-7) and are shown on Figures 4-2 and 4-2. The remaining stations are located downstream of the HRIA study area. SW-1 is located at the downstream end of the culvert passing under Labree Road, and SW-2 is located at the upstream end of the culvert passing under Hamilton Road North. SW-8 is located just downstream of the western boundary of the HRIA. SW-9 is located near SW-1. SW-10 is located 1,300 downstream of Labree Road (approximately 2,500 feet downstream of the HRIA).

The surface water results are discussed from upstream to downstream. SW-4, located in the unnamed ditch east of I-5 (upstream of the HRIA) was sampled once by Ecology in December 1998, and PCE was not detected. SW-6, located near the upstream limit of known contamination in Berwick Creek soils, was sampled four times between July 2002 and February 2003. PCE was detected at concentrations less than 1 µg/L in July 2002, but has not been detected above 0.2 µg/L during later sampling events.

PCE concentrations in surface water within known areas of contamination within the HRIA (locations SW-3, SW-5, and SW-7) have ranged from non-detect at an MRL of 0.2 µg/L to 40 µg/L (location SW-5 in the unnamed ditch in November 2002). The detection of PCE in surface water samples at these three locations has varied considerably and no clear seasonal trend has been identified. However, by far the highest concentrations of PCE at locations SW-7 and SW-5 were detected during November 2002 (12 and 40 µg/L, respectively), which is typically a high precipitation month.

SW-1 and SW-2, located 800 to 1,200 feet downstream of the HRIA and sampled by Ecology in 1998, exhibited PCE concentrations ranging from 8.5 to 16 µg/L, similar to concentrations measured within the HRIA. Repeated sampling by Farallon in this same reach of stream (locations SW-8 and SW-9) in 2002 and 2003 found no PCE concentrations exceeding 1.0 µg/L. Farallon also found concentrations less than 1.0 µg/L in surface water samples from SW-10. These data indicate that there are currently no significant concentrations of PCE in surface water. The source of the PCE detected in surface water samples collected at several stations may be residual contamination in the creek bed sediment/soil.

Surface water sampling results are presented in Appendix C, Table C-3.

4.4.1 Non-VOC Analyses

Analysis for gasoline-range petroleum hydrocarbons was conducted on six surface water samples collected by Farallon during RI/FS investigation. Samples collected from surface water monitoring stations SW-5 through 10 were non-detect for gasoline at an MRL of 100 µg/L.

4.5 CREEK BED SEDIMENT/SOIL

Creek channel samples CC-1 through CC-9 were collected by Farallon in September 2003 during Phase II RI/FS sampling (see Figure 4-1). The samples were collected from various locations along Berwick Creek south of the Breen Property. The samples were collected from the creek bed sediments at approximately 1-foot bgs. No PCE was detected above laboratory detection limits in any of the samples collected.

During EE/CA investigations, 39 shallow soil samples were collected from the bed and bank soil along Berwick Creek and the unnamed ditch (URS 2004). The analytical results of these samples are shown in Table 4-6. The maximum PCE concentration detected was 5,220 mg/kg in creek bed sample SB-409 (see Figure 4-2). The average PCE concentration of all 39 creek bed and bank samples (using half the detection limit for samples with no detectable PCE) was 195 mg/kg.

The northwestern hotspot probably represents the maximum downstream extent of PCE DNAPL movement along the bed of Berwick Creek from the HRIA release location. Creek bed samples showed only intermittent evidence DNAPL downstream indicating that the volume of PCE DNAPL was nearly exhausted by this point (URS 2004).

The approximate extent of PCE and PCE DNAPL in the Berwick Creek bed is shown in Appendix B, Figure 2-3. Creek bed sediment/soil sampling results are presented in Appendix C, Table C-4.

4.6 SOIL GAS

This section summarizes the results of soil gas investigations conducted at the Breen Property and HRIA. The results of the soil vapor sampling are shown in Table 4-7 and Appendix C, Table C-5. Soil gas sampling locations are shown on Figures 4-1 and 4-2.

4.6.1 Breen Property

Soil vapor surveys was performed in the area of RS-1 and RS-2 (see Figure 4-1) in November 2002 to qualitatively assess the potential source area associated with the elevated PCE concentration detected in the groundwater samples collected from these locations. Soil vapor samples were collected in the area RS-1 at RS-1/SG1-1 through SG1-10, SG1-12 through SG1-14, and SG1-20. Soil vapor samples collected from 5 feet bgs and analyzed for PCE and TCE by EPA Method 8021B at RS-2/SG1-2, SG1-8 through SG1-10, SG-13, SG1-14, and SG1-20. All samples were collected from 5 feet bgs and were analyzed for PCE and TCE. Results for all soil gas samples were reported as non-detectable at the laboratory PQL, indicating these areas were not likely PCE source areas (Farallon 2003).

4.6.2 HRIA

A soil gas survey was conducted north of the Berwick Creek within the HRIA to assess a possible spill off of I-5. During the survey, 38 soil-gas samples were collected and analyzed for PCE using a mobile laboratory (see Figure 4-2). In general, PCE concentrations in the soil-gas samples collected along I-5 were very low to not detectable. Two samples, SG-208 and SG-209, contained significant PCE concentrations of 1.7 and 3.2 parts per million-volume (ppm-v), respectively. Other samples from near these sampling locations did not reveal a definable release location. Overall, the soil-gas survey results do not support the scenario of a release from I-5 (URS 2004).

5. CONTAMINANT FATE AND TRANSPORT

This section describes the general fate and transport of PCE in groundwater at the Site including a discussion of the conceptual site model and the results of three-dimensional groundwater modeling.

5.1 BEHAVIOR OF CONTAMINANTS IN THE ENVIRONMENT

The primary release of PCE appears to have occurred at the HRIA as a spill or dumping to Berwick Creek in the vicinity of sampling location MW-602 (see Figure 4-2) sometime before 1990 (URS 2004).

Berwick Creek within the HRIA is a relatively low-velocity stream. Upon contact with the water in Berwick Creek, some of the PCE immediately dissolved into the water and was carried downstream with the flow of the creek. The bulk of the PCE remained as DNAPL and migrated quickly through the water column into the creek sediments under the influence of gravity, since the density of PCE is greater than water. Once in the creek sediments, the PCE continued to migrate vertically downward through the porous creek sediments until constrained by the lower-permeability silt layer that occur beneath the creek channel and directly above the shallow groundwater aquifer in the HRIA. Sufficient DNAPL was present to penetrate the 1-foot thick silt layer present beneath the creek in this area and seep to the shallow aquifer, leaving residual DNAPL in the silt layer. The PCE slowly migrated through the low permeability silt and ultimately reached groundwater.

Once in the shallow aquifer, the PCE DNAPL appears to have continued to move vertically as a DNAPL and also laterally as dissolved phase through the more permeable zones of the shallow aquifer. Dissolved concentrations of PCE moved with groundwater flow near the top of the aquifer, just below the silt layer. PCE at concentrations potentially indicative of DNAPL is generally not found below about 35 feet bgs (URS 2004). Dissolved concentrations of PCE in groundwater also decline substantially below 35 feet bgs. PCE at concentrations potentially indicative of DNAPL is not found at the aquitard, and relatively low concentrations of PCE are found sorbed to the upper portion of the aquitard material.

The northwestern hotspot within the HRIA study area appears to be the result of PCE DNAPL movement in Berwick Creek downstream from the release location, in relatively small quantities compared to the release location itself. This hotspot probably represents the maximum downstream extent of PCE DNAPL movement along the bed of Berwick Creek from the HRIA release location. Sample of creek bed soils showed only intermittent evidence of PCE DNAPL downstream indicating that the volume of PCE DNAPL was nearly exhausted by this point. However, sufficient DNAPL was present to result in dissolved concentrations of PCE in the area of the northwestern hotspot. The highest concentration was reported in AB-6 at 46 feet bgs, indicating that relatively high concentrations were able to penetrate to near the aquitard.

Outside the HRIA, the PCE is found only in the dissolved phase in groundwater. PCE concentrations in groundwater at the Breen Property and areas downgradient and crossgradient of the Breen Property are migrating within the shallow aquifer in the dissolved phase. No PCE concentrations potentially indicative of DNAPL have been identified at the Breen Property.

The primary natural attenuation processes at the Hamilton/Labree Site includes physical advection of dissolved PCE in groundwater, chemical dispersion, and simultaneous dilution.

Based on the findings of the EE/CA investigations (URS 2004), biodegradation is not considered to be a major natural attenuation process at the Site.

5.2 CONCEPTUAL SITE MODEL FOR POTENTIAL PATHWAYS AND RECEPTORS

The following section described the general conceptual site model for the Site. A graphical depiction of the model is shown in Figure 5-1. A technical memorandum discussing the model is presented in Appendix A.

5.2.1 Primary Sources of Contamination and Primary Release Mechanisms

The two primary sources of contamination at the Hamilton/Labree Roads site appear to be:

- Liquid PCE released directly into Berwick Creek within the HRIA.
- PCE leaked or spilled onto the soil at both the HRIA and Breen Property. The form of the PCE released (concentrated liquid or PCE dissolved in solutions) is unknown.

5.2.2 Secondary Sources of Contamination

Upon released to Berwick Creek, some of the PCE was dissolve into surface water and was carried downstream with the flow of the creek. The remaining PCE sank as DNAPL into the creek sediments. Once in the creek sediments, the PCE continued to migrate vertically through the porous sediments until constrained by the lower-permeability silt layer that occurs beneath the creek channel and directly above the shallow groundwater aquifer in the HRIA. The PCE slowly migrated through the low permeability silt and ultimately reached groundwater.

PCE introduced into the soils beneath the HRIA and Breen Property would have behaved in accordance with the nature of the soils. Fine-grained surficial soils would tend to retain the PCE. More permeable soils would allow PCE to migrate vertically downward more quickly.

In areas near the contamination sources, PCE present in liquid form as a DNAPL may collect on top of low-permeability zones in strata below the water table. The DNAPL would gradually dissolve to groundwater providing an additional source of PCE contamination in groundwater.

5.2.3 Secondary Release Mechanisms

When a released contaminant is retained in an environmental medium, such as soil or sediment, the medium functions as a secondary source for further release of the chemicals. The following paragraphs discuss the release mechanisms from the secondary sources.

Sediment Migration in Berwick Creek

Contaminated sediment in Berwick Creek has the potential to migrate downstream under the influence of the stream current. The timing and magnitude of migration depends upon surface water flow conditions that change seasonally under the influence of precipitation.

Leaching from Contaminated Berwick Creek Sediment to Surface Water

Contaminated sediment that migrates downstream is in constant contact with surface water, creating the potential for leaching of PCE to surface water at points downstream from the original release to Berwick Creek.

Volatilization from Surface Water to Air

PCE that may become dissolved in Berwick Creek water via sediment contact would be subject to volatilization from the water into the ambient air. The magnitude of this volatilization would depend upon the concentrations in the stream and ambient weather conditions.

Volatilization from Soil to Air

Soil contaminated with PCE provides the potential for volatilization and release of PCE to ambient air, depending upon soil concentration, distance between the contamination and the surface of the soil, and weather conditions.

Leaching to Groundwater

Precipitation infiltrating through soil contaminated with PCE is a mechanism for migration of PCE to groundwater. Groundwater occurs at relatively shallow depths in the study area, and the rate and magnitude of migration depends on the nature of the soils above the water table and the amount of seasonal precipitation.

Volatilization from Groundwater through Soil to Air

Volatilization of PCE in groundwater has the potential to migrate to the soil and ultimately to ambient air. Such releases would be dependent upon the concentration in groundwater, the depth of groundwater below land surface, presence or absence of a low-permeability layer above the groundwater table, and weather conditions.

Downgradient Discharge from Groundwater to Surface Water

Hydrogeologic data collected in the study area indicates that the reach of Berwick Creek that flows through the HRIA and Breen Property is underlain by fine-grained silt and clay, which separates the stream from groundwater. If this layer is absent or breached by the Berwick Creek, Dillenbaugh Creek or the Newaukum River downstream of the HRIA and Breen Property, the potential exists for PCE-contaminated groundwater to enter surface water.

Further discussion of the conceptual site model as it relates to potential risk to human health and the environment is discussed in Section 6, Baseline Risk Assessment.

5.3 MODELING OF CONTAMINANT FLOW AND TRANSPORT

Several modeling efforts have been completed for the Site to access contaminant flow, transport, and fate in groundwater. These efforts are summarized in the following sections.

