DEPARTMENT OF
ECOLOGY
State of Washington

Montesano Groundwater Investigation of Leaking Underground Storage Tanks

September 2008 and April 2009

November 2009

Publication No. 09-03-056

Publication Information

This report is available on the Department of Ecology's website at
www.ecy.wa.gov/biblio/0903056.html

Data for this project are available at Ecology's Environmental Information Management (EIM) website www.ecy.wa.gov/eim/index.htm. Search User Study ID, PMART004.

Ecology's Study Tracker Code for this study is 05-046-05.

Contact Information

For more information contact:

Publications Coordinator
Phone: (360) 407-6764

Author: Pamela B. Marti, Hydrogeologist
Washington State Department of Ecology
Environmental Assessment Program
Phone: (360) 407-6768
Address: PO Box 47600, Olympia WA 98504-7600

Washington State Department of Ecology - www.ecy.wa.gov/

- Headquarters, Olympia (360) 407-6000
- Northwest Regional Office, Bellevue (425) 649-7000
- Southwest Regional Office, Olympia (360) 407-6300
- Central Regional Office, Yakima (509) 575-2490
- Eastern Regional Office, Spokane (509) 329-3400

This report was prepared by a licensed hydrogeologist. A signed and stamped copy of the report is available upon request.

Montesano Groundwater Investigation of Leaking Underground Storage Tanks

September 2008 and April 2009

by
Pamela B. Marti

Environmental Assessment Program
Washington State Department of Ecology
Olympia, Washington 98504-7710

Waterbody Number: WA-22-4040

This page is purposely left blank

Table of Contents

List of Figures and Tables

Page

Figures

Tables

Abstract

The surficial aquifer beneath downtown Montesano, Washington is contaminated with petroleum products.

The contamination is largely the result of releases from three identified source areas:

1. Tony's Short Stop/Grays Harbor Grange.
2. Whitney's Inc./Key Bank (Sterling Savings).
3. Brumfield-Twidwell.

To characterize the lateral extent of contamination, the Washington State Department of Ecology (Ecology) collected groundwater samples from 25 monitoring wells during September 2008 and 24 wells in April 2009. Samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX), total petroleum hydrocarbons as gasoline (TPH-G), and volatile organic compounds (VOCs).

The highest concentrations of gasoline-range petroleum hydrocarbons were detected in monitoring wells at or near the three source areas. BTEX and TPH-G concentrations were higher than allowable Model Toxic Control Act (MTCA) cleanup levels for groundwater. Benzene and TPH-G reached concentrations of 9,000 µg/L and 240,000 µg/L, respectively. Free-phase petroleum product observed in wells at the source areas continue to serve as a source of dissolved-phase contamination.

Chlorinated solvents were also detected in wells within the study area. Most VOC concentrations are near the reporting limits and are below MTCA cleanup levels for groundwater. Tetrachloroethene is consistently present in wells KBMW-1, GSMW-1, and GSMW-2. The presence of chlorinated compounds in the Key Bank and Grange wells suggests the possible presence of a VOC-contaminated plume in these parts of the study area.

Ecology also collected water samples from the city's storm drain and abandoned sanitary sewer to determine if these underground utilities were providing another contaminant migration pathway. Petroleum-related contaminants were detected. This is of concern since the storm drain empties into the Chehalis River system.

Because of the high concentrations of groundwater contamination and the potential for contaminants to continue to migrate from the source areas, additional investigations are being conducted to better define the nature and extent of the contamination. Some remediation has already been completed at Tony's Short Stop and Brumfield-Twidwell. Work on these projects is continuing.

This page is purposely left blank

Background

Site History

The near surface aquifer beneath downtown Montesano, Washington is contaminated with petroleum products, which includes the presence of light non-aqueous phase liquid (LNAPL) in the form of free-phase petroleum product. As discussed in previous reports (Marti, 2009, GeoEngineers, 2005), the contamination is largely the result of releases from three identified source areas (Figure 1):

1. Tony's Short Stop/Grays Harbor Grange
2. Whitney's Inc./Key Bank (Sterling)
3. Brumfield-Twidwell

The source areas which have created large areas of soil and groundwater contamination were identified through a combination of groundwater sampling by Ecology and investigations by GeoEngineers, Inc. In 2004 Ecology began an area-wide investigation using existing monitoring wells on properties with known releases of petroleum. The study area encompassed several blocks, primarily from Pioneer Avenue south along Main Street. Ecology sampled select wells semi-annually from 2004 through 2009.

Additional data was collected by GeoEngineers with the installation of new monitoring wells between the three source areas to monitor off-site contaminant migration (GeoEngineers, 2006). Ground penetrating radar was used to locate any remaining underground storage tanks at two of the source areas. Soil and groundwater samples were collected from direct push borings to determine if utility corridors were providing another migration pathway for the contaminants.

During the Ecology investigation, chlorinated solvents were also detected in groundwater at some of the well locations (Marti, 2006). Past or present activities within the study area that are potential sources of chlorinated solvents include auto repair and paint shops.

This report is the last in the Ecology series and presents groundwater data collected by Ecology in September 2008 and April 2009. Consultant investigations are underway at the identified source areas to better define the nature and extent of the contamination. Some remediation work has already been completed at Tony's Short Stop and Brumfield-Twidwell. Work on these projects is continuing.

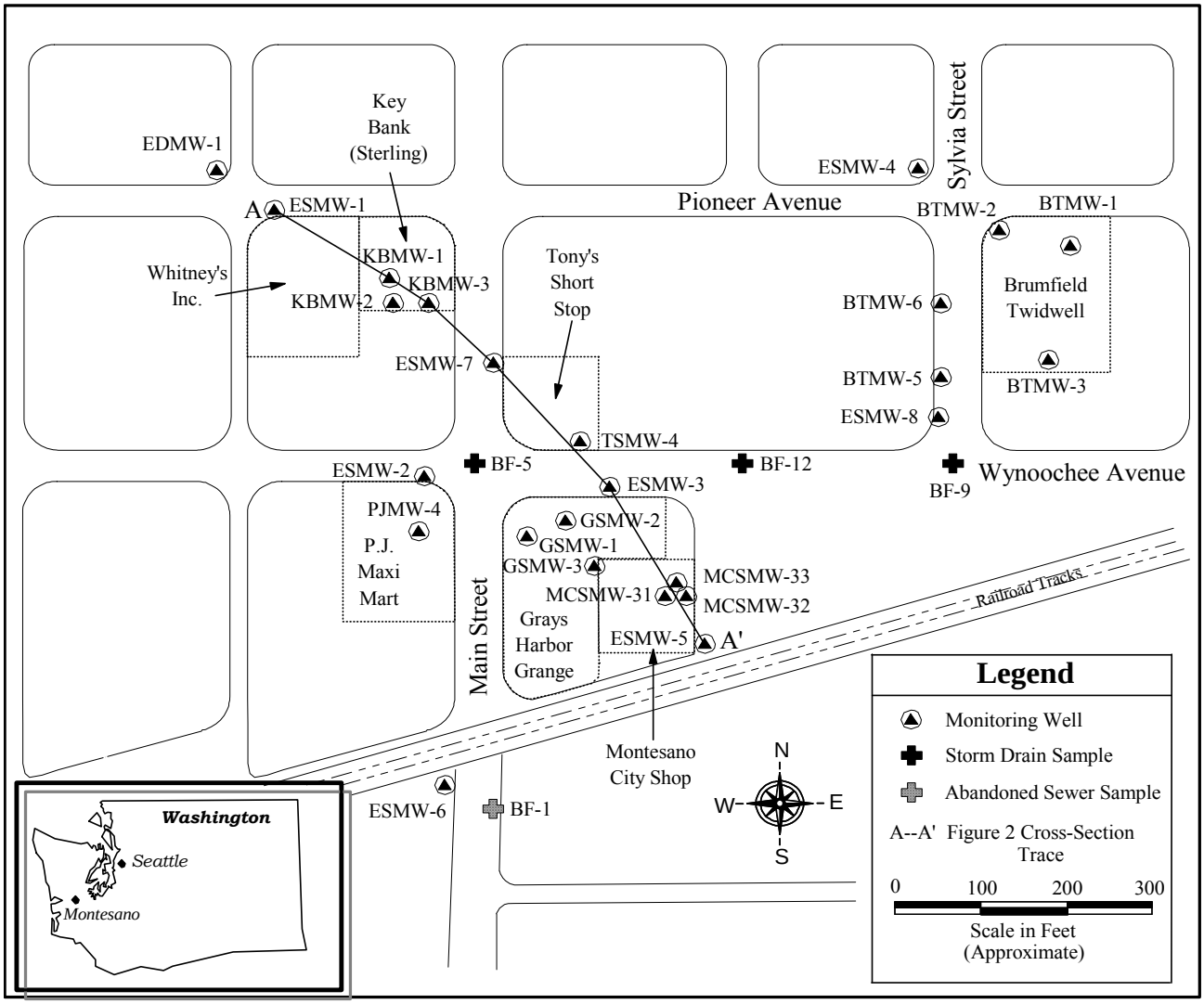


Figure 1. Montesano Groundwater Investigation Location and Site Map.

Setting/Physical Description

Downtown Montesano is situated on the north side of the Chehalis River valley. The ground surface in the study area generally slopes gently downhill (south-southeast) to the Chehalis River over a distance of about 3,000 feet. Figure 2 shows a generalized geologic cross-section of the study area as interpreted from area well logs.

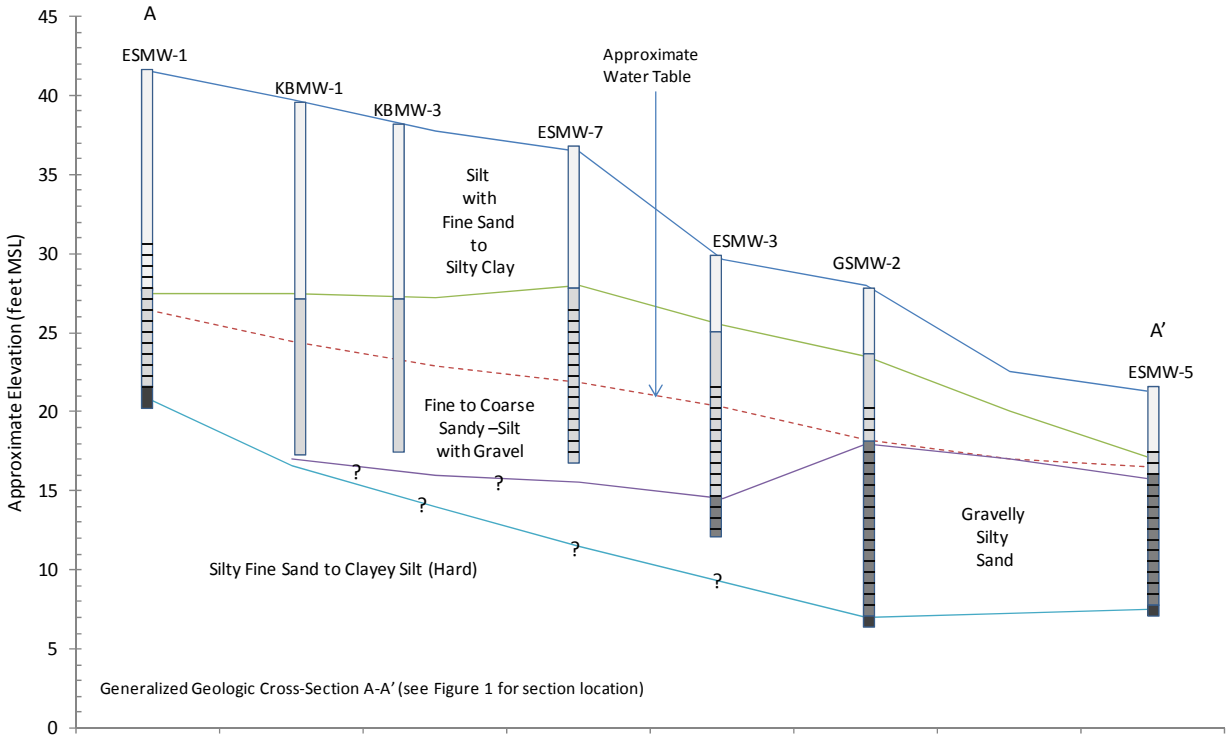


Figure 2. Interpreted Geologic Cross-Section of the Study Area.

The geology of the area is comprised mostly of alluvial deposits, consisting of unconsolidated to partly consolidated fluvial and glaciofluvial sand and gravels, with interbeds of clay and silt up to 20 feet thick. The uppermost unit consists of brown, moist, medium-dense silt with fine sand to medium-stiff silty clay. This is underlain by a brown, moist-to-wet, dense-to-very-dense fine sand with gravel which grades to a sandy gravel with interbeds of silty, sand layers. These layers are underlain by a gray-to-brown, medium-dense-to-dense, wet, gravelly silty sand unit. The alluvial deposits are underlain by a relatively impermeable silty fine sand or clayey silt unit of unknown thickness. Regional groundwater flow is to the south-southeast toward the Chehalis River. The water table occurs approximately 3 to 15 feet below the ground surface.

This page is purposely left blank

Methods

Groundwater Sampling

The primary contaminants of concern in the study area are gasoline-range hydrocarbons, which include benzene, toluene, ethylbenzene, and xylene (BTEX), as well as total petroleum hydrocarbons as gasoline (TPH-G). Ecology collected groundwater samples for BTEX and TPH-G analysis from 25 monitoring wells in September 2008 and from 24 wells in April 2009 (Figure 1). Samples were also collected and analyzed for 72 target volatile organic compounds (VOCs) from eight of the wells. These wells were selected based on their proximity to potential sources such as auto repair and paint shops.