5.3.1 History of Modeling Efforts

During completion of the EE/CA, the future fate and transport of PCE at the HRIA was evaluated using EPA's screening tool Biochlor, Version 2.2. This model was used to estimate the maximum extent of the PCE plume downgradient of the HRIA in the absence of source control and to estimate the general effects of implementing source control. The results of the Biochlor analysis show the following:

- One or more sources located downgradient of the HRIA are contributing to the site-wide plume. The HRIA source area alone cannot account for the downgradient distribution of PCE.
- With biodegradation assumed, the maximum plume length resulting from a constant source at Berwick Creek is unlikely to exceed three miles; but without biodegradation, the maximum plume length cannot be estimated and concentrations

beyond three miles will eventually exceed 30 µg/L. However, sampling and analysis conducted during EE/CA investigation show that biodegradation is likely not a major attenuation process at the Hamilton/Labree Site.

- With the constant source (DNAPL) removed and dissolved concentrations reduced by 85 percent, the maximum plume length is unlikely to exceed 2 miles even with no biodegradation.

With concentrations at the HRIA/Berwick Creek source area reduced by 85 percent, the plume is predicted to eventually attenuate to an average concentration below MCLs, although attenuation in the source areas may require hundreds of years.

Modeling using Biochlor was completed by Farallon (2004, unpublished) during completion Phase II RI/FS activities. The Biochlor analysis concluded that PCE concentrations currently detected at the wash-down pad would be reduced to below 1.0 µg/L within 12 years and would not migrate greater than 3,500 feet from the Breen Property, with or without biodegradation occurring. The same modeling results were also observed for the Thurman well PCE concentration under that same scenario.

5.3.2 Overview and Results of Three-Dimensional Modeling

Three-dimensional groundwater modeling was completed using MODFLOW-96 and MT3DMS. The objectives of the groundwater modeling task were to:

- Develop a steady-state numerical model of the hydrogeologic system at the Site.
- Build a solute transport model into the numerical model to describe the fate and transport of dissolved PCE within the aquifer.
- Assess the behavior of the PCE in groundwater assuming a "no action" remedial alternative and assuming source removal at the HRIA/Berwick Creek source area.

The results of the groundwater modeling effort showed the following:

- Under current conditions (no source control), the PCE plume from the HRIA/Berwick Creek source area will continue to increase in concentration and will continue to migrate, potentially impacting drinking water sources located greater than three miles downgradient of the HRIA.
- If the source of dissolved-phase PCE is removed to the extent that practicable and dissolved concentrations are reduced by 85 percent or more at the HRIA/Berwick Creek source area, the maximum plume length in the shallow aquifer is unlikely to exceed three miles and will eventually be remediated through natural attenuation including physical advection of dissolved PCE in groundwater, chemical dispersion, and simultaneous dilution. Biodegradation was not considered to be a natural attenuation process occurring at the Site for the purposes of groundwater modeling. PCE concentration at the source area will be decrease to below 5 µg/L within five years of remedial action.
- Source areas at the Breen Property appear to have been the main contributor of PCE at the leading edge of the plume. Modeling results showed that the PCE concentration detected in groundwater at MW-25 (located about 2,400 feet downgradient of the Breen Property) is not associated with the HRIA/Berwick Creek source area.

- The portion of the plume originating at the Breen Property will most likely reduced through natural attenuation processes to concentrations below MCLs prior to reaching additional downgradient drinking water sources. This assumes no continuing source of dissolved PCE to groundwater is present at the Property.
- With or without source control, PCE-impacted groundwater may have the potential to discharge to surface water (Dillenbaugh Creek and the Newaukum River) downgradient and crossgradient of MW-25. Additional data may be necessary to determine if groundwater/surface water interaction is occurring in this area.

A draft technical memorandum describing the modeling effort and summarizing results is included as Appendix D.

5.4 CONCENTRATION TREND ANALYSIS

Groundwater and surface water data were analyzed to determine potential concentration trend at various well locations and surface water sampling points. Wells and surface water sampling points were selected based on location and number of data points available. Sampling points with less than three data points were not analyzed.

Concentration trend plots are presented in Appendix E.

5.4.1 Monitoring Wells

Breen Property

Generally, the monitoring wells on the Breen Property have shown an “up and down” trend but relatively flat trend or slightly increasing trend in PCE concentration. Monitoring wells MW-6, -17 and -19 have shown and “up and down” trend, but the overall change in concentration is relatively small. MW-8, located downgradient of the wash-down pad, has also shown an “up and down” trend with concentration fluctuating between approximately 1,400 µg/L and 2,100 µg/L between 1997 and 2003.

Monitoring wells MW-2, -20, and -21 showed a slightly increasing trend in PCE concentration over time. MW-20 and -21 are located downgradient of the wash-down pad near the west property boundary (see Figure 4-1). MW-2 is located in approximately the center of the property in the Building C and the Torpedo Tube area (see Section 4.3.1).

MW-18 located west and downgradient of Building B has shown a steady increase in PCE concentrations in 2002 and 2003, with concentrations increasing from approximately 55 µg/L to 90 µg/L.

HRIA

In general, most wells within the HRIA immediately downgradient of the HRIA/Berwick Creek source area showed an increase in PCE concentrations in groundwater over time. MWR-1, -2, -4, -5, -7, and -10 all show increasing PCE concentration over time. These wells are all located downgradient of the source area. MWR-1,-2, and -5 are located closest to the HRIA/Berwick Creek source area and have shown the highest increase in concentration over time.

Decreasing PCE concentrations were observed in MWR-6 and -9 between 2000 and 2002, but have recently shown an increase). Both these wells are located downgradient of the HRIA/Berwick Creek source area. MWR-8, which is located between MWR-6 and -9 has shown a strong "up and down" trend. MWR-3, located northwest of the source area, also showed an "up and down" trend.

Two monitoring wells (MW-5 and MW-7) showed no significant overall change in concentration.

Decreasing concentrations were observed in MW-9, located adjacent to the HRIA/Berwick Creek source area, and at MWR-11, located southeast of the United Rentals Building (see Figure 4-2). Between August 2000 and November 2003, MW-9 has shown a decrease of almost 35,000 µg/L.

Area South of Breen Property

Monitoring wells MW-23, and -24, located south of the Breen Property showed a general flat trend, but indicate a recent increase in PCE concentrations. This is expected due to the movement of the PCE plume form the HRIA downgradient towards these wells. MW-4 which is located downgradient of MW-23 and -24 has also showed and increase in PCE concentration with time. The concentration at this well showed a sharp increase in 2000, followed by a steady decrease in concentration, and recent increase. Concentrations are still 450 µg/L higher than prior to the sharp increase in 2000. The recent increase may also be related to the migration of the PCE plume from the HRIA.

5.4.2 Private Wells

Groundwater data collected from private wells between 1993 to 2003 reflects different trends. Private wells PW-4, -5, and -7 have shown decreasing concentrations of PCE over time. PCE concentrations at these wells have primarily shown a decrease following installation of the new City of Chehalis water supply line in 2002. The downward concentration trend in a number of the private wells may be associated with decreased well pumping following installation of the water supply line in 2002.

PW-3 located on the United Rentals property within the HRIA (see Figure 4-2) shows an increase in concentration of PCE between 1993 and 2002.

PW-9 (Thurman well) has shown an "up and down" trend between 1994 and 2003. This well is located south of the Breen Property within and area of elevated PCE concentration (see Section 4.3.3).

5.4.3 Surface Water Monitoring Stations

Samples collected from Berwick Creek monitoring stations (SW-5 through 10) have generally shown an "up and down" trend. This type of trend is anticipated because of seasonal changes in flow rate in the creek and the potential for "releases" of PCE from creek bed sediment during periods of high flow and creek bed scouring.

5.4.4 Conclusions

The following general PCE concentration trends were observed during data analysis:

- PCE concentrations in groundwater at the Breen Property display an "up and down", but relatively flat trend or slightly increasing trend in concentration.
- In general, monitoring wells located downgradient of the HRIA/Berwick Creek source area continue to show an increase in concentration of PCE over time. Wells located at the upgradient edge of the source area (i.e., MW-9) or crossgradient (i.e., MWR-11) have shown decrease concentration with time.

6. BASELINE RISK ASSESSMENT

The baseline risk assessment report for the Site is included as Appendix F. A summary of the risk assessment results is included below.

6.1 SUMMARY OF BASELINE RISK ASSESSMENT RESULTS

The objectives of the baseline risk assessment were to:

- Evaluate potential effects of chemicals detected in soil and groundwater on human and ecological receptors at and surrounding the HRIA and Breen Property source areas,
- Evaluate impacts to groundwater at areas downgradient and cross-gradient of the source areas, and
- Evaluate impacts to surface water and sediments in Berwick Creek associated with the source areas.

Existing environmental data were reviewed to determine COPCs. Chemical concentrations were summarized for four exposure areas (areas upgradient of the HRIA, HRIA, Breen Property, and areas downgradient of the Breen Property) and compared to risk-based screening benchmarks for human and ecological health. The COPCs related to human health at the HRIA, Breen Property, and downgradient areas identified from the risk screening and evaluated in the baseline risk assessment included:

- cis-1,2-DCE
- Methylene chloride
- PCE
- Tetrahydrofuran
- TCE
- Vinyl chloride

No COPCs were identified for the areas upgradient of the HRIA.

COPCs evaluated for ecological risk included:

- cis-1,2-DCE
- PCE
- TCE.

The overall results of the human health risk assessment indicate that current contaminant concentrations (predominantly PCE) in groundwater associated with the HRIA and Breen Property source areas represent a potential for elevated health risks to current or future site workers or downgradient residents. These risks are predicted only if receptors were to use the groundwater for domestic purposes. Currently this receptor population is connected to the municipal water system.

The overall results of the ecological risk assessment indicate that current contaminant concentrations (predominantly PCE) in sediment associated with the HRIA source area and PCE in subsurface soils may represent a potential for elevated risks to organisms encountering the HRIA/Berwick Creek source area. However, risks to ecological receptors are considered to be minimal since (1) highly conservative exposure estimates were utilized in the baseline risk assessment and (2) the HRIA spill area is confined to a small area within Berwick Creek and is not shown to be moving downstream.

The following are the general conclusions from the baseline risk assessment:

- The human health risk assessment concluded that drinking current or future groundwater concentrations of VOCs (particularly PCE) may potentially adversely affect the health of on-site workers or downgradient residents. However, the commercial and private properties within this area are all on municipal water systems. Thus, current human populations are not drinking contaminated water. However, there are potential risks to human health if future wells are installed that draw water from the effected groundwater aquifer. Estimated risks from the volatilization of contaminants in groundwater to indoor air appear to be elevated above risk threshold levels only at the buildings present at the HRIA (i.e., United Rentals). Indoor air estimates are likely to be overestimated due to the nature of the Johnson and Ettinger volatilization model and limited air sampling results indicated low PCE concentrations (WDOH 2004). Recreational activities at Berwick Creek are anticipated to be of minimal concern if conducted away from the primary PCE source at the HRIA.

- The ecological risk assessment concluded that current concentrations of PCE in Berwick Creek sediments may adversely affect ecological receptors only at the PCE source area at the HRIA. Additionally, VOC concentrations in soils at the HRIA and Breen sites may present risks to burrowing animals. Surface water concentrations do not appear to pose a risk to aquatic receptors within Berwick Creek.

- Overall, PCE and associated VOC risks at the HRIA are localized in soils and sediments and groundwater. Domestic use of groundwater is the primary concern at the Hamilton/Labree Site (i.e., HRIA, Breen Property and downgradient). Institutional controls (i.e., use of municipal water systems rather than groundwater sources and restricted access to the source areas) and remedial actions to reduce source concentrations or dissolved plume concentrations will reduce exposure to contaminants associated with the HRIA and Breen Property source areas.

7. SUMMARY AND CONCLUSIONS

A summary of the finding of the RI and conclusions based on these finding are presented in the following sections.

7.1 NATURE AND EXTENT OF CONTAMINATION

The primary contaminant of potential concern (COPC) is PCE. Degradation products including TCE, cis-1,2-DCE, and vinyl chloride have been detected in soil and groundwater samples collected at the Site, but less frequently and at much lower concentrations than PCE. Also, the results of the baseline risk assessment show PCE to be the primary risk driver. Therefore, PCE is the primary contaminant of concern at the Hamilton/Labree Site.

7.1.1 Soil

Currently, the only identified surface/near surface soil source for PCE concentrations to groundwater is creek bed sediments/soil in the HRIA. Only minor surface soil contamination has been identified at the Breen Property and in areas downgradient of the HRIA/Berwick Creek source area in the HRIA.