The initial monitoring wells used in this study were installed on, or adjacent to, six sites with known releases: Tony's Short Stop, Grays Harbor Grange, Key Bank (Sterling), Brumfield-Twidwell, P.J. MaxiMart, and Montesano City Shop (Figure 1). The wells were installed between 1995 and 2006. These wells are constructed of either 2″ or 4″ PVC and range in depth from approximately 12 to 25 feet, with screen lengths of 10 and 15 feet.

In May 2006, Ecology installed nine additional wells throughout the study area to address data gaps in the existing monitoring network. The Ecology wells are constructed of 2″ PVC and range in depth from about 15 to 22 feet, with 10-foot screen lengths. Well construction details are provided in Appendix A.

Static water levels were measured in wells that did not have LNAPL using a calibrated Solinst water level meter prior to well purging and sampling. Measurements were recorded to 0.01 foot and are accurate to 0.03 foot. The probe was rinsed with deionized water between measurements. In wells known to be contaminated, the probe was washed with laboratory grade detergent and rinsed with deionized water.

Ecology purged and sampled most of the 25 monitoring wells using a Grundfos® Redi-Flo2 stainless steel submersible pump, using low-flow sampling techniques. The pump intake was placed at the mid-screen interval in each well, and purged and sampled at a pump rate of 0.5 to 1-liter/ minute. Wells were purged through a continuous flow cell until pH, specific conductance, dissolved oxygen, and temperature readings stabilized.

At the completion of purging, samples were collected directly from the dedicated pump discharge tubing into laboratory-supplied containers. The pump was decontaminated between each well by circulating laboratory-grade detergent/water through the pump followed by a clean water rinse, with each cycle lasting five minutes. Rinsate blanks were collected to determine if the field cleaning procedures were sufficient to prevent cross-contamination of samples from the sample equipment.

Because of the recurring presence of free-phase petroleum product in wells TSMW-4 at Tony's Short Stop, KBMW-2 at Key Bank (Sterling), and BTMW-2 at Brumfield-Twidwell, these wells were purged and sampled with decontaminated Teflon bailers. When free-phase petroleum product was present, the bailed thickness was measured. At the completion of purging, samples were transferred from the bailer to the laboratory-supplied bottles using a bottom-emptying, controlled flow assembly. The bailers had been pre-cleaned with a Liquinox® wash and sequential rinses of hot tap water, 10% nitric acid, deionized water, and pesticide-grade acetone. After cleaning, the bailers were air-dried and wrapped in aluminum foil.

Purge water from the wells was collected and stored in 55-gallon drums at a secure facility. Purge water is transported and disposed of in accordance with Washington State Dangerous Waste Regulations (Chapter 173-303 WAC).

Storm and Sewer Drain Sampling

In addition to the groundwater samples, Ecology collected water samples in April 2009 from the City of Montesano's storm drain and abandoned sanitary sewer system. Both of these drains appear to collect groundwater. To ensure the samples would be representative of groundwater leaking into the drains, samples were collected during periods of dry weather. Three samples were collected from manholes on the storm drain along Wynoochee Avenue, and one sample was collected from the abandoned sanitary sewer system on Main Street (Figure 1). Samples were not collected in September 2008 due to the rainy weather.

Samples from the storm and sewer drains were collected using pre-cleaned glass beakers that were lowered from manholes into the drain systems. The glass beakers were cleaned with a Liquinox® wash and sequential rinses of hot tap water, deionized water, and pesticide-grade acetone. After cleaning, the beakers were air-dried and wrapped in aluminum foil. Samples were transferred from the beakers into laboratory-supplied bottles. Water samples collected from the storm and sewer drains were analyzed for VOCs and TPH-G.

BTEX, TPH-G, and VOC samples were each collected free of headspace in three 40-mL glass vials with Teflon-lined septa lids and preserved with 1:1 hydrochloric acid. After sample collection and proper labeling, all samples were stored in ice-filled coolers. Samples were transported to Ecology's Operation Center in Lacey. Samples were kept in the walk-in cooler until taken by courier to Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Laboratory protocols (Ecology, 2005).

Laboratory

Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. Samples were analyzed for BTEX, TPH-G, and VOCs.

Table 1. Field and Laboratory Methods.

Field Measurements	Instrument Type	Method	Accuracy
Water Level	Solinst Water Level Meter	SOP EAP052	±0.03 feet
pH	Sentix® 41-3 probe[1]	EPA Method 150.1	±0.1 std. units
Dissolved Oxygen	VWR 4000 Dissolved Oxygen Meter	EPA Method 360.1	±0.3 mg/L
Specific Conductance	Tetracon® 325 probe[1]	EPA Method 120.1	±10 µmhos/cm
Temperature	Sentix® 41-3 probe[1]	EPA Method 150.1	±0.1 ºC
Laboratory Analytes	Method	Reference	Reporting Limit
BTEX	EPA SW-846 Method 8021B	EPA 1996	1 µg/L
TPH-G	TPH-Gx	Ecology 2003	0.14 mg/L
VOCs	EPA SW-846 Method 8260B	EPA 1996	1-5 µg/L

SOP = standard operating procedure.
EAP = Environmental Assessment Program.
EPA = U.S. Environmental Protection Agency.
[1] Probe used with a WTW multiline P4 meter.

This page is purposely left blank

Data Quality

Quality control samples collected in the field consisted of blind field duplicate samples and equipment rinsate blanks. Field duplicates were collected by splitting the pump discharge between two sets of sample bottles, which provides a measure of the overall sampling and analytical precision. Precision estimates are influenced not only by the random error introduced by collection and measurement procedures, but also by the natural variability of the concentrations in the media being sampled.

Field duplicates were collected from wells ESMW-1, ESMW-7, and ESMW-3 in September 2008 and April 2009. These wells were selected because they represent the range of concentrations found over the study area.

Tables 2 and 3 show results of the duplicate samples and the relative percent difference (RPD). RPD is calculated as the difference between sample results, divided by the mean and expressed as a percent.

Table 2. Relative Percent Difference (RPD) of Duplicate Sample Results (µg/L), September 2008.

Sample ID:	ES MW-1	ES MW-1A	RPD	ES MW-7	ES MW-7A	RPD	ES MW-3	ES MW-3A	RPD
	µg/L	µg/L	%	µg/L	µg/L	%	µg/L	µg/L	%
Benzene	11	13	17	232	261	12	8200	9600	16
Toluene	2	2.1	5	534	495	8	12,400	15,800	24
Ethylbenzene	17	16	6	648	679	5	1400	1500	7
m,p-xylene	3	2.5	18	2000	2000	0	4500	5100	12
o-xylene	0.5 J	0.48 J	--	682	642	6	1700	1900	11
TPH-G	210	220	5	16,000	15,000	6	84,000	42,000	67

J – Analyte was positively identified. The associated numerical result is an estimate.

Table 3. Relative Percent Difference (RPD) of Duplicate Sample Results (µg/L), April 2009.

Sample ID:	ES MW-1	ES MW-1A	RPD	ES MW-7	ES MW-7A	RPD	ES MW-3	ES MW-3A	RPD
	µg/L	µg/L	%	µg/L	µg/L	%	µg/L	µg/L	%
Benzene	12	9.3	25	300	310	3	3600	3600	0
Toluene	2.8	2.8	0	540	500	8	1200	1200	0
Ethylbenzene	40	40	0	700	720	3	340	340	0
m,p-xylene	2.8	2.3	20	1900	1900	0	1100	1100	0
o-xylene	1 U	1 U	--	520	520	0	220	220	0
TPH-G	760	770	1	15,000	15,000	0	9800	9400	4

U – Analyte was not detected at or above the reported value.

In September 2008, duplicate samples were collected from wells ESMW-1, ESMW-7, and ESMW-3. The RPD for the September results were good and ranged from 0% to 24%, with the exception of the TPH-G analysis for well ESMW-3. Although the RPD is outside the data quality objectives, high concentration of other petroleum constituents in the duplicate samples indicates that TPH-G is present. Therefore, an average TPH-G concentration of the duplicate samples will be used in the remainder of this report and will be "J" qualified as estimated.

In April 2009, duplicate samples were also collected from wells ESMW-1, ESMW-7, and ESMW-3. The RPDs for the April results were good and ranged from 0% to 25%.

Results from wells with free-phase petroleum product should be used with caution since past duplicate results from these wells have had high RPDs. Because of the uncertainty introduced by the presence of a LNAPL, data from wells where free-phase petroleum product was encountered have been "J" qualified. This includes the September 2008 data from wells BTMW-2 and KBMW-2, as well as the September 2008 and April 2009 data from well TSMW-4.

Rinsate blanks were also collected in the field to determine if field cleaning procedures were sufficient to prevent cross-contamination of samples from the sample equipment. Rinsate blanks were collected by pumping deionized water through the submersible pump after the pump had been cleaned. BTEX and TPH-G were not detected in any of the rinsate blanks.

The September 2008 and April 2009 data met the measurement quality objectives established in the Quality Assurance Project Plan (Marti, 2004) and are considered good and usable as qualified.

A review of the data quality control and quality assurance from laboratory case narratives indicates that overall analytical performance was good. The reviews include descriptions of analytical methods, holding times, instrument calibration checks, blank results, surrogate recoveries, and laboratory control samples. No major problems were reported that compromised the usefulness or validity of the sample results; therefore, all results are usable as qualified. Quality assurance case narratives and laboratory reporting sheets are available upon request.

All field measurements and analytical result data are available in electronic format from Ecology's EIM data management system: www.ecy.wa.gov/eim/index.htm. Search study ID, PMART004.

Results

Field Observations

Field measurements were taken at each site to assess groundwater conditions prior to and during well purging. Samples were collected after field parameter readings stabilized. Field parameters measured included depth-to-water, pH, dissolved oxygen, specific conductance, and total purge volume. These values are listed in Table 4.

Temperature measurements were collected for comparative purposes and have not been included in Table 4. Because temperatures measured in a flow cell are influenced by ambient air conditions, they are not considered to be representative of in-situ groundwater conditions.

Completion depths for the monitoring wells range from approximately 12 to 25 feet. Depth-to-groundwater below the land surface ranged from about 6 to 18 feet in September 2008 and about 5 to 16 feet in April 2009.

During the monitoring period, groundwater pH averaged 6.3. Dissolved oxygen measurements from most of the wells in September were low, < 0.8 mg/L, suggesting anaerobic or reducing conditions. Specific conductance measurements had a mean range of 104 to 1096 µmhos/cm. Groundwater temperatures measured in the flow cell averaged 16.3ºC in September and 14.5ºC in April. The higher temperatures in September are partly influenced by the warmer ambient air.

While purging at the lowest flow possible, water levels dropped in well KBMW-3, ESMW-1, ESMW-2, ESMW-3, ESMW-6, ESMW-7, and EDMW-1 during both sample rounds.

In September 2008, free-phase petroleum product was present in water bailed from Tony's Short Stop well TSMW-4, Key Bank (Sterling) well KBMW-2, and Brumfield-Twidwell well BTMW-2. Free-phase petroleum product was also present in water bailed from well TSMW-4 in April 2009. Although there was no discernible petroleum product present in wells BTMW-2 and KBMW-2 in April, the purge water did have a strong petroleum odor and a visible sheen on the surface. Approximate product thickness as measured in the bailer is listed in Table 4.

Table 4. Summary of Field Parameter Results, September 2008 and April 2009.

Well Sample ID	Total Depth (feet)[1]	Depth-to-Water Below Ground Surface (feet)		Water Table Elevation (feet msl)		pH (standard units)		Dissolved Oxygen (mg/L)		Specific Conductance (umhos/cm)		Purge Volume (gallons)	
		9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
Brumfield-Twidwell													
BTMW-1	23.30	14.98	11.65	22.62	25.95	6.5	6.0	0.54	--	112	96	4	5
BTMW-2	24.9	Product (~2")	12.30	--	25.53	--	--	--	--	--	--	3	3
BTMW-3	22.28	12.79	11.36	17.58	19.01	6.3	6.1	0.4	--	188	215	4.5	4
BTMW-5	24	14.30	14.09	16.40	16.61	6.5	6.2	0.61	--	150	153	4	5
BTMW-6	24	14.21	12.22	20.23	22.22	6.4	6.0	0.31	--	193	198	4	5
Whitney's Inc./ Key Bank (Sterling)													
KBMW-1	21.97	17.88	15.69	21.84	24.03	6.3	5.7	0.33	--	214	201	4	6
KBMW-2	20.16	Product (~0.5")	14.56	--	23.94	--	--	--	--	--	--	3	3
KBMW-3	20.17	16.60	14.79	21.08	22.89	6.5	6.2	--	--	392	524	3.5[(2)]	5[(2)]
P.J. MaxiMart													
PJMW-4	20	12.77	NS	18.41	NS	5.9	NS	0.48	NS	174	NS	4	NS
Tony's Short Stop													
TSMW-4	--	Product (~2")	Product (~0.25")	--	--	--	--	--	--	--	--	3	3
Grays Harbor Grange													
GSMW-1	22.7	11.09	10.22	17.15	18.02	6.2	5.8	0.71	--	260	248	4	4
GSMW-2	21.74	11.01	10.12	16.91	17.80	6.3	5.9	0.29	--	236	255	4.5	6
GSMW-3	17.73	7.28	6.46	15.75	16.57	6.4	6.5	0.33	--	348	399	4	7
Montesano City Shop													
MCSMW-31	12.50	6.26	5.44	15.13	15.95	6.5	6.4	0.32	--	349	355	4	4.5
MCSMW-32	12.50	6.98	6.16	14.91	15.73	6.3	6.3	0.34	--	292	280	3.5	4.5
MCSMW-33	12.11	7.43	6.66	15.07	15.84	6.3	5.7	0.33	--	352	297	4	5.5
Ecology Wells													
ESMW-1	20.08	17.23	15.29	24.28	26.22	6.5	6.2	0.33	--	181	197	4[(2)]	4[(2)]
ESMW-2	19.68	12.67	11.60	20.05	21.12	6.3	6.2	2.2	--	163	159	4.5[(2)]	5[(2)]
ESMW-3	17.53	10.71	9.63	18.85	19.93	6.4	6.2	1.08	--	373	350	3[(2)]	3.5[(2)]
ESMW-4	20.09	16.08	11.97	21.94	26.05	5.6	5.6	6.4	--	110	108	4.5	6
ESMW-5	14.73	6.17	5.31	15.04	15.90	6.4	6.2	0.36	--	331	262	4	5.5
ESMW-6	14.70	9.80	9.33	12.90	13.37	6.8	6.8	0.38	--	1068	1123	2.5[(2)]	2.5[(2)]
ESMW-7	19.53	15.96	14.69	20.49	21.76	6.6	6.2	--	--	281	345	2.5[(2)]	5[(2)]
ESMW-8	15.10	10.12	9.67	15.33	15.78	6.5	6.3	0.45	--	197	182	4.5	5
EDMW-1	22.61	15.60	13.82	26.71	28.49	6.8	6.6	0.69	--	193	192	4[(2)]	5[(2)]

-- Not measured. [1] Measured from top of casing. [2] Water level dropped while purging.
Product: Free-phase petroleum product present in the groundwater with approximate bailed thickness.
NS – Not sampled.