7.1.2 Groundwater

The results of groundwater sampling conducted at the Breen Property indicate the presence of a confirmed source at the Building B former drum area and two potential source areas at a former wash-down pad area and at an area between the southeast corner of Building C and the Torpedo Tube area (see Figure 4-1). Concentrations of PCE for location downgradient of Building B indicate that the former drum area is only a minor contributor of PCE to shallow aquifer. Groundwater sampling result collected downgradient of the wash-down pad indicate a potential PCE source at or upgradient of the wash-down pad. Analysis of groundwater sampling results at and downgradient of the Building C and the Torpedo Tube area indicate a potential localized PCE source somewhere between Building C and the Torpedo Tube. However, the PCE sources for this groundwater contamination have not been identified, if still present. Additional investigation may be required to identify remaining sources for the shallow aquifer PCE contamination at the Breen Property.

At the HRIA, the primary source of PCE in groundwater is the HRIA/Berwick Creek source area where PCE was spilled or released to Berwick Creek (see Figure 4-2). PCE DNAPL has been identified in the shallow aquifer beneath the source are to a depth of approximately 30 to 35 feet. PCE DNAPL from release has migrated to a low permeability silt layer beneath the bed of Berwick Creek and is providing a constant source of PCE to groundwater.

7.1.3 Surface Water

Surface water data indicates that there are currently no significant concentrations of PCE in surface water. The source of the PCE detected in surface water samples collected at several stations may be residual contamination in the creek bed sediment/soil.

7.1.4 Creek Bed Sediments/Soil

Creek bed sediment/soil contamination appears to be primarily confined to the HRIA/Berwick Creek source area and an area immediately downstream of this source area.

PCE DNAPL has been identified in a silt layer beneath the Berwick Creek bed. This layer is providing a continuing source of dissolved PCE and PCE DNAPL to groundwater.

7.2 RESULTS OF FATE AND TRANSPORT ANALYSIS

In general, monitoring wells located downgradient of the HRIA/Berwick Creek source area continue to show an increase in concentration of PCE over time. Wells located at the upgradient edge of the source area (i.e., MW-9) or crossgradient (i.e., MWR-11) have shown decrease concentration with time. If the HRIA/Berwick Creek source area is removed and dissolved concentrations are reduced by 85 percent, the maximum plume length in the shallow aquifer is unlikely to exceed three miles and will eventually be remediated through natural attenuation including physical advection of dissolved PCE in groundwater, chemical dispersion, and simultaneous dilution. Biodegradation is not considered to be a major natural attenuation process at the Site.

The portion of the plume originating at the Breen Property will most likely reduced through natural attenuation processes to concentrations below MCLs prior to reaching additional downgradient drinking water sources. Remedial action at the Breen Property does not appear to be necessary.

With or without source control, PCE-impact groundwater appears to have the potential to discharge to surface water (Dillenbaugh Creek and the Newaukum River) downgradient and crossgradient of MW-25.

7.3 RESULTS OF RISK ASSESSMENT

The overall results of the human health risk assessment indicate that current contaminant concentrations (predominantly PCE) in groundwater associated with the HRIA and Breen Property source areas represent a potential for elevated health risks to current or future site workers or downgradient residents. These risks are predicted only if receptors were to use the groundwater for domestic purposes. Currently the affected receptors are connected to the municipal water system.

The ecological risk assessment concluded that current concentrations of PCE in Berwick Creek sediments may adversely affect ecological receptors only at the PCE source area at the HRIA. Additionally, VOC concentrations in soils at the HRIA and Breen sites may present risks to burrowing animals. However, risks to ecological receptors are considered to be minimal since (1) highly conservative exposure estimates were utilized in the baseline risk assessment and (2) the HRIA spill area is confined to a small area within Berwick Creek and is not shown to be moving downstream.

7.4 DATA LIMITATIONS

The data used to develop this RI report was collected during numerous investigations conducted at the Hamilton/Labree Site between 1993 and 2004. In several cases, conclusions developed by the entity that collected and interpreted the original data were used in completing this RI. This was primarily true for the data and interpretation completed for HRIA as described in the EE/CA (URS 2004).

The most recent groundwater monitoring and sampling data collected at the site were used to assess groundwater flow and plume migrations. The last extensive groundwater sampling occurred at the Site in November 2003. These 2003 groundwater data were supplemented with the results of the three-dimensional groundwater modeling to assess the current PCE plume movement throughout the Site.

Limited data regarding groundwater and surface water interaction was available downgradient of the Breen Property. Groundwater modeling was completed using available regional data on the existence of the low permeability silt layer and potential for groundwater discharge to surface water bodies in areas downgradient Berwick Creek/Dillenbaugh Creek confluence.

8. REFERENCES

Dames & Moore, Inc. 1994. *Groundwater Resources Investigation for Ecology Groundwater Right Application No. G2-29004*. Prepared for Chehalis Power, Inc. Chehalis, Washington. July 7.

Farallon. 2003. *Remedial Investigation/Feasibility Study Work Plan, Hamilton/Labree Roads Groundwater Contamination Superfund Site, Chehalis, Washington*. Prepared for S.C. Breen Construction Company. Issaquah, Washington. July.

Farallon. 2004. Unpublished data from Phase II RI/FS Activities.

Fetter, C.W. 1980. *Applied Hydrogeology*. Charles E. Merrill Publishing Company. Columbus, Ohio.

GeoEngineers. 2001. *Interim Remedial Action Report, S.C. Breen Construction Company Property, Chehalis, Washington*. Prepared for S.C. Breen Construction Company. March.

GeoPotential. 2000. *Results of Subsurface Mapping Survey for Buried Waste Drums, Four Areas in the Vicinity of Hamilton/Labree Roads Chlorinated Solvent Site, Chehalis, Washington*. Prepared for Washington State Department of Ecology. Olympia, Washington. February.

Geo-Recon International (Geo-Recon). 1996. *Geophysical Investigation of the Hamilton-LaBree Properties, Chehalis, Washington*. Prepared for Washington State Department of Ecology. Olympia, Washington. October.

Jewett, Peter. 2005. Personal Communication with Peter Jewett of Farallon Consulting. October 31.

Parametrix. 2005. Technical Memorandum: Breen Property Surface Soil Data Review. Prepared by Parametrix for EPA Region 10. November 7.

Parametrix. 2006. Technical Memorandum: Hamilton/Labree Groundwater Contamination Site: Data Validation/Data Usability Review. Prepared by Parametrix for EPA Region 10. January 9.

SAIC. 1997. *Phase I and II Data Presentation Report for Hamilton/Labree Roads Perchloroethylene (PCE) in Groundwater Site*. Prepared by Science Applications International Corporation for Washington Department of Ecology under Ecology Contract C9300048, SAI019. Olympia, Washington. June.

United States Environmental Protection Agency (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*. Interim Final. October

United States Environmental Protection Agency (EPA). 2000. *Removal Assessment Report, Hamilton-Labree Site, Chehalis, Washington*. Prepared by Ecology and Environment, Inc. for USEPA Region 10 under START Contract 68-W6-0008. TDD: 00-01-0015. Seattle, Washington. December.

United States Environmental Protection Agency (EPA). 2001. *Hamilton-Labree Phase III Removal Assessment Report, Chehalis, Washington*. Prepared by Ecology and Environment, Inc. for USEPA Region 10 under START-2 Contract 68-S0-01-01. TDD: 01-01-0010. Seattle, Washington. April.

United States Environmental Protection Agency (EPA). 2002. *Hamilton-Labree Phase IV Removal Assessment, Chehalis, Washington*. Prepared by Ecology and Environment, Inc. for USEPA Region 10 under START-2 Contract 68-S0-01-01. TDD: 01-09-0006. Seattle, Washington. January.

United States Environmental Protection Agency (EPA). 2003. *Hamilton-Labree Removal Action Report, Chehalis, Washington*. Prepared by Ecology and Environment, Inc. for USEPA Region 10 under START-2 Contract 68-S0-01-01. TDD: 02-07-0002. Seattle, Washington. May.

URS. 2004. *Draft (Revision 1) Engineering Evaluation/Cost Analysis Report, Hamilton Road Impact Area, Hamilton-Labree Roads Superfund Site, Chehalis, Washington*. Prepared for USEPA Region 10 under RAC Contract 68-W-98-228. August.

Washington State Department of Ecology (Ecology). 1999a. *Source Investigation Report for Hamilton/Labree Roads Chlorinated Solvent Site. Olympia, Washington*. January.

Washington State Department of Ecology (Ecology). 1999b. *Hamilton/Labree Roads PCE Site Ground Water Monitoring, October 1997 – July 1998*. Olympia, Washington. April.

Washington State Department of Ecology (Ecology). 2000. *Hamilton/Labree Roads PCE Site Ground Water Monitoring, February and July 1999*. Olympia, Washington. September.

Washington State Department of Ecology (Ecology). 2001. *Model Toxics Control Act*. WAC 173-340. February.

Washington State Department of Ecology (Ecology). 2005. *Hydrology and Quality of Groundwater in the Centralia-Chehalis Area Surficial Aquifer*. Washington State Groundwater Assessment Program. Publication No. 05-03-040. December.

Weigle, J.M. and B.L. Foxworthy. 1962. *Geology and Groundwater Resources of Western Central Lewis County, Washington.* Water Supply Bulletin No. 17. State of Washington Department of Conservation, Division of Water Resources.

Western Regional Climate Center. 2006. www.wrcc.dri.edu.

TABLES

Table 1-1. Historical Site Investigations and Key Findings

Date Range	Investigated by	Scope of Investigation	Key Findings	References
1993-1994	Washington State Department of Health (WDOH)	Sampled 18 private water-supply wells in the Hamilton/Labree Roads area.	Tetrachloroethylene (PCE) detected in 6 wells screened in the shallow aquifer	Ecology 1999b
1996	WDOH	Re-sampled 5 of 6 wells previously exhibiting PCE.	Slight increase in PCE concentrations from 1993-1994 sampling event	Ecology 1999b
1996	Geo-Recon and SAIC (for Washington Department of Ecology [Ecology])	Geophysical reconnaissance investigation on the Breen property for sources, sampled private water-supply wells, and installed monitoring wells in the upper aquifer.	Some geophysical anomalies detected, but no obvious cache of buried drums. PCE concentrations have ranged from 500 to 1,350 µg/L in MW-3 and 2.4 to 7 µg/L in MW-5.	SAIC 1997 and Geo-Recon 1996
1997-2001	Ecology	Quarterly sampling of monitoring wells and private water-supply wells. Installed 7 wells intended for monitoring and remediation, all within the HRIA study area. Sampling of surface water in Berwick Creek.	Generated data for tracking of contaminant concentrations.	Ecology 2000; Ecology 1999b; Ecology 2001
1998	Transglobal Environmental Geosciences Northwest, Inc. [TEG] (for Ecology)	Sampled soil and groundwater from 28 temporary borings in the Hamilton/Labree Roads area.	Highest concentration of PCE in groundwater was 60,000 µg/L at location B2.	Ecology 1999a
1999	Northwest Geophysical Associates and GeoEngineers for Breen	Located and removed 70 drums and several small containers, and contaminated soil from beneath a building on the Breen property.	Buried drums were a source of PCE in groundwater.	GeoEngineers 2001
2000 – 2001	START contractor (Ecology and Environment, Inc.) for EPA	Four phases of work as part of a time-critical removal action. Installed and sampled temporary borings, monitoring wells, and combined monitoring and recovery wells. All temporary and permanent sampling locations assessed the shallow aquifer, with various sampling and screen depths. Evaluated removal action alternatives.	Implemented the alternative drinking water supply alternative, connecting affected residences and businesses to the City of Chehalis municipal water supply.	EPA 2000, 2001, 2002
2002	Farallon Consulting for Breen	Phase I investigation work for preparation of a site-wide remedial investigation/feasibility study. Within the HRIA study area, collected surface water from Berwick Creek and groundwater from existing monitoring and private water supply wells. Outside of HRIA study area, installed and sampled temporary borings and permanent monitoring wells, collected stream-bed soil samples from Berwick Creek, collected soil gas samples on Breen property.	To date, eliminated some potential sources areas on the Breen property from consideration. Added to understanding of distribution of PCE in soil and groundwater. Found greater downgradient extent of PCE in groundwater than previous investigations.	Farallon 2003
2003-2004	Response Action Contract (RAC) Contractor (URS Group) for EPA	Engineering evaluation/cost analysis investigation for HRIA study area. Performed geophysical survey to look for targets and characterize subsurface. Collected soil gas samples, stream bed and bank soil samples from Berwick Creek, sampled soil and groundwater from temporary Geoprobe borings to 30 feet bgs, sampled soil and groundwater from auger borings to 50 feet bgs, installed and sampled permanent monitoring wells, performed two constant-discharge aquifer performance tests.	Identified source as dumping to Berwick Creek. Delimited dense nonaqueous-phase liquid (DNAPL) zone and zone of highest PCE concentrations. Obtained soil, groundwater, and aquifer characteristics for screening and design of removal and remedial technologies. Installed wells for use in future remediation and monitoring.	URS 2004
2003-2004	Farallon Consulting	Collected soil, groundwater, surface water data to support the RI/FS on the Breen property. Installed and sampled permanent monitoring wells, performed constant-discharge aquifer performance tests. Data collected but not reported.	Discussed as part of this RI.	Farallon 2004, unreported