A groundwater flow pattern for the study area for April 2009 is shown in Figure 3. The approximate location of the water-table contours was determined using a geostatistical gridding method known as kriging. The groundwater flow direction is approximately perpendicular to the contours. The overall flow direction appears to be to the south and southeast, toward the Chehalis River.

There are multiple factors in the study area that may affect water level measurements and should be taken into consideration. These include (1) the presence of free-phase petroleum product in or near wells KBMW-2, BTMW-2, and TSMW-4, (2) a vapor extraction system operating at P.J. MaxiMart, (3) excavation and removal of contaminated soils and the subsequent placement of clean backfill at Tony's Short Stop and Brumfield-Twidwell, and (4) the possible influence of the storm drain and abandoned sewer systems which appear to collect groundwater.

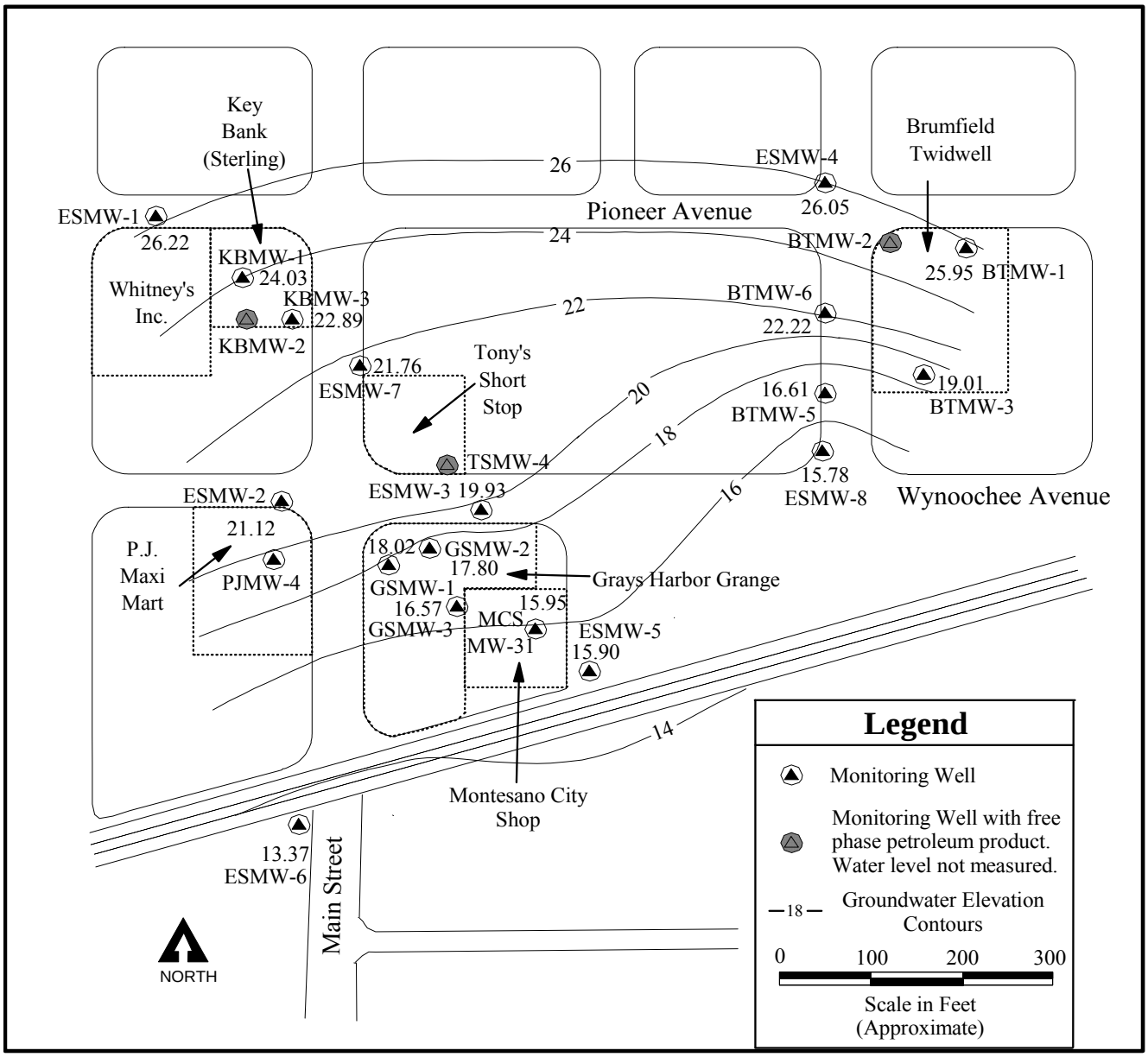


Figure 3. Water Table Elevation (feet) in the Study Area, April 2009.

Analytical Results

Analytical results, as well as MTCA cleanup levels for groundwater, for BTEX and TPH-G are summarized in Tables 5, 7, 9, and 11. For comparison, a summary of project data collected by Ecology since 2004 is presented in Appendix B. These data are also presented as graphs for select wells to illustrate seasonal variations in groundwater elevations and contaminant concentrations. Volatile organic results for September 2008 and April 2009 are summarized in Tables 6, 8, 10, 12, and 13. The tables list volatile organic compounds which have been detected since Ecology began collecting VOC samples in 2005. Project data for select volatile organics are also presented in Appendix C.

Project results have been separated into sections representing the three contaminant source areas, as identified in a previous study (GeoEngineers, 2005): Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell. Tables 11 and 12 present results for the remaining wells, which include wells at P.J. MaxiMart, Montesano City Shop, and the nine Ecology wells. Results are presented graphically in Figures 4 and 5. Table 13 presents results for the storm and sewer drain samples.

Tony's Short Stop/Grays Harbor Grange

The highest concentrations of petroleum-related contamination in the study area were detected in groundwater samples collected from monitoring well TSMW-4 at Tony's Short Stop. Well TSMW-4, which continues to have free-phase petroleum product in the groundwater, had BTEX and TPH-G concentrations which exceeded the MTCA Method A cleanup levels (Table 5).

Table 5. BTEX and TPH-G Results (µg/L) for Tony's Short Stop and Grays Harbor Grange, September 2008 and April 2009.

Analyte:	Benzene		Toluene		Ethylbenzene		m,p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
Tony's Short Stop												
TSMW-4	**9100 J**	**8700 J**	**34,800 J**	**40,000 J**	**5000 J**	**6200 J**	**18,700 J**	**22,000 J**	**6900 J**	**8500 J**	**199,000 J**	**240,000 J**
Grays Harbor Grange												
GSMW-1	**1.1**	**7.9**	1 U	1 U	1 U	1 U	2 U	**10**	1 U	1 U	140 U	**150**
GSMW-2	**91**	**80**	1 U	1 U	1 U	**2.1**	2 U	2 U	1 U	1 U	140 U	140 U
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.
J – Analyte was positively identified. The associated numerical result is an estimate.
U – Analyte was not detected at or above the reported value.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.
Underline – Free-phase petroleum product was present.

Monitoring wells at the Grays Harbor Grange, GSMW-1 and GSMW-2, had much lower BTEX and TPH-G concentrations. Benzene concentrations exceeded the cleanup level in well GSMW-2 in September 2008 and both wells in April 2009.

Samples for VOCs were also collected from wells GSMW-1 and GSMW-2 during this monitoring period. VOC samples were collected from these wells because of the possible historical use of Tony's Short Stop as a service station and other possible upgradient sources. Table 6 is a summary of those results.

Table 6. Summary of VOC Results (µg/L) for Grays Harbor Grange, September 2008 and April 2009.

Volatile Organic Compounds	GSMW-1		GSMW-2	
	9/08	4/09	9/08	4/09
Tetrachloroethene	**0.4 J**	**0.98 J**	**0.62 J**	**1.5**
Trichloroethene	1 U	1 U	1 U	1 U
Cis-1,2-Dichloroethene	1 U	1 U	1 U	1 U
Trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U
Vinyl Chloride	5 U	1 U	5 U	1 U
1,1-Dichloroethane	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	**0.79 J**
1,2-Dichloroethane	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	1 U	1 U	1 U	1 U
Benzene	1 U	**9.3**	**93**	**110**
Toluene	1 U	1 U	1 U	1 U
Ethylbenzene	1 U	1 U	1 U	**3.5**
m,p-Xylene	**0.5 J**	**11**	2 U	**0.81 J**
o-Xylene	1 U	1 U	1 U	1 U
Isopropylbenzene (Cumene)	**1.3**	**3.8**	**0.49 J**	**1.5**
n-Propylbenzene	**3**	**6.2**	**0.76 J**	**3.2**
1,3,5-Trimethylbenzene	1 U	1 U	1 U	1 U
Tert-Butylbenzene	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	**4**	**19**	1 U	**4.6**
Sec-Butylbenzene	**0.26 J**	**0.86 J**	1 U	1 U
p-Isopropyltoluene	1 U	1 U	1 U	1 U
n-Butylbenzene	1 U	1 U	1 U	1 U
Naphthalene	2 U	**2.2**	2 U	**1.4**

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.

Tetrachloroethene continues to be detected in wells GSMW-1 and GSMW-2 at concentrations near or below the practical quantitation limit (Table 6 and Appendix C).

m,p-Xylene was detected in the September VOC sample from well GSMW-1 and the April VOC sample from well GSMW-2 at concentrations below the practical quantitation limit of 2 µg/L. These two analytes were not detected in the BTEX analysis.

Whitney's Inc./Key Bank (Sterling)

Monitoring well KBMW-2, located at Key Bank (Sterling), also had high concentrations of BTEX and TPH-G in the groundwater samples (Table 7). In September 2008, free-phase petroleum product was present in groundwater from this well. Product is typically found in this well when depth-to-water is greater than 15 feet below ground surface. BTEX and TPH-G concentrations exceeded the MTCA cleanup levels during both sample rounds, with the exception of ethylbenzene in April. Benzene and TPH-G concentrations in well KBMW-3 also exceeded the cleanup levels during both sample rounds. BTEX and TPH-G concentrations in well KBMW-3 tend to increase in the fall, at the end of the dry season, when groundwater levels are lower (Appendix B). Benzene concentrations in well KBMW-1 continue to be detected and exceed the cleanup level in the spring (wet season) samples.

Table 7. BTEX and TPH-G Results (µg/L) for Key Bank (Sterling), September 2008 and April 2009.

Analyte:	Benzene		Toluene		Ethylbenzene		m,p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
KBMW-1	1 U	**6**	1 U	1 U	1 U	1 U	2U	2 U	1 U	1 U	140 U	140 U
KBMW-2	**436 J**	**240**	**3700 J**	**3000**	**804 J**	**570**	**2500 J**	**1900**	**1100 J**	**860**	**31,000 J**	**23,000**
KBMW-3	**62**	**24**	**26**	**19**	**284**	**71**	**514**	**120**	**145**	**59**	**6700**	**2100**

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.
Underline – Free-phase petroleum product was present.

Samples were also collected for VOCs from two of the Key Bank (Sterling) wells (Table 8). The Key Bank site is located next to Whitney's Inc., which has an auto repair and painting shop. In 2003, Ecology found that waste solvents and waste oil were being stored at the Whitney's in on-site fuel storage tanks. The tanks were decommissioned and cleaned. Chlorinated solvents have been detected in wells located on the Key Bank (Sterling) property (Ecology, 2007).

Table 8. Summary of VOC Results (µg/L) for Monitoring Wells at Key Bank (Sterling), September 2008 and April 2009.