Table 3-1. Surface Water Monitoring Data

Surface Water Monitoring Station	Date Monitored	Creek Gauge Elevation (feet)[1]	Creek Height (feet)[2]	Surface Water Elevation (feet)	Estimated Groundwater Elevation[3]	Elevation Head Difference (feet)[4]	Flow Rate (cfm)	Flow Rate (gpm)	Channel Depth (feet)[5]
SW-5	9/5/02	209.08	4.32	204.76	201.00	-3.76	0.0	0	2.46
	11/21/02	209.08	4.50	204.58	202.20	-2.38	1.2	<50	2.22
SW-6	9/5/02	209.88	5.13	204.75	201.11	-3.64	0.0	0	2.40
	11/21/02	209.88	5.19	204.69	202.30	-2.39	0.6-4.2	<50	2.60
SW-7	9/5/02	208.77	3.98	204.79	200.90	-3.89	6.0	<50	4.11
	11/21/02	208.77	4.18	204.59	202.18	-2.41	0.0	0	3.91
SW-8	9/5/02	205.00	6.18	198.82	196.42	-2.40	65.0	500	0.37
	11/22/02	205.00	5.88	199.12	198.00	-1.12	190.0	1,400	0.91
SW-9	9/5/02	204.49	7.46	197.03	195.00	-2.03	116.0	870	0.43
	11/22/02	204.49	7.16	197.33	196.00	-1.33	170.0	1,250	0.70
SW-10	9/5/02	196.14	4.13	192.01	192.00	-0.01	0.0	0	2.09
	11/21/02	196.14	4.04	192.10	193.00	0.90	6.0	<50	2.20

Source: Farallon (2003)

Notes:

1 Surveyed elevation of top of stream gauge to vertical datum NGVD 29, in feet above mean sea level.
2 Height measured in feet from top of stream gauge to water surface.
3 Groundwater elevation estimated from corresponding well or groundwater contour.
4 A head difference is calculated by subtracting the groundwater elevation from the surface water elevation.
5 Channel depth in feet, measured in center of channel from water surface to bottom of channel.

cfm = cubic feet per minute
gpm = gallons per minute

Table 4-1. Physical Soil Characteristics

Location ID	Depth (ft bgs)	Moisture Content (% wt)	Density (g/cc)		Porosity (%Vb)			Pore Fluid Saturations (% Pv)		Total Organic Carbon (mg/kg)	Effective Permeability to Water (millidarcy)	Effective Hydraulic (cm/s)	Mean Grain Size Description
			Bulk	Grain	Total	Air Filled	Effective	Water	NAPL				
MW-602	5.0	24.7	1.45	2.60	44.3	8.5	7.5	80.9	0.1U	15,800	0.296	2.82E-07	Silt
MW-603	5.5	21.2	1.47	2.64	44.4	13.3	13.9	70.0	0.1U	2,950	0.925	8.81E-07	Medium sand
MW-601	5.5	20.5	1.61	2.61	38.4	5.1	8.7	86.6	0.1	1,400	0.141	1.34E-07	Silt
MW-602	13.0	22.2	1.53	2.64	41.9	8.0	12.9	81.0	0.1U	11,000	1.28	1.21E-06	Silt
MW-605	13.0	18.1	1.64	2.70	39.4	9.4	17.4	76.1	0.1U	<100	38.1	3.62E-05	Gravel
MW-602	15.5	19.9	1.57	2.68	41.6	10.5	19.1	74.9	0.1U	3,400	3.29	3.14E-06	Coarse sand
MW-652	16.0	14.6	1.75	2.71	35.2	9.1	15.6	74.1	0.1U	2,350	9.81	9.31E-06	Gravel
MW-601	16.0	16.8	1.76	2.70	35.1	5.6	17.6	84.2	0.1U	690	15.9	1.51E-05	Gravel
MW-604	16.1	11.6	1.75	2.71	35.6	14.3	22.1	59.9	0.1U	<100	127	1.21E-04	Gravel
MW-606	16.1	17.8	1.74	2.71	35.7	4.6	20.1	86.4	0.8	420	58.3	5.62E-05	Gravel
MW-603	25.7	10.5	1.46	2.68	45.6	30.0	30.1	34.2	0.1U	<100	238	2.25E-04	Medium sand
MW-601	28.5	22.8	1.42	2.67	46.9	14.4	36.0	66.7	2.5	380	0.476	4.58E-07	Medium sand
MW-605	29.0	14.3	1.73	2.72	36.3	11.3	17.6	69.0	0.1U	600	22.1	2.09E-05	Coarse sand
MW-600	29.1	31.6	1.27	2.64	51.8	11.6	33.7	77.6	0.1U	280	182	1.77E-04	Fine sand
MW-602	30.5	24.5	1.44	2.66	46.0	10.7	23.5	76.3	0.5	<100	50.1	4.81E-05	Fine sand
MW-605	37.5	17.2	1.63	2.68	39.1	10.7	14.0	72.0	0.7	760	3.92	3.73E-06	Coarse sand
MW-603	38.0	13.3	1.71	2.73	37.2	14.1	23.0	62.1	0.1U	280	646	6.13E-04	Medium sand
MW-652	38.0	14.0	1.66	2.69	38.5	14.9	16.3	61.3	0.1U	2,200	117	1.11E-04	Gravel
MW-606	42.6	11.0	1.79	2.63	32.1	12.4	21.0	61.5	0.1U	560	32.7	3.12E-05	Gravel
MW-601	43.5	17.5	1.79	2.69	33.3	1.7	11.2	95.0	0.1U	180	471	4.54E-04	Medium sand
MW-603	47.0	41.9	1.12	2.62	57.3	8.2	16.5	85.7	0.1U	4,650	0.599	5.66E-07	Silt
MW-601	47.0	31.9	1.33	2.68	50.5	8.3	7.1	83.6	0.1U	4,300	1.15	1.11E-06	Silt
MW-652	47.5	30.5	1.19	2.61	54.4	17.8	16.7	66.8	0.6	4,750	0.152	1.45E-07	Silt
MW-602	48.5	35.9	1.23	2.60	52.5	8.3	6.6	84.2	0.1U	2,400	0.322	3.08E-07	Silt

Table 4-1. Physical Soil Characteristics

Location ID	Depth (ft bgs)	Moisture Content (% wt)	Density (g/cc)		Porosity (%Vb)			Pore Fluid Saturations (% Pv)		Total Organic Carbon (mg/kg)	Effective Permeability to Water (millidarcy)	Effective Hydraulic (cm/s)	Mean Grain Size Description
			Bulk	Grain	Total	Air Filled	Effective	Water	NAPL				
MW-606	48.6	30.9	1.40	2.60	46.2	2.9	14.0	93.6	0.1U	1,700	1.44	1.40E-06	Silt
MW-605	49.5	29.2	1.38	2.60	47.1	6.4	14.8	86.4	0.1U	1,100	0.511	4.83E-07	Silt
Mean value 0-13 ft		22.1	1.5	2.6	42.3	8.7	10.74	79.6	0.1	7,790	0.700	6.3E-07	Silt cap
Mean value 13-31 ft		18.4	1.6	2.7	40.8	11.9	22.99	70.8	1.3	756	67.7	6.5E-05	Sand/gravel aquifer
Mean value 31-40 ft		14.8	1.7	2.7	38.2	13.2	17.08	65.2	0.7	1,080	256	2.4E-04	Sand/gravel aquifer
Mean value 40-45 ft		14.3	1.8	2.7	32.7	7.0	16.09	78.2	0.1U	370	252	2.4E-04	Sand/gravel aquifer
Mean value 45-50 ft		33.4	1.3	2.6	51.3	8.6	12.62	83.4	0.6	3,150	0.700	6.7E-07	Silt aquitard
											Overall mean:	1.20E-04	Sand/gravel aquifer
											Overall max:	6.13E-04	
											Overall min:	4.58E-07	

Source: URS (2004)

Notes:
Maximum NAPL saturation = 2.5%.
Minimum measurable NAPL saturation = 0.1%.
Overall mean NAPL saturation = 0.9%.

cm/s = centimeter per second
ft bgs = feet below ground surface at sampling location
g/cc = gram per cubic centimeter
mg/kg = milligram per kilogram
NAPL = nonaqueous-phase liquid
% wt = percent by weight
% Vb = percent of bulk volume
% Pv = percent of pore volume
U = not detected at given detection limit

Table 4-2. Total Metals Analysis for Soil at the HRIA

Metal	Sampling Location/Layer (mg/kg)							
	GP-503/ Silt Cap	MW-602/ Silt Cap	GP-503/ Aquifer	GP-504/ Aquifer	MW-604/ Aquifer	MW-604/ Aquifer	MW-606/ Aquifer	MW-604/ Aquitard
Aluminum	25,900	18,100	25,400	24,400	15,200	13,000	22,800	22,500
Antimony	1.7	6.7	3.75	3.8	6.2	0.7	12.9	7.4
Arsenic	1.8	2.6	1.75	1.8	1.4	1.5	0.9	5.8
Barium	111	163	69.8	77.2	75.7	53.8	62.4	93.5
Beryllium	0.63	0.25	0.56	0.62	0.5	0.495	0.55	0.47
Cadmium	0.015	0.55	0.23	0.26	0.5	0.035	0.44	0.04
Calcium	1,900	2,920	7,510	6,540	5,370	4,190	4,990	3,370
Chromium	22.8	16.1	17.7	14.5	13.5	17.6	27.4	15.6
Cobalt	17.6	10.9	15.9	13.5	12	10.6	18.2	14.8
Copper	17.1	31.8	57.5	44.8	38.3	46.2	50.1	61.2
Iron	20,500	25,300	33,800	34,500	22,400	18,300	25,100	10,400
Lead	6.6	2.8	5.6	5.1	0.97	1.6	0.81	3.7
Magnesium	1,880	3,530	6,580	5,470	4,710	3,990	8,370	3,400
Manganese	462	275	404	538	448	452	588	51.7
Mercury	0.06	0.02	0.055	0.06	0.01	0.015	0.0095	0.02
Nickel	13.8	15.2	18.9	14.4	14.2	14.8	31.6	19.8
Potassium	143	40.65	657	875	472	352	400	339
Selenium	4.25	0.9	4.1	4.15	0.85	0.85	0.6	0.75
Silver	1.2	1.1	1.2	1.2	1.05	1	2.2	1.25
Sodium	91	555	850	271	515	495	540	615
Thallium	1.7	--	0.74	0.88	--	--	--	--
Vanadium	57.5	52.3	96.6	90.8	40.4	32.6	44.6	36.1
Zinc	24.9	31.4	49	57.9	32.2	24.8	39.7	88.7

Source: URS (2004)

mg/kg = milligram per kilogram

Table 4-3. Multi-Level Groundwater Sampling Results at the HRIA

Sample Location	Sample Date	Depth of Sampling (feet)	PCE (ug/L)
MWR-8	11/20/2002	15	4,700
	11/20/2002	26	2,400
	11/20/2002	37	580
	11/20/2002	48.5	360
MWR-11	11/20/2002	20.5	25
	11/19/2002	26	22
	11/19/2002	37	25
	11/19/2002	48.5	23

Source: Farallon (2003)