Volatile Organic Compounds	KBMW-1		KBMW-3	
	9/08	4/09	9/08	4/09
Tetrachloroethene	**0.32 J**	**4**	1 U	1 U
Trichloroethene	1 U	1 U	1 U	1 U
Cis-1,2-Dichloroethene	1 U	1 U	**4.4**	**5**
Trans-1,2-Dichloroethene	1 U	1 U	1 U	1 U
Vinyl Chloride	5 U	1 U	5 U	**0.6 J**
1,1-Dichloroethane	1 U	1 U	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	1 U	1 U
4-Methyl-2-Pentanone	1 U	1 U	1 U	1 U
Benzene	1 U	**6.4**	**45**	**23**
Toluene	1 U	1 U	**21**	**21**
Ethylbenzene	1 U	1 U	**261**	**63**
m,p-Xylene	2 U	1 U	**502**	**110**
o-Xylene	1 U	1 U	**155**	**56**
Isopropylbenzene (Cumene)	1 U	**0.97 J**	**32**	**11**
n-Propylbenzene	1 U	1 U	**65**	**19**
1,3,5-Trimethylbenzene	1 U	1 U	**78**	**18**
Tert-Butylbenzene	1 U	1 U	1 U	1 U
1,2,4-Trimethylbenzene	1 U	1 U	**400**	**59**
Sec-Butylbenzene	**0.88 J**	**1.1**	**6.9**	**5.6**
p-Isopropyltoluene	1 U	1 U	**3.8**	**1.6**
n-Butylbenzene	**0.2 J**	**0.48 J**	**8.4**	**4.5**
Naphthalene	2 U	1 U	**200**	**53**

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.

In addition to other petroleum-related contaminants, some chlorinated compounds – such as tetrachloroethene and cis-1,2-dichloroethene – were detected in wells KBMW-1 and KBMW-3 (Table 8). Vinyl chloride was detected for the first time in the April sample from well KBMW-3 at a concentration that exceeds the 0.2 µg/L MTCA Method A cleanup level for groundwater.

Acetone was identified in the September 2008 sample from well KBMW-3 at a concentration of 23 ug/L. It was also tentatively identified in the April 2009 sample from well KBMW-3 at a concentration of 16 ug/L. Acetone has been detected periodically in the three Key Bank (Sterling) wells during the project period of 2005 to 2009. Acetone is a common cleaning fluid used in a variety of industries. It is also as a common laboratory solvent.

The September naphthalene concentration in well KBMW-3 also exceeded the MTCA Method A cleanup level of 160 µg/L.

Brumfield-Twidwell

Of the five wells sampled at the Brumfield-Twidwell site, monitoring wells BTMW-2 and BTMW-6 continue to contain BTEX and TPH-G in the groundwater samples (Table 9). Free-phase petroleum product was present in groundwater in well BTMW-2 in September 2008. BTEX and TPH-G concentrations for the September sample were the highest reported for this well since Ecology began monitoring in 2004, whereas concentrations for the April sample were the lowest reported for this well. Of the petroleum-related contaminants detected in well BTMW-6, benzene and TPH-G exceeded the cleanup levels in April 2009. As shown in Table 9 and Appendix B, ethylbenzene and m-& p-xylene concentrations in well BTMW-6 increase significantly in samples collected during the wet season when groundwater levels are higher.

Table 9. BTEX and TPH-G Results (µg/L) for Brumfield-Twidwell, September 2008 and April 2009.

Analyte:	Benzene		Toluene		Ethylbenzene		m,p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-2	**3500 J**	1 U	**11,000 J**	**1.6**	**2700 J**	**11**	**12,700 J**	**53**	**4300 J**	**22**	**146,000 J**	7000 U
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-5	1 U	**1.5**	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
BTMW-6	**2.3**	**7**	**2.4**	**9.6**	**21**	**210**	**37**	**200**	**0.98 J**	**3.5**	**380**	**2400**

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.
Underline – Free-phase petroleum product was present.

Well BTMW-6 was also sampled for VOCs during both sample rounds. VOCs had been detected in site soils during excavation and removal activities in 2006, and low concentrations of 1,2-dichloroethane were detected in groundwater samples from this well in March 2007. No chlorinated compounds were detected in this well during this 2008-09 monitoring period (Table 10).

Table 10. Summary of VOC Results (µg/L) for Brumfield-Twidwell, September 2008 and April 2009.

Volatile Organic Compounds	BTMW-6	
	9/08	4/09
Tetrachloroethene	1 U	1 U
Trichloroethene	1 U	1 U
Cis-1,2-Dichloroethene	1 U	1 U
Trans-1,2-Dichloroethene	1 U	1 U
Vinyl Chloride	5 U	1 U
1,1-Dichloroethane	1 U	1 U
1,1,1-Trichloroethane	1 U	1 U
1,2-Dichloroethane	1 U	1 U
4-Methyl-2-Pentanone	1 U	1 U
Benzene	**0.88 J**	**3.3**
Toluene	**1.5**	**9.9**
Ethylbenzene	**24**	**230**
m,p-Xylene	**38**	**210**
o-Xylene	1 U	**8.4**
Isopropylbenzene (Cumene)	**5**	**29**
n-Propylbenzene	**8.6**	**78**
1,3,5-Trimethylbenzene	**4.4**	**50**
Tert-Butylbenzene	1 U	1 U
1,2,4-Trimethylbenzene	**16**	**100**
Sec-Butylbenzene	1 U	**3.1**
p-Isopropyltoluene	1 U	**2**
n-Butylbenzene	1 U	**3.3**
Naphthalene	**9.9**	**59**

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.

Remaining Wells

Samples were also collected from the nine Ecology wells in addition to wells located at P.J. MaxiMart and Montesano City Shop in September 2008 and April 2009. Because the MaxiMart site has had additional groundwater monitoring as part of remedial activities, only well PJMW-4 was sampled. Analytical results for the remaining wells for this monitoring period are shown in Tables 11 and 12.

Table 11. BTEX and TPH-G Results (µg/L) for Ecology Wells, P.J. MaxiMart, and Montesano City Shop, September 2008 and April 2009.

Analyte:	Benzene		Toluene		Ethylbenzene		m,p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
Ecology Wells												
ESMW-1	**11**	**12**	**2**	**2.8**	**17**	**40**	**3**	**2.8**	**0.5 J**	1 U	**210**	**760**
ESMW-2	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-3	**8200**	**3600**	**12,400**	**1200**	**1400**	**340**	**4500**	**1100**	**1700**	**220**	**63,000 J**	**9800**
ESMW-4	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-5	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-6	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
ESMW-7	**232**	**300**	**534**	**540**	**648**	**700**	**2000**	**1900**	**682**	**520**	**16,000**	**15,000**
ESMW-8	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
EDMW-1	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
P.J. MaxiMart												
PJMW-4	**1.9**	--	**25**	--	**53**	--	**260**	--	**150**	--	**2200**	--
Montesano City Shop												
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-32	1 U	1 U	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
MCSMW-33	**59**	1 U	**1.8**	1 U	1 U	1 U	2 U	2 U	1 U	1 U	**190**	140 U

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.
Shade - Values are greater than MTCA cleanup levels.

Elevated concentrations of petroleum-related contaminants were detected in three of the Ecology wells: ESMW-1, ESMW-7, and ESMW-3. Groundwater cleanup levels were exceeded for benzene in well ESMW-1. This well is near the intersection of Pioneer Avenue and 1st Street, where Whitney's Inc. is located. Historically, gasoline was stored and sold from this corner of the business. In 1995, three underground storage tanks were closed in place. Soil samples taken at the time showed high levels of BTEX (Ecology, 2007).

Well ESMW-7 is located along Main Street near the northwest corner of the Tony's Short Stop property. BTEX and TPH-G were detected in this well in both September 2008 and April 2009, exceeding the MTCA cleanup levels, with the exception of toluene and ethylbenzene in September.

BTEX and TPH-G cleanup levels were also exceeded in well ESMW-3 in both September 2008 and April 2009, with the exception of ethylbenzene in April. This well is located along Wynoochee Avenue, between Tony's Short Stop and Grays Harbor Grange. This well is less than 100 feet downgradient from well TSMW-4 which had free-phase petroleum product. With the exception of well TSMW-4, well ESMW-3 has the highest benzene concentrations in the study area.

BTEX and TPH-G were detected in the September 2008 sample from well PJMW-4 at the P.J. MaxiMart site (Table 11). Only TPH-G exceeded the cleanup level. This well was not sampled in April due to maintenance of the on-site vapor extraction system at the time of sampling.

Of the three wells sampled at the Montesano City Shop, petroleum-related contaminants were only detected in well MCSMW-33 (Table 11). Benzene was detected above the cleanup level in September along with low concentrations of TPH-G.

Samples for VOCs were collected from Ecology wells ESMW-1, ESMW-3, and ESMW-7 (Table 12). VOC samples were collected from these wells because the wells are located near properties where chlorinated solvents have been detected in the past.

Tetrachloroethene was detected in the September sample from well ESMW-1 at an estimated concentration of 0.36 µg/L. This is the first occurrence of tetrachloroethene in this well since VOC sampling began in March 2007.

High concentrations of petroleum contaminants in wells ESMW-3 and ESMW-7 in September 2008 caused the practical quantitation limits for the VOC analysis to range from 100 to 1000 µg/L. Chlorinated compounds were not detected in either of these wells during this sample round. However, cis-1,2-dichloroethene and 1,2-dichloroethane were detected in well ESMW-7 in April 2009 (Table 12). 1,2-dichloroethane exceeded the MTCA cleanup level of 5 µg/L. Naphthalene also exceeded the MTCA cleanup level of 160 µg/L in well ESMW-7 during both sample rounds.

Acetone was identified in the September 2008 sample from well ESMW-1 (10 µg/L), as well as the April 2009 samples from wells ESMW-3 (87 µg/L J) and ESMW-7 (36 µg/L NJ). Acetone had previously been tentatively identified in these wells in April 2008.

BTEX and TPH-G results for the three source areas, P.J. MaxiMart, Montesano City Shop, and the nine Ecology wells, are shown in Figures 4 and 5. Figure 4 shows BTEX concentrations for the study area for September 2008 and April 2009. Figure 5 shows TPH-G concentrations for the same time period. Concentration graphs on the two figures have been plotted using a logarithmic scale to accommodate the wide range of concentrations present in the study area.

Table 12. Summary of VOC Results (µg/L) for Three Ecology Wells, September 2008 and April 2009.

Volatile Organic Compounds	ESMW-1		ESMW-3		ESMW-7	
	9/08	4/09	9/08	4/09	9/08	4/09
Tetrachloroethene	**0.36 J**	1 U	200 U	1 U	100 U	1 U
Trichloroethene	1 U	1 U	200 U	1 U	100 U	1 U
Cis-1,2-Dichloroethene	1 U	1 U	200 U	1 U	100 U	**1.1**
Trans-1,2-Dichloroethene	1 U	1 U	200 U	1 U	100 U	1 U
Vinyl Chloride	5 U	1 U	1000 U	1 U	500 U	1 U
1,1-Dichloroethane	1 U	1 U	200 U	1 U	100 U	1 U
1,1,1-Trichloroethane	1 U	1 U	200 U	1 U	100 U	1 U
1,2-Dichloroethane	1 U	1 U	200 U	1 U	100 U	**6.5**
4-Methyl-2-Pentanone	1 U	1 U	200 U	1 U	100 U	1 U
Benzene	**9.1**	**5.6**	**7600**	**4300**	**218**	**260**
Toluene	**1.6**	**1.8**	**9120**	**2100**	**461**	**420**
Ethylbenzene	**19**	**40**	**1030**	**490**	**659**	**620**
m,p-Xylene	**1.9 J**	**2.1**	**3350**	**1400**	**1990**	**1600**
o-Xylene	1 U	**0.51 J**	**1140**	**360**	**682**	**480**
Isopropylbenzene (Cumene)	**2.6**	**7.9**	200 U	**50**	100 U	**59**
n-Propylbenzene	**6.2**	**22**	200 U	**110**	**34 J**	**100**
1,3,5-Trimethylbenzene	1 U	1 U	200 U	**68**	**103**	**110**
Tert-Butylbenzene	1 U	1 U	200 U	1 U	100 U	1 U
1,2,4-Trimethylbenzene	**1.2**	**21**	**460**	**390**	**576**	**540**
Sec-Butylbenzene	**0.68 J**	**2.8**	200 U	1 U	100 U	**9.4**
p-Isopropyltoluene	1 U	1 U	200 U	**1.1**	100 U	**6**
n-Butylbenzene	**0.41 J**	**1.1**	200 U	**4.1**	100 U	**15**
Naphthalene	**0.29 J**	**31**	**44 J**	**68**	**324**	**430**

U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.

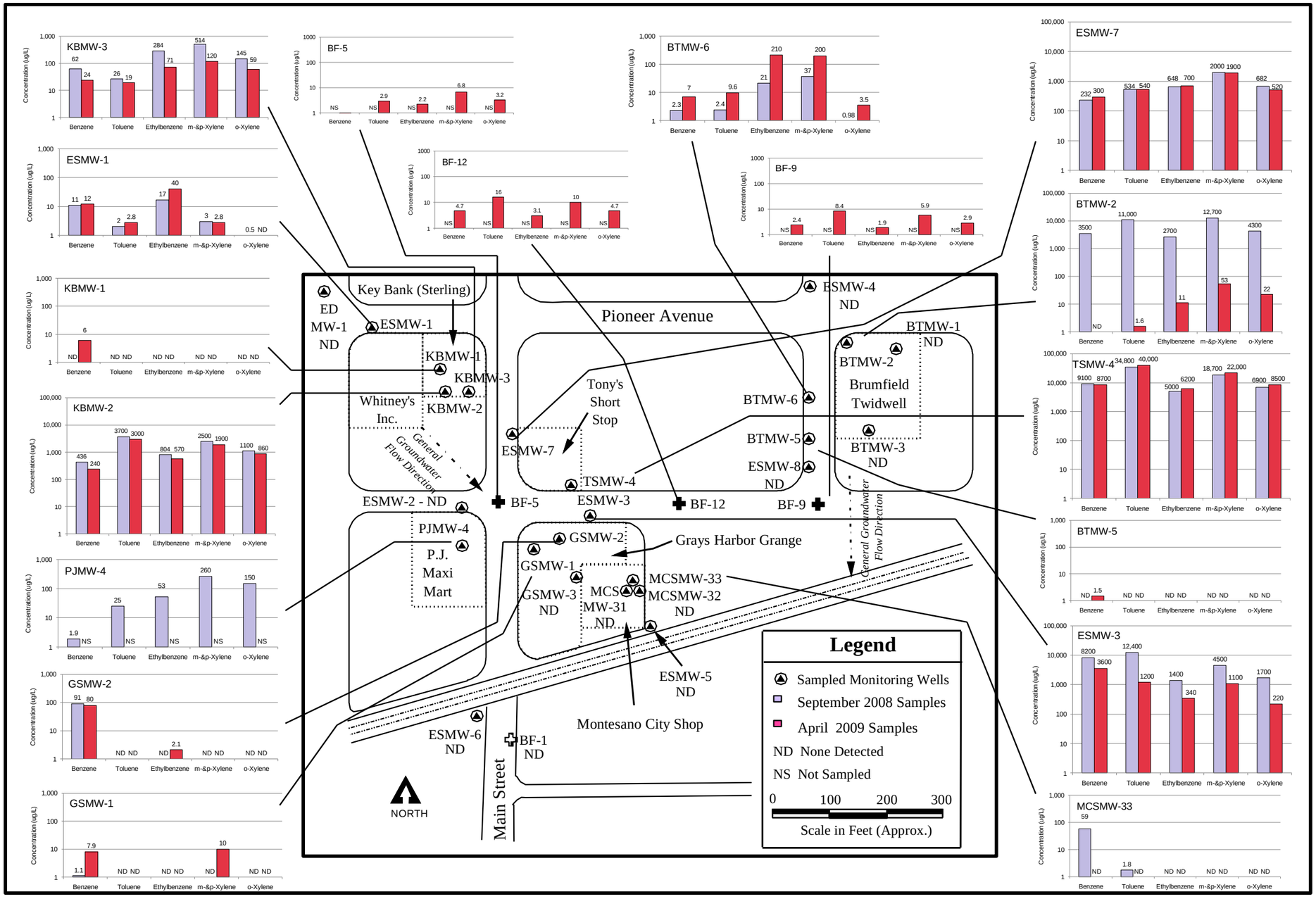


Figure 4. BTEX Results (ug/L- log scale), September 2008 and April 2009.

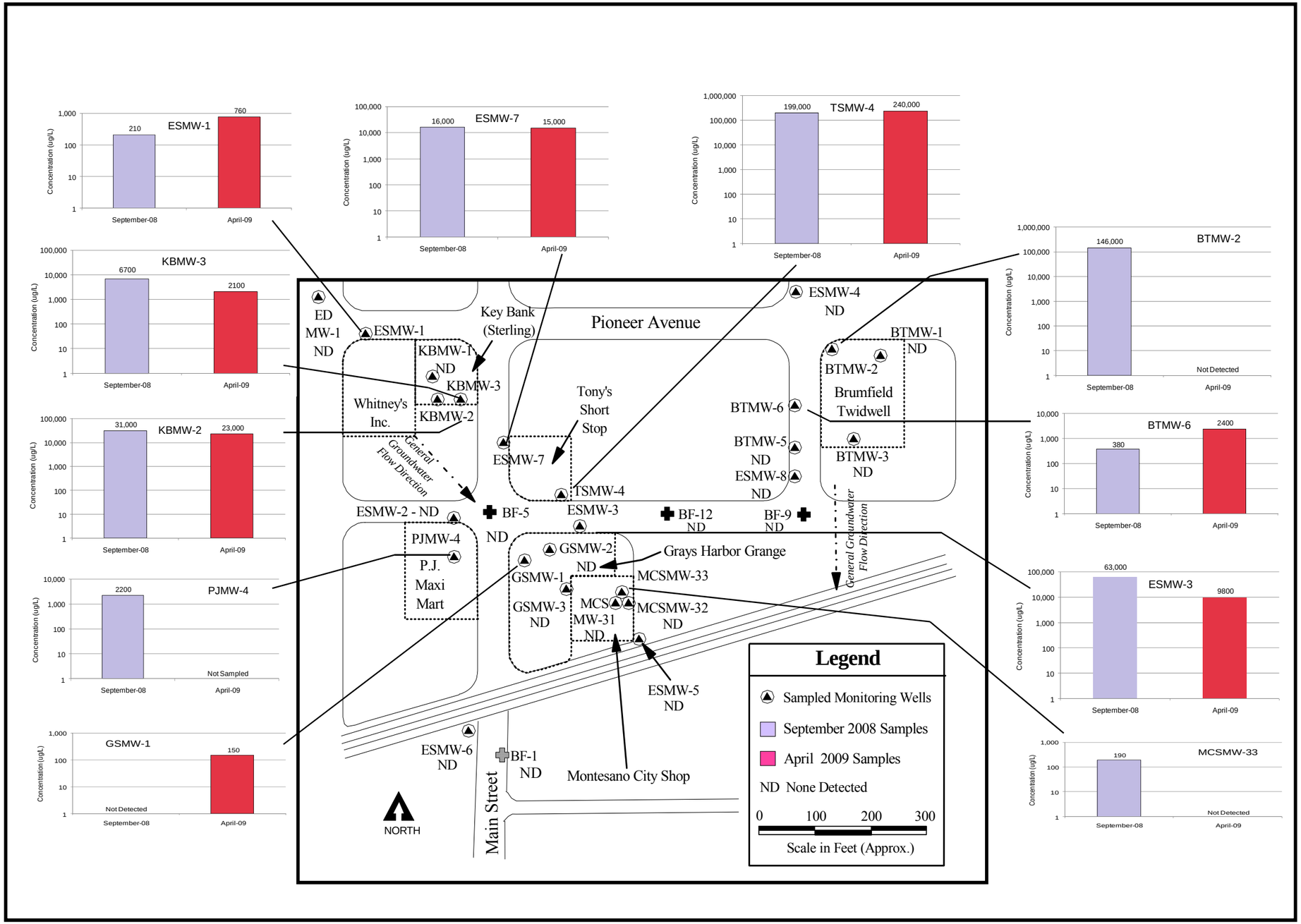


Figure 5. TPH-G Results (ug/L- log scale), September 2008 and April 2009.

Storm and Sewer Drains

Water samples were collected from the City of Montesano's storm drain and abandoned sanitary sewer system to determine if these underground utility corridors are providing preferential pathway for the migration of the contaminated groundwater. Samples were collected in April 2009 and analyzed for VOCs and TPH-G (Table 13). For comparison, BTEX and TPH-G results from past sample events are included in the Appendix B tables.

Table 13. Summary of VOC and TPH-G Sample Results (µg/L) for the City of Montesano Storm Drain and Abandoned Sanitary Sewer, April 2009.

Volatile Organic Compounds	BF-1		BF-5		BF-12		BF-9	
	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
Tetrachloroethene	--	1 U	--	1 U	--	1 U	--	1 U
Trichloroethene	--	1 U	--	1 U	--	1 U	--	1 U
Cis-1,2-Dichloroethene	--	1 U	--	1 U	--	1 U	--	1 U
Trans-1,2-Dichloroethene	--	1 U	--	1 U	--	1 U	--	1 U
Vinyl Chloride	--	1 U	--	1 U	--	1 U	--	1 U
1,1-Dichloroethane	--	1 U	--	1 U	--	1 U	--	1 U
1,1,1-Trichloroethane	--	1 U	--	1 U	--	1 U	--	1 U
1,2-Dichloroethane	--	1 U	--	1 U	--	1 U	--	1 U
4-Methyl-2-Pentanone	--	1 U	--	1 U	--	1 U	--	1 U
Benzene	--	1 U	--	**0.63 J**	--	**4.7**	--	**2.4**
Toluene	--	1 U	--	**2.9**	--	**16**	--	**8.4**
Ethylbenzene	--	1 U	--	**2.2**	--	**3.1**	--	**1.9**
m & p-Xylene	--	1 U	--	**6.8**	--	**10**	--	**5.9**
o-Xylene	--	1 U	--	**3.2**	--	**4.7**	--	**2.9**
Isopropylbenzene (Cumene)	--	1 U	--	1 U	--	1 U	--	1 U
n-Propylbenzene	--	**0.67 J**	--	1 U	--	1 U	--	1 U
1,3,5-Trimethylbenzene	--	1 U	--	**1**	--	**0.75 J**	--	**0.56 J**
Tert-Butylbenzene	--	1 U	--	1 U	--	1 U	--	1 U
1,2,4-Trimethylbenzene	--	1 U	--	**2.2**	--	**1.8**	--	**1.1**
Sec-Butylbenzene	--	1 U	--	1 U	--	1 U	--	1 U
p-Isopropyltoluene	--	1 U	--	1 U	--	1 U	--	1 U
n-Butylbenzene	--	**0.46 J**	--	1 U	--	1 U	--	1 U
Naphthalene	--	1 U	--	**0.92 J**	--	**0.84 J**	--	**0.69 J**
TPH-G	--	140 U	--	140 U	--	140 U	--	140 U

-- Not Sampled.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.

Three samples were collected from the storm drain along Wynoochee Avenue, and one sample was collected from the abandoned sanitary sewer system on Main Street (Figure 1). Water in the storm drain along Wynoochee Avenue flows west to east. Sample BF-5 was collected from the manhole at the intersection of Main Street and Wynoochee Avenue. Sample BF-12 was collected from the manhole east of well ESMW-3. Sample BF-9 was collected from the manhole at the intersection of Wynoochee Avenue and Sylvia Street. The manhole at this intersection accesses the storm drain along Wynoochee Avenue and a north-south storm drain along Sylvia Street.

Petroleum-related contaminants were detected primarily in the samples collected from the storm drain along Wynoochee Avenue. Contaminant concentrations were higher in samples collected from station BF-12 which is located approximately 200 feet east of wells TSMW-4 and ESMW-3. TPH-G was not detected in any of the storm drain samples.

As with some of the monitoring wells, acetone was identified at estimated concentration (2.5 µg/L) in storm drain sample BF-9. Acetone was used in the cleaning procedures of the beakers used to collect the water samples from the storm drains.

One sample (BF-1) was collected from the abandoned sanitary sewer on south Main Street. n-Propylbenzene and n-Butylbenzene were detected in the April sample, but at concentrations below the practical quantitation limit of 1 µg/L. TPH-G was not detected in this sample.

Discussion

Petroleum Contamination

High concentrations of gasoline-range petroleum hydrocarbons are present throughout the near surface aquifer underlying downtown Montesano. LNAPL in the form of free-phase petroleum product is present at the three identified source areas: Tony's Short Stop, Whitney's/Key Bank (Sterling), and Brumfield-Twidwell.

Table 14 provides a summary of those wells where BTEX and TPH-G concentrations exceeded MTCA groundwater cleanup levels in September 2008 and April 2009. Analytical results are discussed, along with past project data for comparison. Project data collected by Ecology since 2004 is presented as tables and graphs in Appendices B and C. Figure 6 shows estimated TPH-G concentration contours in groundwater for the 2008-09 monitoring period.

Table 14. BTEX and TPH-G Concentrations (µg/L) that Exceeded MTCA Method A Cleanup Levels for Groundwater during September 2008 and April 2009.

Analyte:	Benzene		Toluene		Ethylbenzene		m,p-Xylene		o-Xylene		WTPH-G	
MTCA Cleanup Level:	5 µg/L		1000 µg/L		700 µg/L		1000 µg/L				800 (1000*) µg/L	
Date:	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09	9/08	4/09
Tony's Short Stop												
TSMW-4	**9100 J**	**8700 J**	**34,800 J**	**40,000 J**	**5000 J**	**6200 J**	**18,700 J**	**22,000 J**	**6900 J**	**8500 J**	**199,000 J**	**240,000 J**
Grays Harbor Grange												
GSMW-1	**1.1**	**7.9**	1 U	1 U	1 U	1 U	2 U	**10**	1 U	1 U	140 U	**150**
GSMW-2	**91**	**80**	1 U	1 U	1 U	**2.1**	2 U	2 U	1 U	1 U	140 U	140 U
Whitney's Inc./Key Bank (Sterling)												
KBMW-1	1 U	**6**	1 U	1 U	1 U	1 U	2 U	2 U	1 U	1 U	140 U	140 U
KBMW-2	**436 J**	**240**	**3700 J**	**3000**	**804 J**	**570**	**2500 J**	**1900**	**1100 J**	**860**	**31,000 J**	**23,000**
KBMW-3	**62**	**24**	**26**	**19**	**284**	**71**	**514**	**120**	**145**	**59**	**6700**	**2100**
Brumfield-Twidwell												
BTMW-2	**3500 J**	1 U	**11,000 J**	**1.6**	**2700 J**	**11**	**12,700 J**	**53**	**4300 J**	**22**	**146,000 J**	7000 U
BTMW-6	**2.3**	**7**	**2.4**	**9.6**	**21**	**210**	**37**	**200**	**0.98 J**	**3.5**	**380**	**2400**
Ecology Wells												
ESMW-1	**11**	**12**	**2**	**2.8**	**17**	**40**	**3**	**2.8**	**0.5 J**	1 U	**210**	**760**
ESMW-3	**8200**	**3600**	**12,400**	**1200**	**1400**	**340**	**4500**	**1100**	**1700**	**220**	**63,000 J**	**9800**
ESMW-7	**232**	**300**	**534**	**540**	**648**	**700**	**2000**	**1900**	**682**	**520**	**16,000**	**15,000**
Montesano City Shop												
MCSMW-33	**59**	1 U	**1.8**	1 U	1 U	1 U	2 U	2 U	1 U	1 U	**190**	140 U

* MTCA Method A cleanup level for TPH-G is 1,000 µg/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.
Underline – Free-phase petroleum product was present.