Table 4-4. Conventional Chemistry in Groundwater at the HRIA

Well ID	Sulfate (mg/L)	Chloride (mg/L)	Alkalinity, Total (mg/L)	Nitrate/ Nitrite (mg/L)	Total Sulfides (mg/L)	pH (sU)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (δC)	Oxygen-Reduction Potential (mV)	Iron (mg/L)
MW-600	1	7.5	118	0.8	2 U	6.45	0.209	11.7	0.69	12.59	25	0.2 U
MW-601	1.8	5.9	117	1	2 U	6.74	0.198	96.6	2.35	11.83	-9	0.2 U
MW-602	34	9	72	1	2 U	6.50	0.251	151.0	2.80	11.65	-30	0.2 U
MW-603	3	5.6	100	1.1	2 U	6.70	0.195	47.2	2.13	12.03	-63	0.2 U
MW-604	1.4	5.4	101	1	2 U	6.63	0.204	48.5	4.02	13.26	64	0.2 U
MW-605	6.2	1.1	150	0.5	2 U	6.65	0.280	12.3	1.96	13.26	-51	0.2 U
MW-606	13	1	94	1.7	2 U	6.68	0.199	27.1	2.93	12.83	86	0.2 U
MW-607	7.1	1.3	82	1.4	2 U	6.64	0.172	35.7	4.06	13.11	140	0.2 U
MW-608	4.6	1.1	88	1	2 U	6.61	0.164	57.1	3.08	12.71	55	0.2 U
Mean conc.	8.0	4.2	102	1.1	2 U	6.6	0.2	45.6	2.6	12.6	59.4	0.2 U
Standard Dev.	10.4	3.1	23.3	0.3	0	0.1	0.0	32.9	1.2	0.5	57.2	0
Max conc.	34	9	150	1.7	2 U	6.7	0.3	96.6	4.1	13.1	140.0	0.2 U
Min conc.	1	1	72	0.5	2 U	6.5	0.2	11.7	0.7	11.8	-9.0	0.2 U

Source: URS (2004)

ºC = degree Celsius
mg/L = milligram per liter
mS/cm = milliSiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity unit
SU = standard unit
U = not detected at given detection limit

Table 4-5. Surface Water Sampling Results

Location	Sampled By	Sample Date	Concentrations (µg/L)		
			PCE	TCE	c-1,2-DCE
SW-1	Ecology	4/29/98	16	0.98 J	1.2
		7/23/98	8.5	1 U	2.3
		12/28/98	NA	NA	NA
SW-2	Ecology	4/29/98	NA	NA	NA
		7/23/98	9.8	1 U	2.7
		12/28/98	NA	NA	NA
SW-3	Ecology	4/29/98	NA	NA	NA
		7/23/98	15	1 U	4
		12/28/98	NA	NA	NA
SW-4	Ecology	4/29/98	NA	NA	NA
		7/23/98	NA	NA	NA
		12/28/98	1 U	2 U	1 U
SW-5	Farallon Consulting	7/18/02	0.66	0.23	0.62
		8/20/02	0.2	0.2 U	0.2 U
		11/21/02	40	0.2 U	0.2 U
		2/4/03	0.2 U	0.2 U	0.2 U
SW-6	Farallon Consulting	7/18/02	0.62	0.27	0.74
		8/20/02	0.2 U	0.2 U	0.2 U
		11/21/02	0.2 U	0.2 U	0.2 U
		2/4/03	0.2 U	0.2 U	0.2 U
SW-7	Farallon Consulting	7/18/02	0.82	0.31	1.3
		8/20/02	0.28	0.2 U	0.47
		11/21/02	12	0.2 U	0.2 U
		2/4/03	0.53	0.2 U	0.2 U
SW-8	Farallon Consulting	7/18/02	0.6	0.25	1
		8/20/02	0.2 U	0.2 U	0.2 U
		11/22/02	0.2 U	0.2 U	0.2 U
		2/4/03	0.67	0.2 U	0.2 U
SW-9	Farallon Consulting	7/18/02	0.44	0.2 U	0.69
		8/20/02	0.2 U	0.2 U	0.2 U
		8/20/02	0.2 U	0.2 U	0.2 U
		11/22/02	0.2 U	0.2 U	0.2 U
		2/5/03	1	0.2 U	0.2 U
SW-10	Farallon Consulting	7/19/02	0.41	0.2 U	0.3
		8/20/02	0.21	0.2 U	0.2 U
		11/21/02	0.2 U	0.2 U	0.2 U
		2/5/03	0.85	0.2 U	0.2 U

Table 4-6. Creek Bed Samples

Sample Location	Date Sampled	Start Depth	End Depth	PCE (mg/kg)	TCE (mg/kg)	cis-1,2-DCE (mg/kg)
BS-451	15-Aug-03	12	36	0.0341 U		
BS-452	15-Aug-03	12	36	0.0304 U		
BS-453	15-Aug-03	12	36	0.0254 U		
BS-454	15-Aug-03	12	36	0.0272 U		
BS-455	19-Aug-03	12	36	0.0224 U		
BS-456	19-Aug-03	12	36	0.03 U		
BS-457	22-Aug-03	12	36	0.0316		
BS-458	22-Aug-03	12	36	0.0278		
BS-459	22-Aug-03	12	36	0.0221 U		
BS-460	22-Aug-03	12	36	0.0159 U		
BS-461	22-Aug-03	12	36	0.0116 U		
BS-462	26-Aug-03	12	36	0.118		
BS-463	26-Aug-03	12	36	0.0214 U		
BS-464	26-Aug-03	12	36	0.0161 U		
BS-465	26-Aug-03	12	36	0.0327 UJ		
BS-466	26-Aug-03	12	36	0.0405 U		
BS-467	27-Aug-03	12	36	0.0252 U		
BS-468	27-Aug-03	12	36	0.0223 U		
BS-469	27-Aug-03	12	36	0.01 U		
BS-470	27-Aug-03	12	36	0.0183 U		
CC-1	02-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-2	02-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-3	02-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-4	02-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-5	04-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-6	04-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
CC-7	04-Sep-03	1	1	0.0012 U	0.0012 U	0.0012 U
CC-8	04-Sep-03	0	0	0.0013 U	0.0013 U	0.0013 U
CC-9	04-Sep-03	1	1	0.0013 U	0.0013 U	0.0013 U
SB-400	12-Aug-03	3	12	8.7		
SB-401	12-Aug-03	0	12	25.5		
SB-402	12-Aug-03	0	12	28.3		
SB-403	12-Aug-03	4	12	0.0887		
SB-404	12-Aug-03	0	12	0.0201		

Table 4-6. Creek Bed Samples

Sample Location	Date Sampled	Start Depth	End Depth	PCE (mg/kg)	TCE (mg/kg)	cis-1,2-DCE (mg/kg)
SB-405	12-Aug-03	0	12	0.0117 U		
SB-406	12-Aug-03	3	12	0.0099 U		
SB-407	13-Aug-03	0	12	0.0237		
SB-408	13-Aug-03	2.5	12	0.0142		
SB-409	13-Aug-03	6	12	5220		
SB-410	13-Aug-03	6	12	1650		
SB-411	13-Aug-03	2	12	685		
SB-412	14-Aug-03	0	12	0.0187		
SB-413	14-Aug-03	0	12	0.0071 U		
SB-414	14-Aug-03	0	12	0.0065 U		
SB-415	14-Aug-03	0	12	0.0986		
SB-416	14-Aug-03	0	12	0.0135 U		
SB-417	15-Aug-03	0	12	1.29		
SB-419	03-Sep-03	12	36	0.0197 U		

Table 4-7. Soil Gas Samples

Sample Location	Date Sampled	Depth (feet)	PCE (ppm)	TCE (ppm)
SG1-1	2002	Unknown	<0.02	<0.02
SG1-2	2002	Unknown	<0.02	<0.02
SG1-3	2002	Unknown	<0.02	<0.02
SG1-4	2002	Unknown	<0.02	<0.02
SG1-5	2002	Unknown	<0.02	<0.02
SG1-6	2002	Unknown	<0.02	<0.02
SG1-7	2002	Unknown	<0.02	<0.02
SG1-8	2002	Unknown	<0.02	<0.02
SG1-9	2002	Unknown	<0.02	<0.02
SG1-10	2002	Unknown	<0.02	<0.02
SG1-12	2002	Unknown	<0.02	<0.02
SG1-13	2002	Unknown	<0.02	<0.02
SG1-14	2002	Unknown	<0.02	<0.02
SG1-20	2002	Unknown	<0.02	<0.02
SG2-1	2002	Unknown	<0.02	<0.02
SG2-2	2002	Unknown	<0.02	<0.02
SG2-3	2002	Unknown	<0.02	<0.02
SG2-4	2002	Unknown	<0.02	<0.02
SG2-5	2002	Unknown	<0.02	<0.02
SG2-6	2002	Unknown	<0.02	<0.02
SG2-7	2002	Unknown	<0.02	<0.02
SG2-8	2002	Unknown	<0.02	<0.02
SG2-9	2002	Unknown	<0.02	<0.02
SG2-15	2002	Unknown	<0.02	<0.02
SG-209	13-Aug-03	4	3.2	-
SG-211	13-Aug-03	4	0.36	-
SG-212	13-Aug-03	4	0.074	-
SG-213	13-Aug-03	4	0.091	-
SG-214	13-Aug-03	4	0.081	-
SG-215	13-Aug-03	4	0.074	-
SG-216	14-Aug-03	5	0.059	-
SG-217	14-Aug-03	4	0.041	-
SG-218	14-Aug-03	4	0.05	-
SG-219	14-Aug-03	4	0.021	-
SG-220	14-Aug-03	4	0.018	-
SG-221	14-Aug-03	4	0.021	-
SG-222	14-Aug-03	4	0.016	-
SG-223	14-Aug-03	4	0.049	-
SG-224	14-Aug-03	4	0.044	-

Table 4-7. Soil Gas Samples

Sample Location	Date Sampled	Depth (feet)	PCE (ppm)	TCE (ppm)
SG-225	14-Aug-03	4	0.04	-
SG-226	14-Aug-03	4	0.024	-
SG-227	14-Aug-03	4	0.024	-
SG-228	15-Aug-03	4	0.006	-
SG-229	15-Aug-03	4	0.082	-
SG-230	15-Aug-03	4	0.006 U	-
SG-231	15-Aug-03	4	0.018	-
SG-232	15-Aug-03	4	0.006	-
SG-233	15-Aug-03	4	0.025	-
SG-234	15-Aug-03	4	0.066	-
SG-235	15-Aug-03	4	0.062	-
SG-236	15-Aug-03	4	0.006 U	-