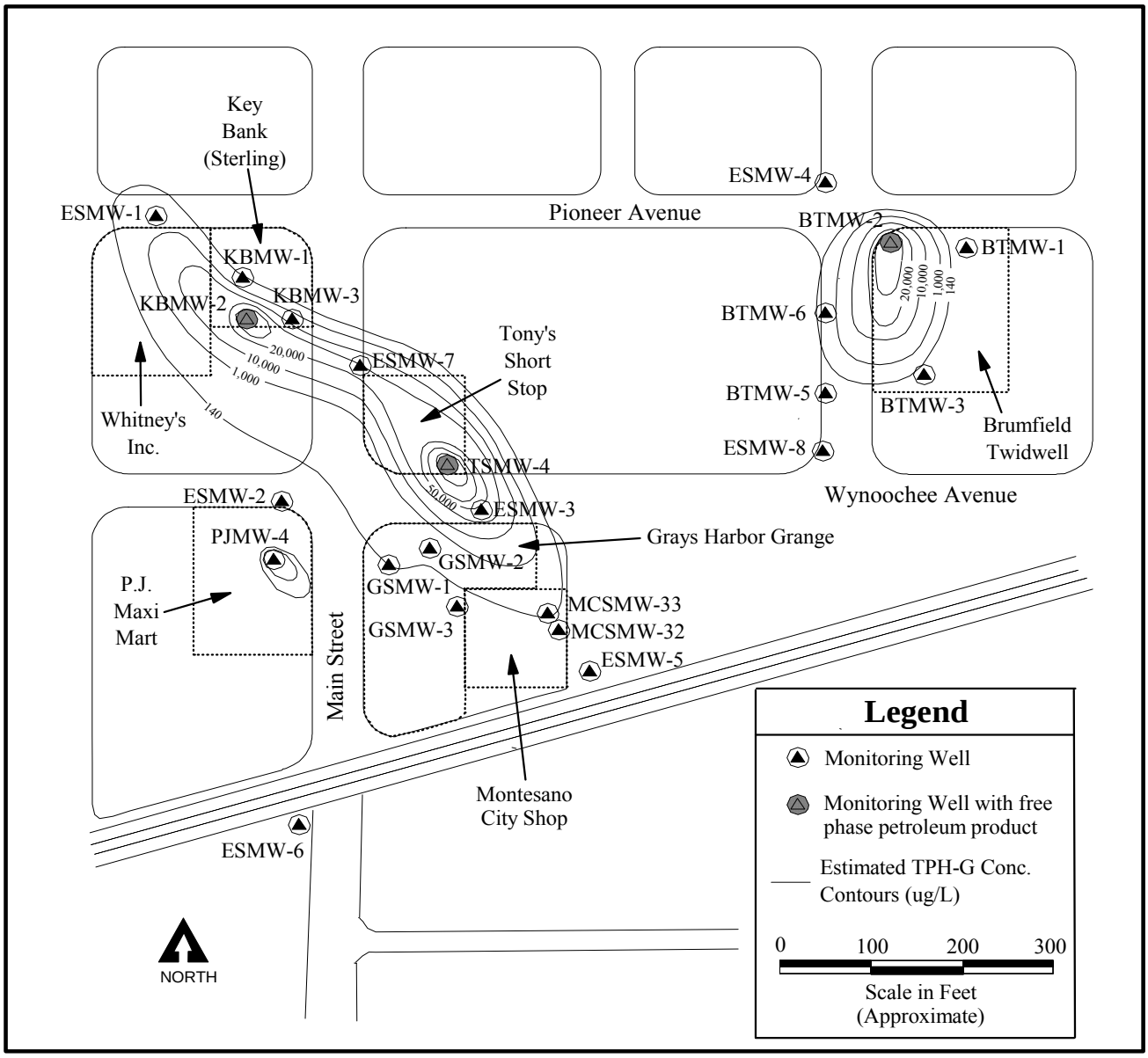


Figure 6. Estimated Dissolved TPH-G Groundwater Concentration Contours (µg/L).

Well ESMW-1 at the northwest corner of Whitney's Inc. confirms that the shallow groundwater is contaminated with petroleum products in this part of the study area. Historically gasoline was stored and sold from this corner of the business. Soil contamination was discovered in this area when three underground tanks were closed in place in 1995 (Ecology, 2007). At this time, Ecology has not established any other potential sources in the area other than Whitney's Inc.

Groundwater flow direction in this part of the study area appears to be to the southeast, suggesting that the three wells located at Key Bank (Sterling) are downgradient of Whitney's Inc. Free-phase petroleum product has been present in well KBMW-2 since Ecology began monitoring in October 2004. The presence of LNAPL appears to depend on the groundwater elevation in the well. The LNAPL continues to serve as a source area for the dissolved-phase

plume. Consequently, high concentrations of BTEX and TPH-G are detected in well KBMW-3. Benzene has also been detected seasonally in well KBMW-1 at concentrations above the cleanup level (Appendix B).

Well ESMW-7 was installed to provide information between two of the identified source areas, Whitney's Inc. and Tony's Short Stop. BTEX and TPH-G concentrations detected in this well are consistently above the MTCA cleanup levels. Since well ESMW-7 appears to be located upgradient of the primary source of fuel contamination at Tony's Short Stop, it is likely that contamination from Whitney's Inc. has migrated to this part of the study area.

The primary source of fuel contamination at Tony's Short Stop was identified during a remedial investigation in 2006. During removal of the old tanks in May 2006, contractors encountered free product on the north edge of the excavation pit where the old product line trench was located. It was concluded that the primary source of contamination at the site appeared to be the old product lines located approximately in the middle of the property (AEG, 2007). Well TSMW-4 is downgradient of the former tanks and lines. Free-phase petroleum product has been present in this well during each monitoring event, and BTEX and TPH-G concentrations continue to be the highest detected in the study area. The LNAPL at this location also continues to serve as a source area for a dissolved-phase plume.

Well ESMW-3, located along Wynoochee Avenue, is less than 100 feet downgradient from well TSMW-4 which has free-phase petroleum product. BTEX and TPH-G concentrations in this well were also some of the highest detected in the study area. Contamination from the former lines and tank area at Tony's Short Stop appears to have migrated off-site as indicated by contaminant concentrations in well ESMW-3 (Appendix B).

Since monitoring began in October 2004, wells GSMW-1 and GSMW-2, which appear to be downgradient of Tony's Short Stop, have had much lower BTEX and TPH-G concentrations as compared to wells TSMW-2, TSMW-4, and ESMW-3. However, benzene concentrations in well GSMW-2 have consistently exceeded the MTCA cleanup levels since monitoring began in October 2004.

The wells located at Montesano City Shop also appear to be hydraulically downgradient of Tony's Short Stop/Grays Harbor Grange (Marti, 2006). Two wells, MCSMW-32 and MCSMW-33, had elevated benzene concentrations when monitoring began in 2004 (Appendix B). Since then, benzene concentrations have decreased considerably in these wells. The continued presence of low concentrations of benzene and TPH-G in well MCSMW-33, and the absence of contaminants in downgradient wells MCSMW-32 and ESMW-5, possibly suggest the front edge of the contaminated plume.

The presence of LNAPL and related high BTEX and TPH-G concentrations at Whitney's/ Key Bank (Sterling) and Tony's Short Stop , along with groundwater flow direction in this part of the study area, suggest that petroleum contamination from these two source areas have co-mingled to form a large plume across downtown Montesano. It is possible that the plume extends from monitoring well ESMW-1 to as far as well MCSMW-33 at Montesano City Shop.

BTEX and TPH-G concentrations in Brumfield-Twidwell well BTMW-2 also continue to be among the highest in the study area. Free-phase petroleum product has been present in groundwater from this well since October 2006. Free-phase petroleum product was present in this well in September 2008, and the associated BTEX and TPH-G concentrations were the highest reported for this well since Ecology began monitoring in 2004. The LNAPL continues to serve as a source area for a dissolved-phase plume. Since Ecology began monitoring, activities at this site have included the removal of several underground storage tanks and contaminated soil, as well as the construction of a new building at the location of the former Brumfield-Twidwell building.

BTEX and TPH-G have also been detected in well BTMW-6, indicating that petroleum contamination may be migrating from the Brumfield-Twidwell site. Well BTMW-6 is located west of Brumfield-Twidwell and is near the storm drain that runs down Sylvia Street. Based on petroleum contaminants detected in samples from station BF-9 and the mapped groundwater contours, it appears that the storm drain is influencing groundwater flow in this portion of the study area. The storm drain is possibly acting as a hydraulic barrier to contaminant migration to the west, but also as a possible preferential pathway for contaminants to the south in the storm drain. Specialized sampling of the system upgradient from station BF-9 is planned to determine if this site is contributing contaminants to the storm system.

With the exception of the April 2008 results, the BTEX and TPH-G concentrations in well PJMW-4 at P.J. MaxiMart have had a decreasing trend since monitoring began in October 2004. This site is being remediated with a vapor extraction system.

In April 2009, water samples were collected from the City of Montesano's storm drain and abandoned sanitary sewer system to determine if these underground utility corridors are providing a preferential pathway for the contaminant migration. Petroleum-related contaminants were primarily detected in the samples collected from the storm drain along Wynoochee Avenue. The presence of petroleum-related contaminants in storm drain samples collected during dry weather suggests that contaminated groundwater is entering the storm drain.

One sample was collected from the abandoned sanitary sewer on south Main Street. Petroleum-related contaminants continue to be detected in samples from this location, but at concentrations below the practical quantitation limit.

The presence of contaminants in the city's storm drain and abandoned sewer system indicate that these utilities may be providing preferential pathways for contaminants. This is of concern since the storm drain empties into the Chehalis River system.

Chlorinated Compound Contamination

Chlorinated compounds have been detected in some wells in the study area, primarily at Key Bank (Sterling) and Grays Harbor Grange. Most VOC concentrations are near or below the laboratory practical quantitation limits. VOC data are presented in Appendix C.

Tetrachloroethene was detected for the first time in well ESMW-1 at a concentration below the practical quantitation limit of 1 µg/L. This well is located adjacent to Whitney's Inc. which has an auto repair and paint shop. It was reported in 2003 that waste solvents and waste oil were being improperly stored in underground tanks on the site (Ecology, 2007).

Tetrachloroethene continues to be detected in samples collected from well KBMW-1 at concentrations near the MTCA cleanup level of 5 µg/L. Vinyl chloride was detected for the first time in the April 2009 sample from well KBMW-3 at an estimated concentration of 0.6 µg/L; this exceeds the MTCA cleanup up level of 0.2 µg/L. Other chlorinated compounds detected in the Key Bank (Sterling) wells include trichloroethene, cis-1,2-dichloroethene, 1,2-dichloroethane, and trans-1,2-dichloroethene. These wells are also located adjacent to Whitney's Inc. The presence of these chlorinated solvents in these wells suggests a VOC-contaminated plume is present in this portion of the study area.

Low concentrations of some chlorinated compounds, such as cis-1,2-dichloroethene and 1,2-dichloroethane, have been detected in well ESMW-7. Well ESMW-7 appears to be located hydraulically between Whitney's Inc./Key Bank (Sterling) and Tony's Short Stop. The presence of chlorinated solvents in this well suggests the possible migration of a VOC-contaminated plume.

Tetrachloroethene also continues to be detected in wells GSMW-1 and GSMW-2 at concentrations near the practical quantitation limit of 1 µg/L. These wells are downgradient of Whitney's Inc. and Tony's Short Stop. In the past, solvents may have been used at Tony's Short Stop when it was a service station. Chlorinated compounds have not been detected in wells TSMW-2 or TSMW-4. However, because of the high petroleum contaminant concentrations in these wells, the laboratory reporting limits have been high and may have masked low levels of other organic compounds.

This page is purposely left blank

Conclusions and Recommendations

Conclusions

Water quality results over the 2008-09 monitoring period confirm that the near surface aquifer is contaminated with gasoline-range petroleum hydrocarbons throughout the study area. The contaminants present at the various sites are believed to have come from leaking tanks and piping over time.

Analytical data show that the highest contaminant concentrations remain in the vicinity of three source areas: Tony's Short Stop/Grays Harbor Grange, Whitney's Inc./Key Bank (Sterling), and Brumfield-Twidwell. The presence of free-phase petroleum product in the areas of wells TSMW-4, KBMW-2, and BTMW-2 continues to serve as sources of dissolved-phase contamination.

Petroleum contamination from Whitney's/Key Bank (Sterling) and Tony's Short Stop has possibly co-mingled to form a large plume across downtown Montesano. Groundwater flow direction in this part of the study area appears to be to the southeast. The contaminated plume may extend from Whitney's Inc. to as far as the Montesano City Shop.

The presence of chlorinated compounds in the wells at Whitney's Inc./Key Bank, Ecology well ESMW-7, and the Grange wells GSMW-1 and GSMW-2 also suggests the possible presence of a VOC-contaminated plume in these parts of the study area.

Petroleum-related contaminants were also detected in water samples collected from the city's storm drain and abandoned sanitary sewer. The presence of contaminants in the storm drain and sewer system indicates that these utilities may be providing preferential pathways for contaminants. This is of concern since the storm drain empties into the Chehalis River system.