FIGURES

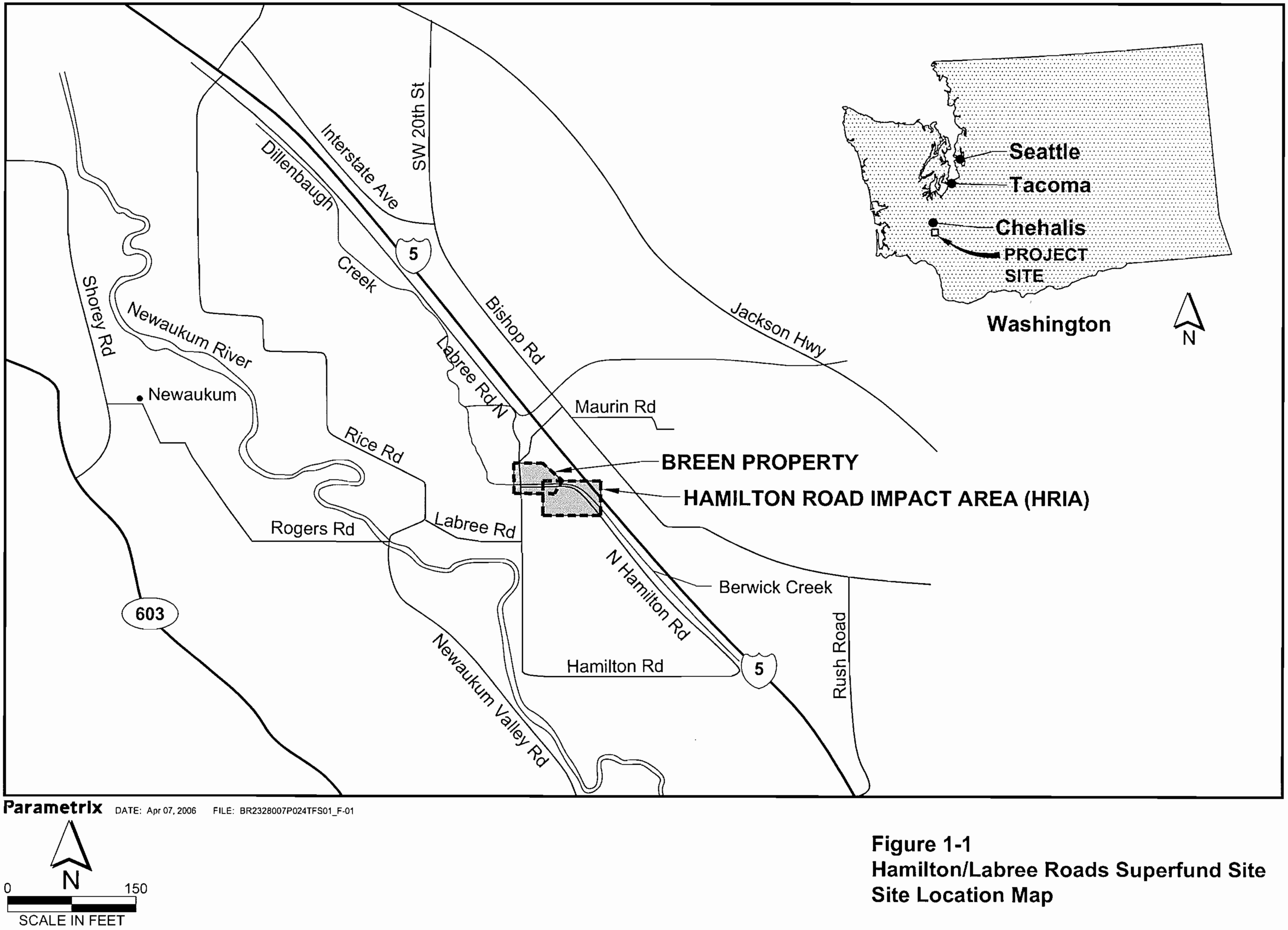
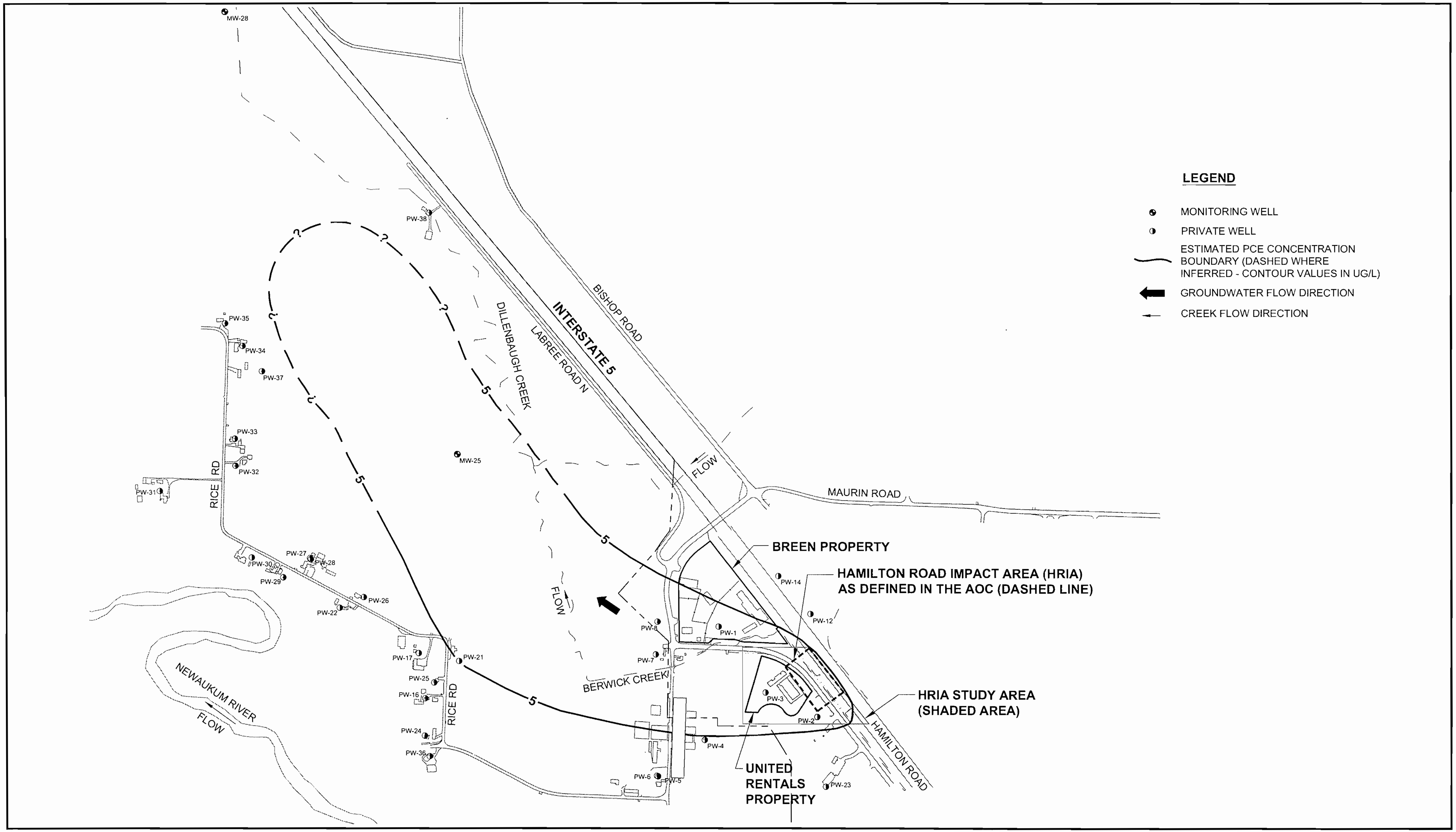
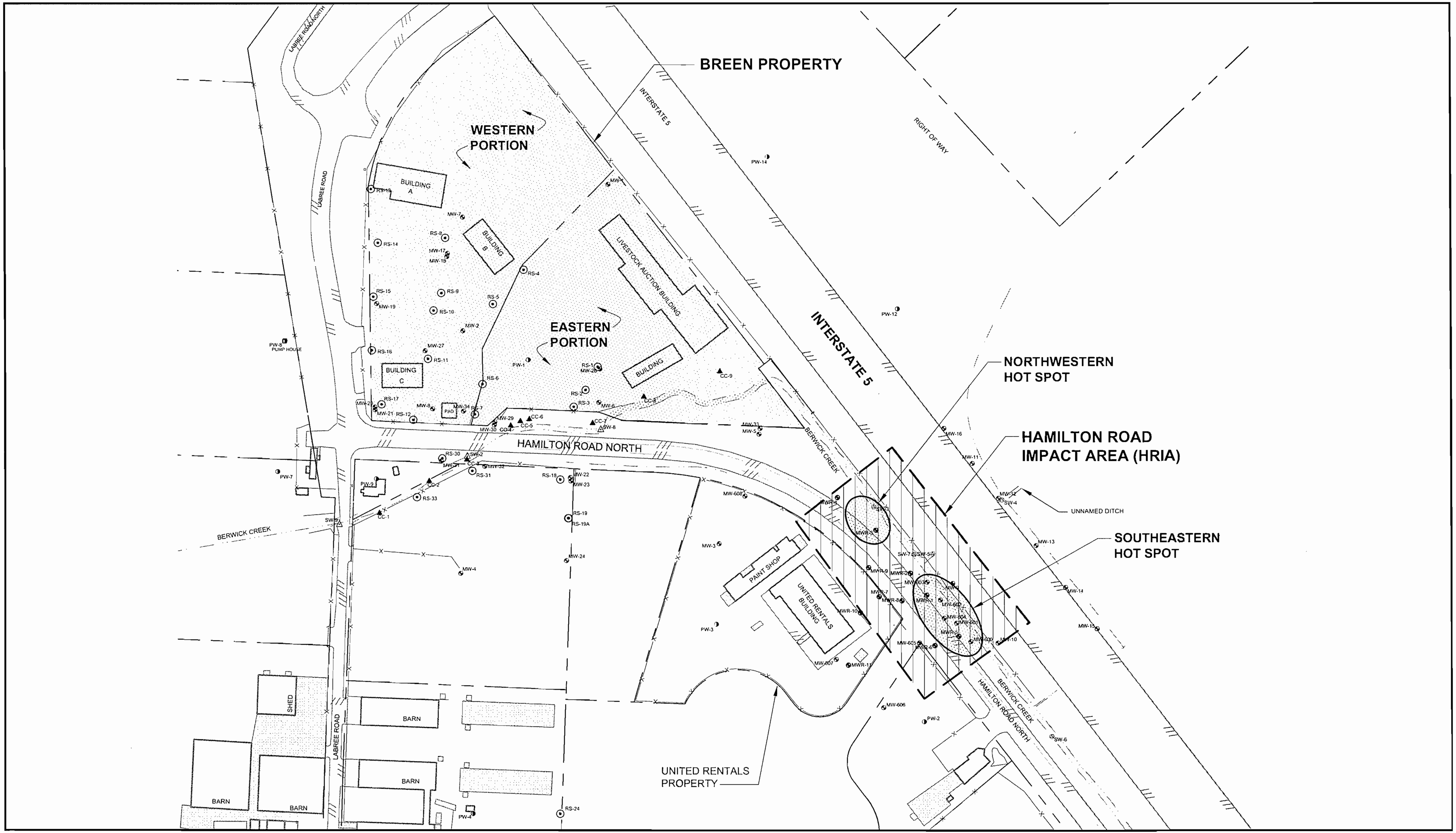


Figure 1-1
Hamilton/Labree Roads Superfund Site
Site Location Map



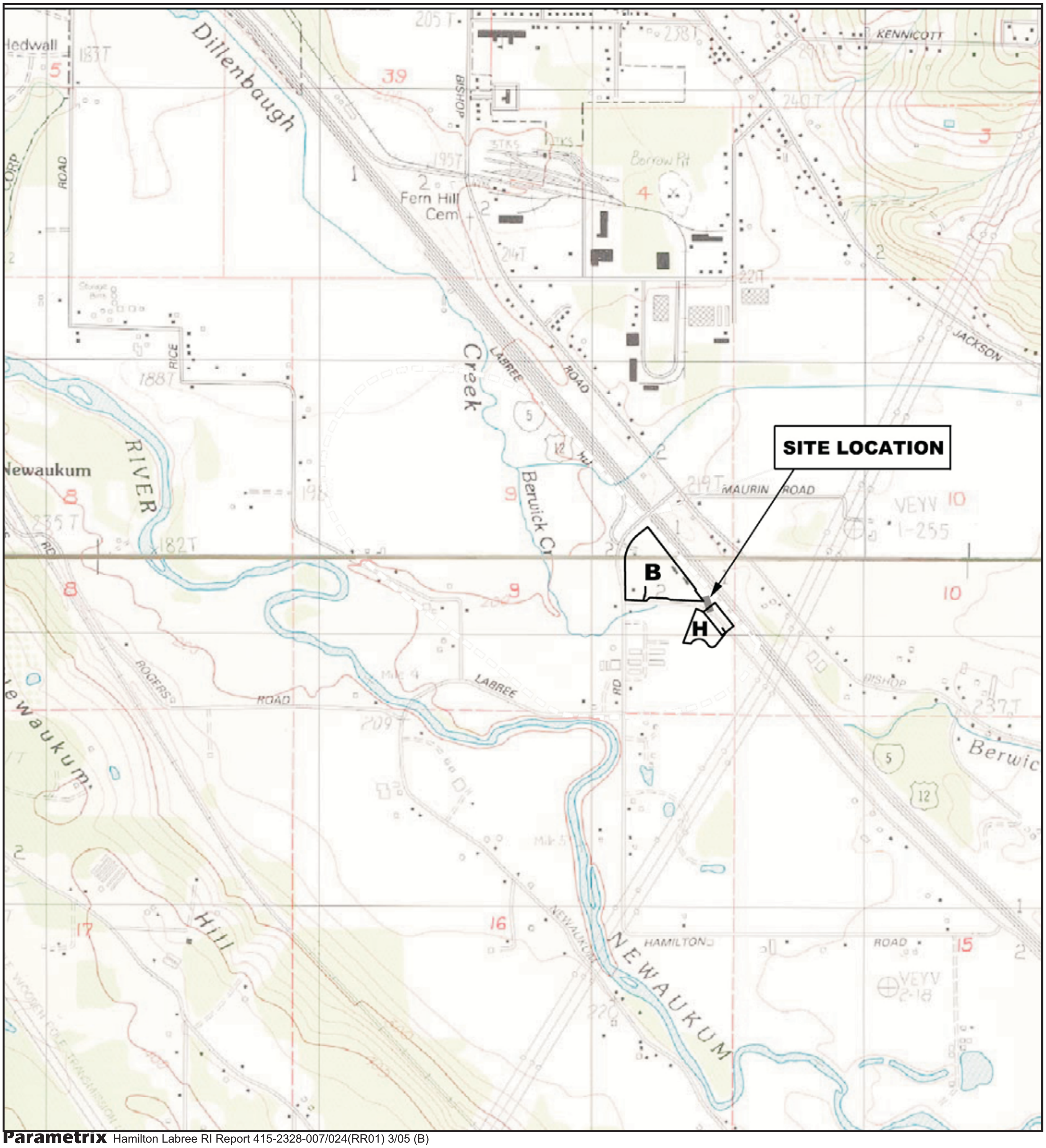
Parametrix DATE: May 23, 2005 FILE: BR2328007P024TFS01_F-09