Because of the level of the groundwater contamination, investigations continue to be conducted at the three source areas to better define the nature and extent of the contamination across the study area.

Recommendations

Based on the results of this 2008-2009 monitoring, the following recommendations are provided:

- Investigations should continue at the three source areas –Tony's Short Stop, Whitney's Inc., and Brumfield-Twidwell – to determine the extent of the free-phase petroleum product and the associated contaminated plumes. Areas of the LNAPLs should be removed or remediated because they continue to serve as sources for dissolved-phase contamination.
- Additional investigation is needed at the Whitney's/Key Bank (Sterling) site to determine the source of the chlorinated compounds and the extent of the contamination. The existing monitoring wells may not be deep enough to adequately characterize the VOC plume.

Deeper wells may need to be installed because chlorinated compounds are dense non-aqueous phase liquids (DNAPLs).

- Additional wells east and southeast of well ESMW-3 should be installed to better define the southern portion of the contaminated plume.
- The storm drain appears to be providing another contaminant migration pathway. Because the storm drain discharges to the Chehalis River system, samples should be collected at the pipe discharge or as close to the discharge point as possible.

References

References Cited

AEG (Associated Environmental Group), 2007. Supplemental Remedial Investigation, Tony's Short Stop 326 Main St., Montesano Washington. #05-228.

Ecology, 2005. Manchester Environmental Laboratory - Lab Users Manual. Eighth edition. Washington State Department of Ecology, Manchester, WA.

Ecology, 2007. Whitney's Chevrolet Fact Sheet, Montesano, June 2007. Washington State Department of Ecology, Olympia, WA. Publication No. 07-09-121. www.ecy.wa.gov/biblio/0709121.html.

EPA, 1996. Test Methods for Evaluating Solid Waste, SW-846. Office of Emergency Response, U.S. Environmental Protection Agency, Washington D.C. www.epa.gov/SW-846/pdfs/0100.pdf.

GeoEngineers, 2005. Groundwater Investigation - Downtown Montesano, Montesano, Washington. File No. 0504-024-00. August 5, 2005. Prepared for Washington State Department of Ecology, Olympia, WA.

GeoEngineers, 2006. Additional Groundwater Investigation - Downtown Montesano, Montesano, Washington. File No. 0504-024-01. March 20, 2006. Prepared for Washington State Department of Ecology, Olympia, WA.

Marti, Pamela, 2004. Quality Assurance Project Plan: Montesano Groundwater Investigation of Leaking Underground Storage Tank Sites. Washington State Department of Ecology, Olympia, WA. Publication No. 04-03-114. www.ecy.wa.gov/biblio/0403114.html.

Marti, Pamela, 2006. Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2004 and March 2005. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-008. www.ecy.wa.gov/biblio/0603008.html.

USGS, 2006. National Field Manual for the Collection of Water-Quality Data - Chapter 4 Collection of Water Samples. Section 6.2 Dissolved Oxygen. U.S. Geological Survey.

Other References

AEG (Associated Environmental Group), 2003a. Quarterly Monitoring Report for Montesano Farm and Home, Montesano, Washington. #23-122-01.

AEG (Associated Environmental Group), 2003b. Quarterly Monitoring Report for 301 E. Pioneer Ave, Montesano, Washington. #22-241-01.

Landau Associates, 2004. Well Installation and Groundwater Sampling Activities, Time Oil Site #01-392, Montesano Washington.

Marti, Pamela, 2007. Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2005 and March 2006. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-004. www.ecy.wa.gov/biblio/0703004.html.

Marti, Pamela, 2008. Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2006 and March 2007. Washington State Department of Ecology, Olympia, WA. Publication No. 08-03-011. www.ecy.wa.gov/biblio/0803011.html.

Marti, Pamela, 2009. Montesano Groundwater Investigation of Leaking Underground Storage Tanks, October 2007 and April 2008. Washington State Department of Ecology, Olympia, WA. Publication No. 09-03-011. www.ecy.wa.gov/biblio/0903011.html.

Appendices

This page is purposely left blank

Appendix A. Well Construction Details

Table A-1. Well Construction Details.

Well #	Latitude (degrees)	Longitude (degrees)	Completed Well Depth (feet)	Casing Diameter (inches)	Tag/ Rim Elevation (feet)	PVC Elevation	Groundwater Level (feet bls)	Water Table Elevation (feet msl)	Groundwater Level (feet bls)	Water Table Elevation (feet msl)
							September 2008		April 2009	
BTMW-1	46-58-46.108	-123-35-52.159	23.30	2	37.60	37.39	14.98	22.62	11.65	25.95
BTMW-2	46-58-46.112	-123-35-53.435	24.9	2	37.83	37.44	Product	--	12.30	25.53
BTMW-3	46-58-44.489	-123-35-53.040	22.28	2	30.37	30.08	12.79	17.58	11.36	19.01
BTMW-5	46-58-44.220	-123-35-54.600	24	2	30.70	30.30	14.30	16.40	14.09	16.61
BTMW-6	46-58-45.156	-123-35-54.600	24	2	34.44	34.04	14.21	20.23	12.22	22.22
KBMW-1	46-58-45.2164	-123-36-04.770	21.97	2	39.72	39.37	17.88	21.84	15.69	24.03
KBMW-2	46-58-44.7979	-123-36-04.798	20.16	2	38.50	38.17	Product	--	14.56	23.94
KBMW-3	46-58-44.7976	-123-36-03.698	20.17	2	37.68	37.31	16.60	21.08	14.79	22.89
PJMW-4	46-58-41.867	-123-36-04.117	20	4	31.18	30.97	12.77	18.41	--	--
TSMW-4	46-58-43.186	-123-36-00.973	--	2	--	--	Product	--	Product	--
GSMW-1	46-58-41.866	-123-36-02.078	22.70	2	28.24	27.95	11.09	17.15	10.22	18.02
GSMW-2	46-58-42.094	-123-36-01.187	21.74	2	27.92	27.29	11.01	16.91	10.12	17.80
GSMW-3	46-58-41.248	-123-36-00.713	17.73	2	23.03	22.60	7.28	15.75	6.46	16.57
MCSMW-31	46-58-41.127	-123-35-59.462	12.42	2	21.39	21.17	6.26	15.13	5.44	15.95
MCSMW-32	46-58-41.176	-123-35-59.107	11.87	2	21.89	21.43	6.98	14.91	6.16	15.73
MCSMW-33	46-58-41.342	-123-35-59.344	12.11	2	22.50	22.34	7.43	15.07	6.66	15.84
ESMW-1	46-58-45.9498	-123-36-06.84437	20.08	2	41.51	41.14	17.23	24.28	15.29	26.22
ESMW-2	46-58-42.5028	-123-36-03.7656	19.68	2	32.72	32.32	12.67	20.05	11.60	21.12
ESMW-3	46-58-42.5726	-123-36-00.46377	17.53	2	29.56	29.27	10.71	18.85	9.63	19.93
ESMW-4	46-58-46.4124	-123-35-54.6567	20.09	2	38.02	37.66	16.08	21.94	11.97	26.05
ESMW-5	46-58-40.4508	-123-35-58.0532	14.73	2	21.21	20.85	6.17	15.04	5.31	15.90
ESMW-6	46-58-38.6616	-123-36-03.46933	14.70	2	22.70	22.31	9.80	12.90	9.33	13.37
ESMW-7	46-58-44.2068	-123-36-02.65674	19.53	2	36.45	35.96	15.96	20.49	14.69	21.76
ESMW-8	46-58-43.1724	-123-35-54.4704	15.10	2	25.45	25.20	10.12	15.33	9.67	15.78
EDMW-1	46-58-46.5780	-123-36-07.7976	22.61	2	42.31	41.92	15.60	26.71	13.82	28.49

VERTICAL DATUM: N.A.V.D. '88.
HORIZONTAL DATUM: NAD '83/'91.
bls = below land surface.
feet msl = feet relative to mean sea level.

This page is purposely left blank

Appendix B. BTEX and TPH-G Results, October 2004 to April 2009

Table B-1. BTEX and TPH-G Results (µg/L), October 2004 to April 2009.

Analyte:	Benzene									
MTCA Cleanup Level:	5 ug/L									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	10 U	10 U	1 U	1 U	**1.1**	**1.4**	1 U	25 U	**1.9**	--
PJMW-6	1 U	5 U	1 U	1 U	--	--	--	--	--	--
PJMW-7	**0.92 J**	1 U	1 U	1 U	--	--	--	--	--	--
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-2	**75**	20 U	**48**	**170**	**155 J**	**405 J**	1 U [a]	10 U	**3500 J**	1 U
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-5	--	--	--	--	1 U	**1.8**	1 U	**1.6**	1 U	**1.5**
BTMW-6	--	--	--	--	1 U	**14**	**7**	**14**	**2.3**	**7**
KBMW-1	1 U	**2.2**	1 U	**12**	1 U	**48**	1 U	**16**	1 U	**6**
KBMW-2	--	**338**	**510**	**360**	**360**	**850**	**520**	**274**	**436 J**	**240**
KBMW-3	**160**	**118**	**220**	**56**	R	**40**	**86** [a]	**20 J**	**62**	**24**
TSMW-2	**8500**	--	**8400**	--	**2600**	--	--	--	--	--
TSMW-4	--	--	--	--	--	**28,300**	**11,600**	**13,800**	**9100 J**	**8700 J**
GSMW-1	**5.1**	10 U	**420**	1 U	**51**	1 U	1 U	**11**	**1.1**	**7.9**
GSMW-2	**54**	**140**	**54**	**394**	**140**	**120**	**18**	**51**	**91**	**80**
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-32	1 U	1 U	**149**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-33	**980 J**	**1500**	**294**	1 U	**67**	**3**	**2.2**	1 U	**59**	1 U
ESMW-1	--	--	--	--	**25**	**49**	**11**	**16**	**11**	**12**
ESMW-2	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-3	--	--	--	--	**4900**	**8300**	**14,300** [a]	**5000**	**8200**	**3600**
ESMW-4	--	--	--	--	1 U	**3.1**	1 U	1 U	1 U	1 U
ESMW-5	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-6	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-7	--	--	--	--	**640**	**290**	**648** [a]	**789**	**232**	**300**
ESMW-8	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
EDMW-1	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
BF-1	--	--	--	--	--	**0.21 J**	1 U	**0.39 J**	--	1 U
BF-5	--	--	--	--	--	--	1 U	**1.3**	--	**0.63 J**
BF-12	--	--	--	--	--	**64**	1 U	**8.7**	--	**4.7**
BF-9	--	--	--	--	--	**39**	1 U	**4.5**	--	**2.4**

Table B-1 (continued).

Analyte:	Toluene									
MTCA Cleanup Level:	1000 ug/L									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	**120**	**65**	**3.5**	**12**	**14**	**28**	**25**	**66 J**	**25**	--
PJMW-6	1 U	**11**	1 U	1 U	--	--	--	--	--	--
PJMW-7	1 U	1 U	1 U	1 U	--	--	--	--	--	--
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-2	**23**	20 U	**31**	**150**	**200 J**	**880 J**	**180** [a]	**38 J**	**11,000 J**	**1.6**
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-5	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-6	--	--	--	--	1 U	**18**	**15**	**13 J**	**2.4**	**9.6**
KBMW-1	1 U	1 U	1 U	1 U	1 U	**1.4**	1 U	1 U	1 U	1 U
KBMW-2	--	**3320**	**3200**	**2400 E**	**1500 J**	**7900**	**2500**	**2600**	**3700 J**	**3000**
KBMW-3	**82**	**58 J**	**110**	**14**	R	**2.5**	**31** [a]	**3.7 J**	**26**	**19**
TSMW-2	**13,000 J**	--	**15,400**	--	**4500 E**	--	--	--	--	--
TSMW-4	--	--	--	--	--	**91,300**	**29,700**	**50,800 E**	**34,800 J**	**40,000 J**
GSMW-1	1 U	10 U	**690**	1 U	**33 J**	1 U	1 U	1 U	1 U	1 U
GSMW-2	2 U	10 U	1 U	**4.6**	2 U	1 U	1 U	10 U	1 U	1 U
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-32	**3.7**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-33	10 U	50 U	1 U	1 U	**1.9**	1 U	1 U	1 U	**1.8**	1 U
ESMW-1	--	--	--	--	**2.1 J**	**70**	**4.7**	**5.7 J**	**2**	**2.8**
ESMW-2	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-3	--	--	--	--	**4100**	**9000**	**20,800** [a]	**4100**	**12,400**	**1200**
ESMW-4	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-5	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-6	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-7	--	--	--	--	**1300 J**	**470**	**1270** [a]	**1000**	**534**	**540**
ESMW-8	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
EDMW-1	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
BF-1	--	--	--	--	--	**0.37 J**	1 U	**0.26 J**	--	1 U
BF-5	--	--	--	--	--	--	1 U	**5.1**	--	**2.9**
BF-12	--	--	--	--	--	**195**	1 U	**30**	--	**16**
BF-9	--	--	--	--	--	**127**	1 U	**16**	--	**8.4**

Table B-1 (continued).