Figure 1-2
Hamilton/Labree Roads Superfund Site
Overview of Hamilton Labree
Superfund Site



Parametrix DATE: May 23, 2006 FILE: BR2328007P024TFS01_F-07

Figure 1-3
Hamilton/Labree Roads Superfund Site
HRIA and Breen Property
Site Map



Parametrix Hamilton Labree RI Report 415-2328-007/024(RR01) 3/05 (B)

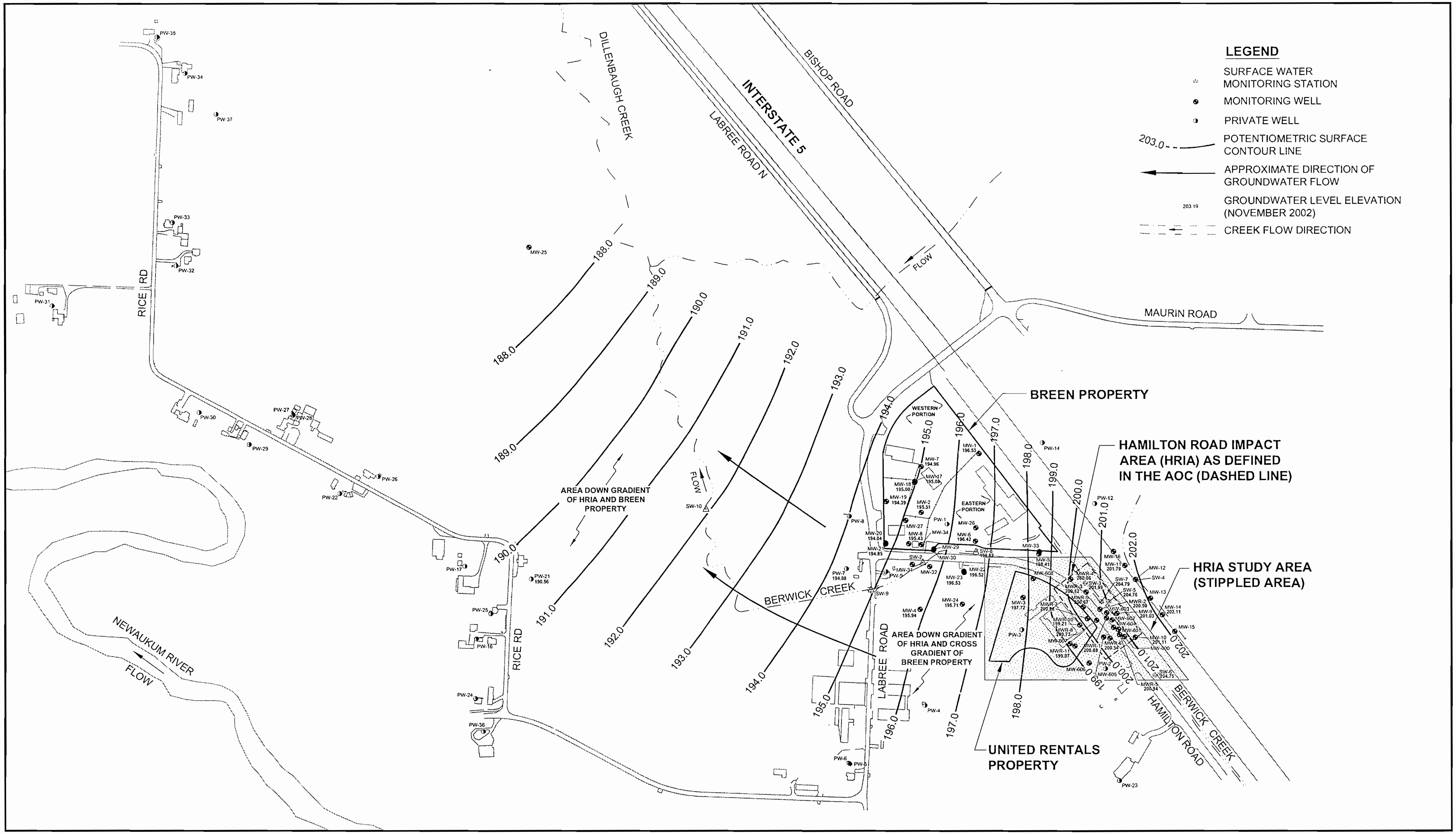
N

0 500 1000

APPROXIMATE SCALE IN FEET

Reference: 7.5 Minute USGS Quadrangle Centralia, Washington. Dated 1985
B = Breen Property
H = HRIA

Figure 3-1
Hamilton/Labree Roads Superfund Site
Regional Topography
and Drainage



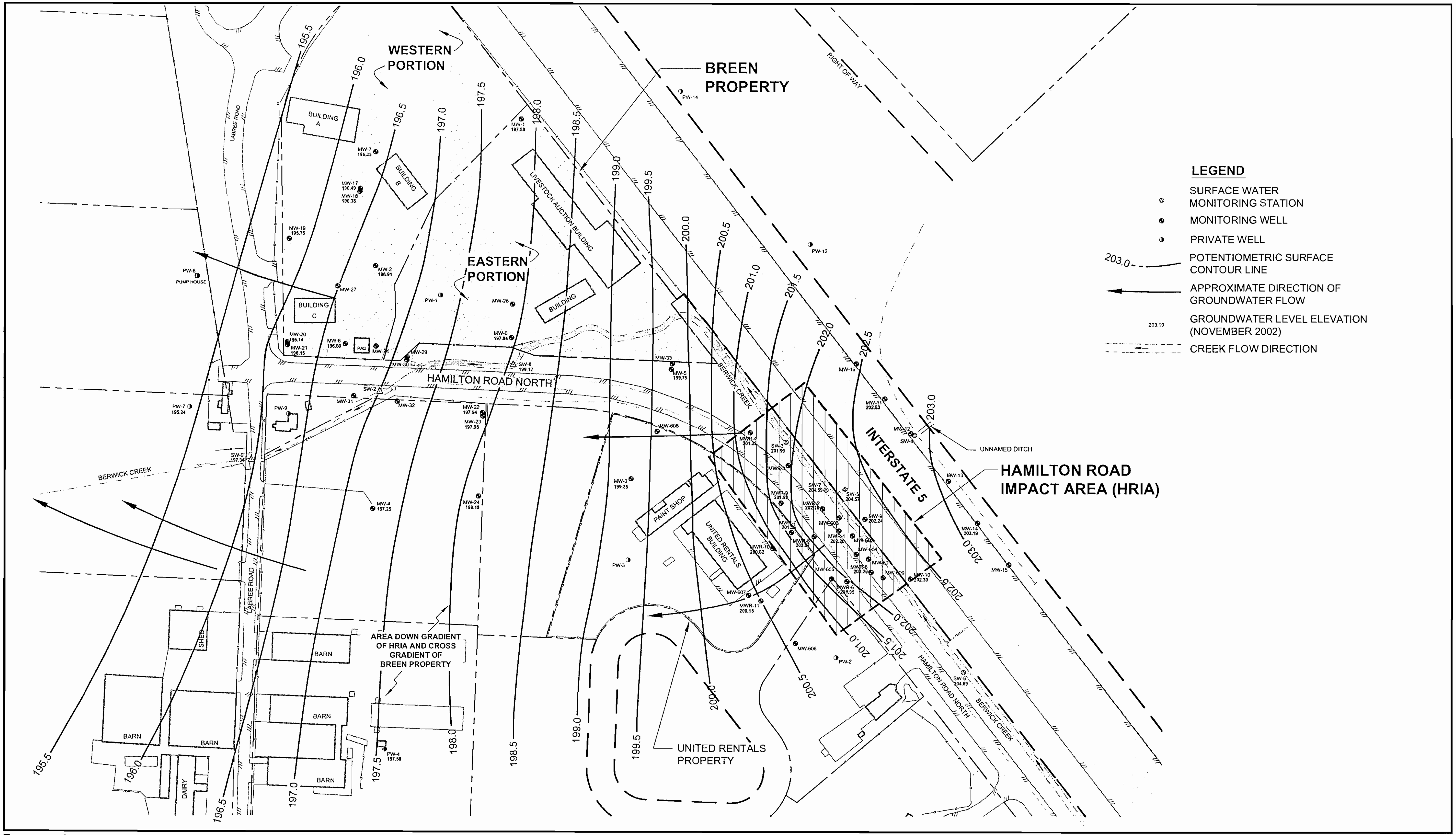
Parametrix DATE: May 18, 2006 FILE: BR2328007P024TRR01_F-04

N

0 500
SCALE IN FEET

Source: Farallon (2003)

Figure 3-2
Hamilton/Labree Roads Superfund Site
Site-Wide Groundwater Elevation Contour Map
September 2002



Parametrix DATE: May 17, 2006 FILE: BR2328007P024TRR01_F-03

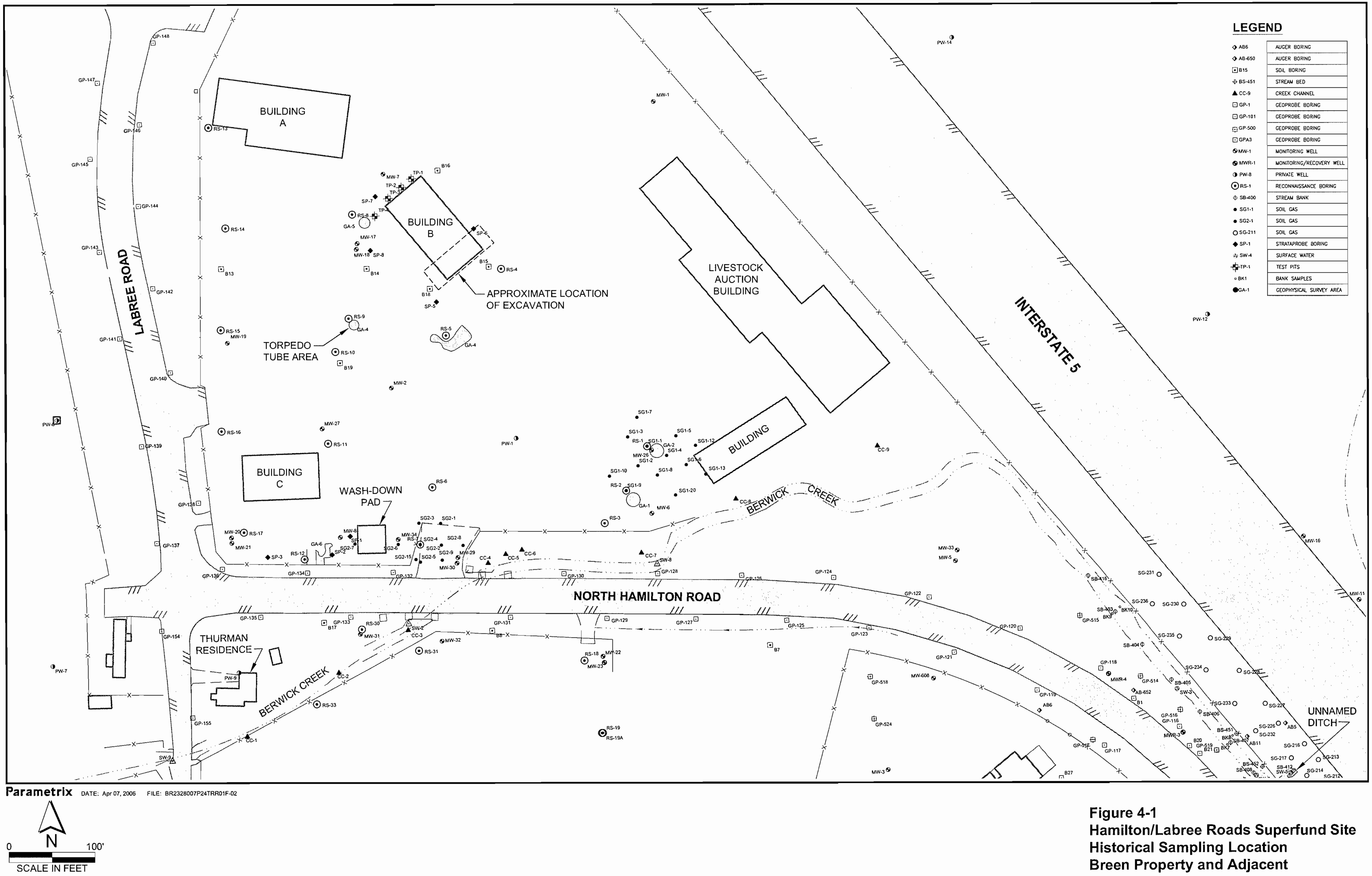
N

0 200

SCALE IN FEET

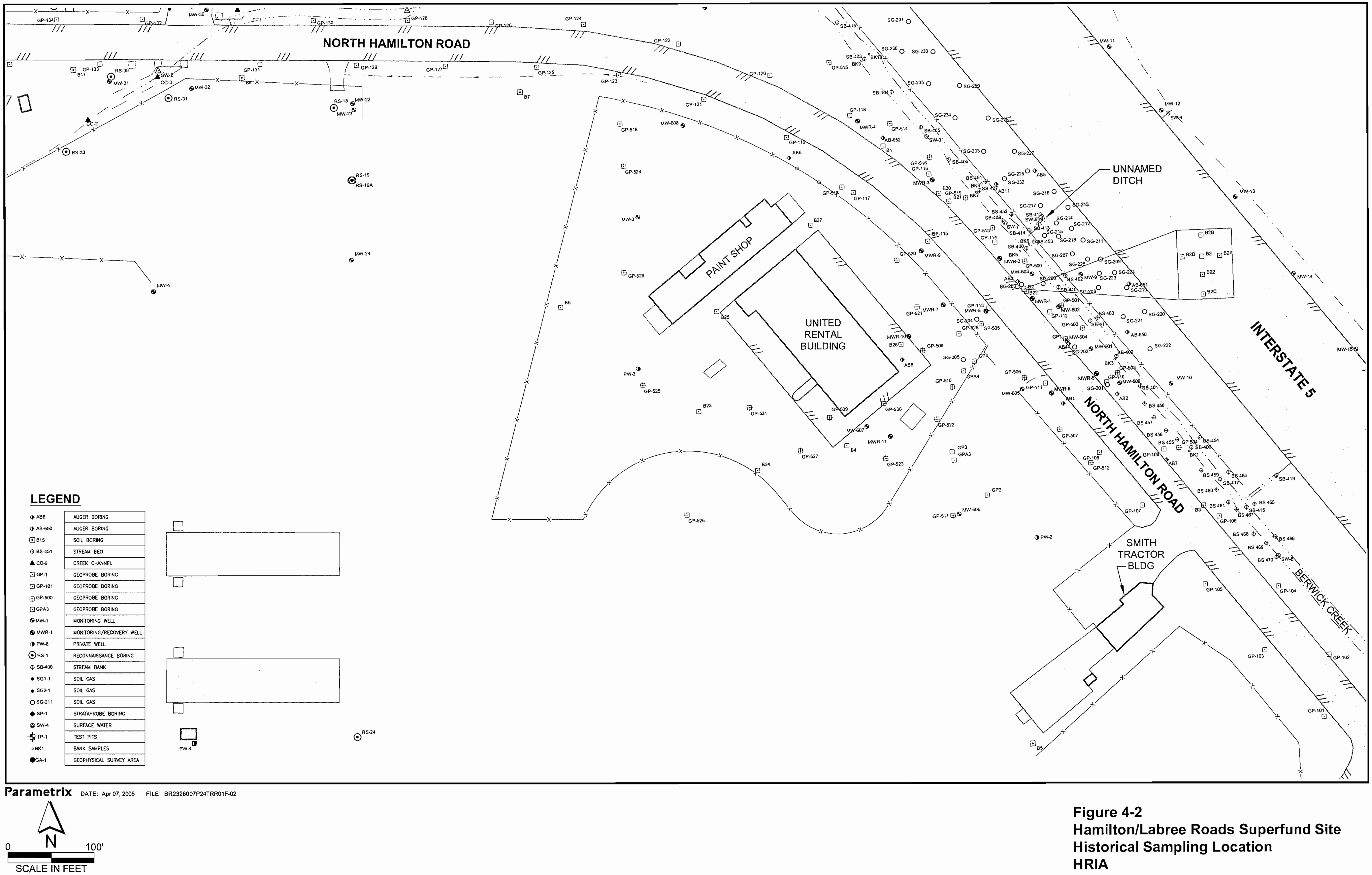
Source: Farallon (2003)

Figure 3-3
Hamilton/Labree Roads Superfund Site
Source Area Groundwater Elevation Contour Map
November 2002



Parametrix DATE: Apr 07, 2006 FILE: BR2328007P24TRR01F-02

Figure 4-1
Hamilton/Labree Roads Superfund Site
Historical Sampling Location
Breen Property and Adjacent



Parametrix DATE: Apr 07, 2006 FILE: BR2328007P24TRR01F-02

Figure 4-2
Hamilton/Labree Roads Superfund Site
Historical Sampling Location
HRIA

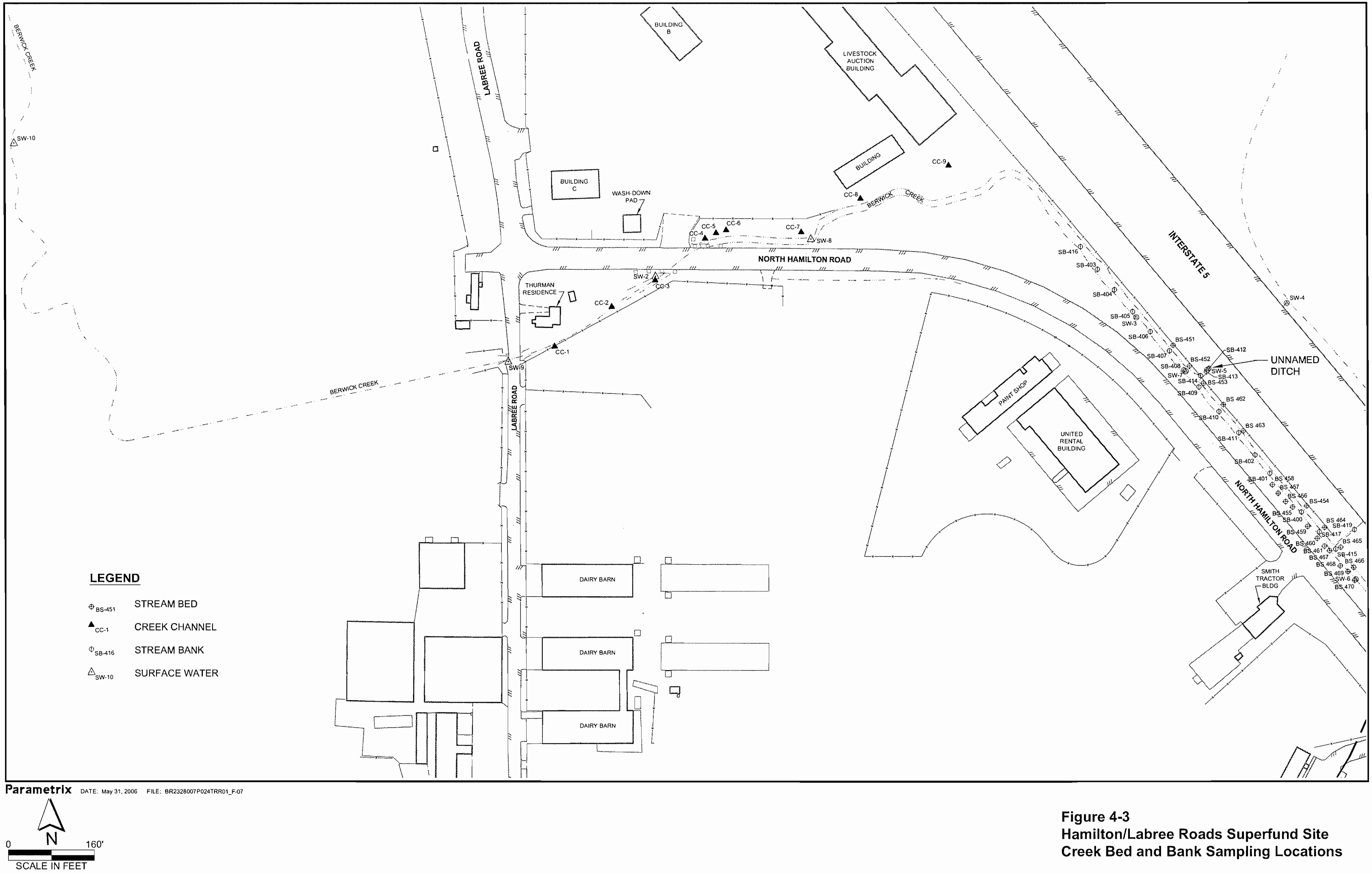
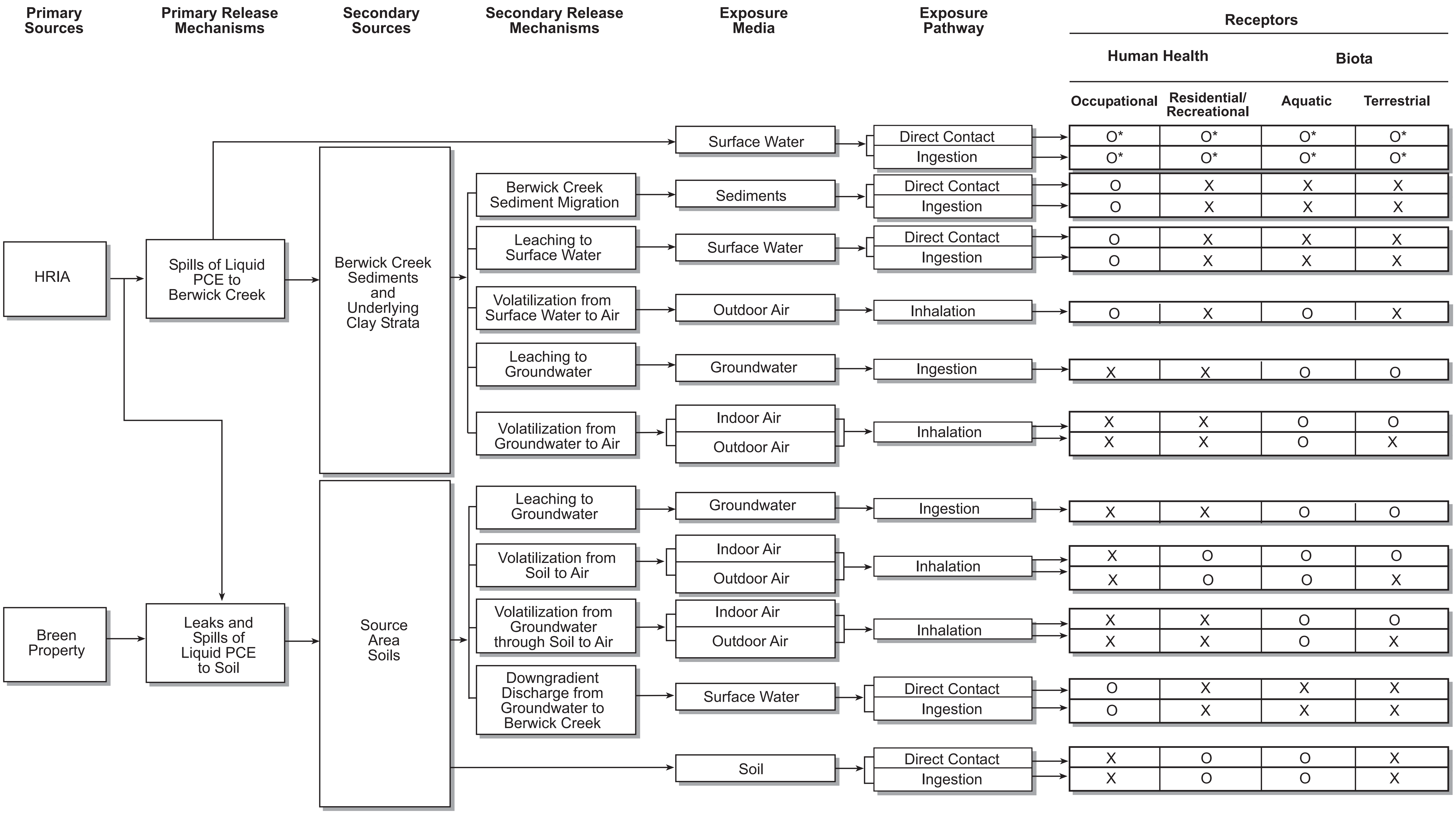


Figure 4-3
Hamilton/Labree Roads Superfund Site
Creek Bed and Bank Sampling Locations



NOTES:
X = Potentially Complete Exposure Pathway
O = Incomplete Exposure Pathway
* Initial mass of dissolved PCE in surface water moved downstream and is no longer present

Figure 5-1
Conceptual Site Model
Hamilton/Labree Roads Superfund Site
Chehalis, Washington

Plate 1 Site-wide Historical Sampling Locations

Plate 2 Site-wide Historical Sampling Locations