Analyte:	Ethylbenzene									
MTCA Cleanup Level:	700 ug/L									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	**130**	**73**	1 U	**26**	**25**	**58**	**57**	**243**	**53**	--
PJMW-6	**0.78 J**	**45**	**2.8**	**2.1**	--	--	--	--	--	--
PJMW-7	**25**	1 U	1 U	1 U	--	--	--	--	--	--
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-2	**430**	**58**	**275**	**650**	**955 J**	**1800 J**	**642** [a]	**57**	**2700 J**	**11**
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-5	--	--	--	--	1 U	1 U	1 U	**1.3**	1 U	1 U
BTMW-6	--	--	--	--	**1.6**	**280**	**33**	**404**	**21**	**210**
KBMW-1	1 U	**0.82 J**	1 U	1 U	1 U	**3.1**	1 U	1 U	1 U	1 U
KBMW-2	--	**654**	**610**	**460**	**430**	**1900**	**700**	**540**	**804 J**	**570**
KBMW-3	**430**	**331**	**700**	**75**	R	**4.5**	**355** [a]	**9.1 J**	**284**	**71**
TSMW-2	**1300**	--	**1500**	--	**2400**	--	--	--	--	--
TSMW-4	--	--	--	--	--	**10,000**	**4500**	**5600**	**5000 J**	**6200 J**
GSMW-1	**1.3**	**91**	**370**	**6.3**	**37**	1 U	**1.4**	**9.7**	1 U	1 U
GSMW-2	2 U	**15**	1 U	**33**	2 U	**34**	1 U	**22**	1 U	**2.1**
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-32	1 U	1 U	**1.1**	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-33	10 U	**56**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	**8.6**	**110**	**20**	**59**	**17**	**40**
ESMW-2	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-3	--	--	--	--	**1700**	**950**	**2580** [a]	**904**	**1400**	**340**
ESMW-4	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-5	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-6	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-7	--	--	--	--	**1100**	**410**	**1150** [a]	**1400**	**648**	**700**
ESMW-8	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
EDMW-1	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
BF-1	--	--	--	--	--	**0.93 J**	1 U	**0.84 J**	--	1 U
BF-5	--	--	--	--	--	--	1 U	**3.5**	--	**2.2**
BF-12	--	--	--	--	--	**34**	1 U	**6.6**	--	**3.1**
BF-9	--	--	--	--	--	**28**	1 U	**4.4**	--	**1.9**

Table B-1 (continued).

Analyte:	m- & p-Xylene									
MTCA Cleanup Level:	1000 ug/L (total xylene)									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	**550**	**340**	**33**	**151**	**62 E**	**280**	**9.9**	**1100**	**260**	--
PJMW-6	**1.9 J**	**100**	**3**	2 U	--	--	--	--	--	--
PJMW-7	**11**	2 U	2 U	2 U	--	--	--	--	--	--
BTMW-1	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
BTMW-2	**1280**	**300**	**905**	**2000 E**	**2450 J**	**7650 J**	**3190** [a]	**322**	**12,700 J**	**53**
BTMW-3	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
BTMW-5	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
BTMW-6	--	--	--	--	**5.2**	**380**	2 U	**391**	**37**	**200**
KBMW-1	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
KBMW-2	--	**2290**	**1900**	**1300**	**1200**	**6800**	**2300**	**1900**	**2500 J**	**1900**
KBMW-3	**700 J**	**354**	**1400**	**68**	R	**2.1**	**552** [a]	**7.9 J**	**514**	**120**
TSMW-2	**5300**	--	**5900**	--	**1700**	--	--	--	--	--
TSMW-4	--	--	--	--	--	**37,500**	**10,200**	**21,900**	**18,700 J**	**22,000 J**
GSMW-1	**9.6**	**180**	**930**	**11**	**39**	2 U	**2.9**	**59**	2 U	**10**
GSMW-2	4 U	20 U	2 U	**23**	4 U	**63**	2 U	**22**	2 U	2 U
GSMW-3	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
MCSMW-31	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
MCSMW-32	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
MCSMW-33	20 U	100 U	2 U	**2.2**	2 U	2 U	2 U	2 U	2 U	2 U
ESMW-1	--	--	--	--	2 U	**360**	**10**	**33**	**3**	**2.8**
ESMW-2	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
ESMW-3	--	--	--	--	**1700**	**2900**	**7410** [a]	**2900**	**4500**	**1100**
ESMW-4	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
ESMW-5	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
ESMW-6	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
ESMW-7	--	--	--	--	**2200**	**1100**	**3240** [a]	**3100**	**2000**	**1900**
ESMW-8	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
EDMW-1	--	--	--	--	2 U	2 U	2 U	2 U	2 U	2 U
BF-1	--	--	--	--	--	**2.8 J**	4 U	**2.4**	--	1 U
BF-5	--	--	--	--	--	--	4 U	**10**	--	**6.8**
BF-12	--	--	--	--	--	**120**	**1.9 J**	**22**	--	**10**
BF-9	--	--	--	--	--	**99**	**1.7 J**	**14**	--	**5.9**

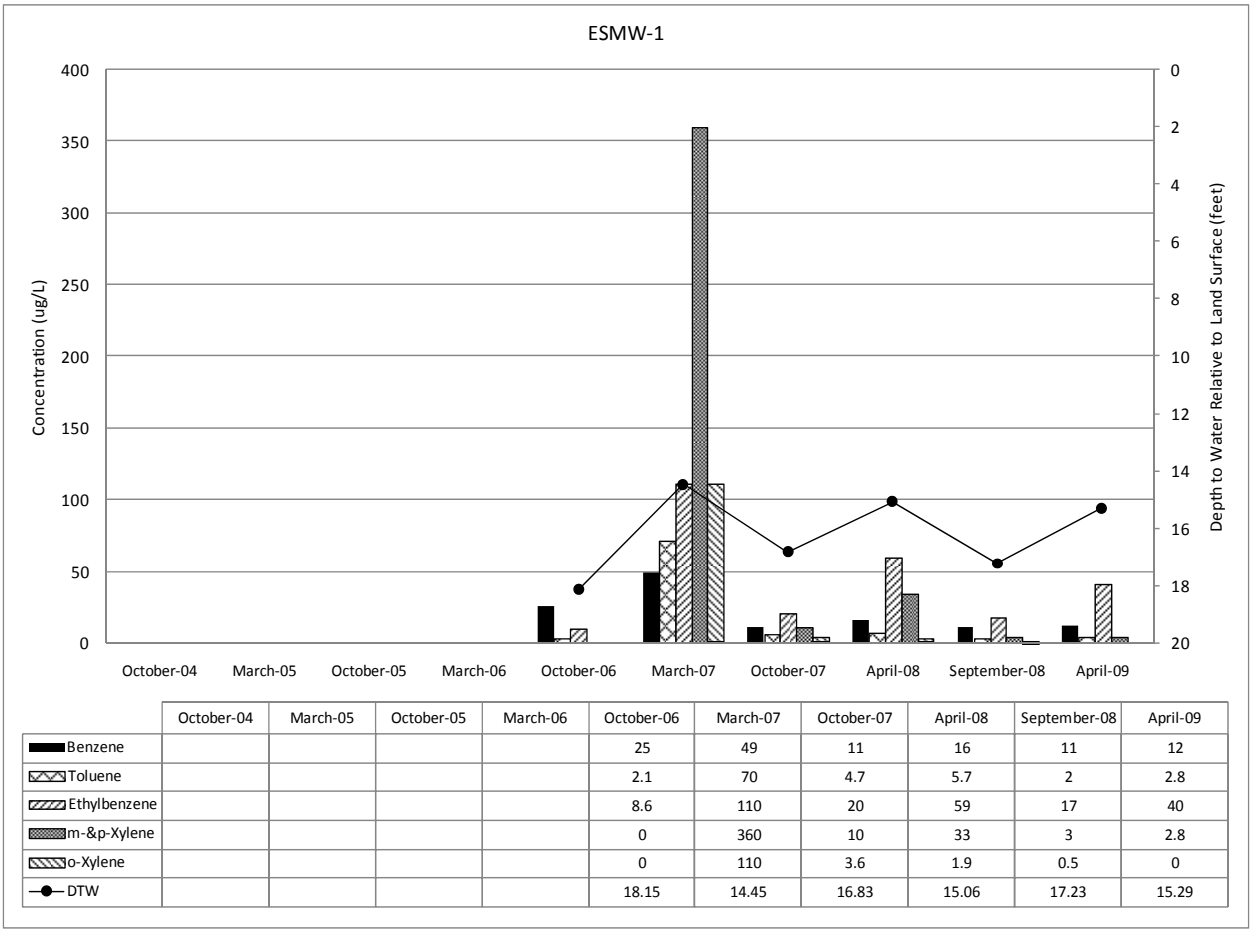
Table B-1 (continued).

Analyte:	o-Xylene									
MTCA Cleanup Level:	1000 ug/L (total xylene)									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	**210**	**130**	**33**	**28**	**37 E**	**110**	**11**	**383**	**150**	--
PJMW-6	1 U	**38**	**1.6**	1 U	--	--	--	--	--	--
PJMW-7	1 U	1 U	1 U	1 U	--	--	--	--	--	--
BTMW-1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-2	**310**	**160**	**330**	**770 E**	**985 J**	**3500 J**	**1380** [a]	**166**	**4300 J**	**22**
BTMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
BTMW-5	--	--	--	--	1 U	1 U	**1.7**	1 U	1 U	1 U
BTMW-6	--	--	--	--	1 U	10 U	**2.9**	10 U	**0.98 J**	**3.5**
KBMW-1	1 U	1 U	1 U	1 U	1 U	**1.3**	1 U	1 U	1 U	1 U
KBMW-2	--	**977**	**910**	**660**	**550**	**3300**	**930**	**900**	**1100 J**	**860**
KBMW-3	**280**	**218**	**570**	**64**	R	**8**	**210** [a]	**14 J**	**145**	**59**
TSMW-2	**2000**	--	**2400**	--	**1900 E**	--	--	--	--	--
TSMW-4	--	--	--	--	--	**15,200**	**3900**	**8400**	**6900 J**	**8500 J**
GSMW-1	1 U	**120**	**420**	**9.1**	**32 J**	1 U	1 U	1 U	1 U	1 U
GSMW-2	2 U	10 U	1 U	**11**	**26**	**5.5**	1 U	10 U	1 U	1 U
GSMW-3	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-32	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
MCSMW-33	10 U	50 U	1 U	**1.1**	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	1 U	**110**	**3.6**	**1.9**	**0.5 J**	1 U
ESMW-2	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-3	--	--	--	--	**1400**	**1100**	**2600** [a]	**738**	**1700**	**220**
ESMW-4	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-5	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-6	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-7	--	--	--	--	**1000**	**470**	**1170** [a]	**1100**	**682**	**520**
ESMW-8	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
EDMW-1	--	--	--	--	1 U	1 U	1 U	1 U	1 U	1 U
BF-1	--	--	--	--	--	**0.59 J**	2 U	**0.72 J**	--	1 U
BF-5	--	--	--	--	--	--	2 U	**5.8**	--	**3.2**
BF-12	--	--	--	--	--	**61**	2 U	**11**	--	**4.7**
BF-9	--	--	--	--	--	**59**	2 U	**7.4**	--	**2.9**

Table B-1 (continued).

Analyte:	WTPH-G									
MTCA Cleanup Level:	800 (1000*) ug/L									
Date:	10/04	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
PJMW-4	**4200**	**3300**	**340**	**800**	**770**	**2000**	**2200**	**6700**	**2200**	--
PJMW-6	140 U	**1100**	140 U	140 U	--	--	--	--	--	--
PJMW-7	**650**	**310**	140 U	140 U	--	--	--	--	--	--
BTMW-1	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U
BTMW-2	**14,000**	**1,500 J**	**11,000**	**15,000**	**32,500 J**	**81,000 J**	**29,000 E**	**3900**	**146,000 J**	7000 U
BTMW-3	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U
BTMW-5	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
BTMW-6	--	--	--	--	140 U	**3700**	**2300**	**3900**	**380**	**2400**
KBMW-1	140 U	140 U	140 U	**240**	140 U	**560**	140 U	**140**	140 U	140 U
KBMW-2	--	**56,000**	**26,000**	**15,000**	**19,000**	**74,000**	**46,000 E**	**19,000**	**31,000 J**	**23,000**
KBMW-3	**12,000**	**4700**	**17,000**	**3000**	**16,000**	**1200**	**6900 E**	**1100**	**6700**	**2100**
TSMW-2	**81,000**	--	**78,000**	--	**140,000 E**		--	--	--	--
TSMW-4	--	--	--	--	--	**490,000**	**226,000**	**236,000**	**199,000 J**	**240,000 J**
GSMW-1	**110 J**	**2200**	**7700**	**200**	**550**	140 U	140 U	**480**	140 U	**150**
GSMW-2	140 U	**170**	140 U	**340**	280 U	**390 J**	140 U	**230**	140 U	140 U
GSMW-3	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U
MCSMW-31	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U
MCSMW-32	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U	140 U
MCSMW-33	**220**	**730**	**160**	140 U	**250**	140 U	140 U	**160**	**190**	140 U
ESMW-1	--	--	--	--	140 U	**9300**	**550**	**1700**	**210**	**760**
ESMW-2	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
ESMW-3	--	--	--	--	**86,000**	**43,000**	**83,000 E**	**25,000**	**63,000 J**	**9800**
ESMW-4	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
ESMW-5	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
ESMW-6	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
ESMW-7	--	--	--	--	**21,000**	**7100**	**20,000 E**	**26,000**	**16,000**	**15,000**
ESMW-8	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
EDMW-1	--	--	--	--	140 U	140 U	140 U	140 U	140 U	140 U
BF-1	--	--	--	--	--	140 U	140 U	140 U	--	140 U
BF-5	--	--	--	--	--	--	140 U	**110 J**	--	140 U
BF-12	--	--	--	--	--	**1000**	140 U	**210**	--	140 U
BF-9	--	--	--	--	--	**1215**	140 U	**140**	--	140 U

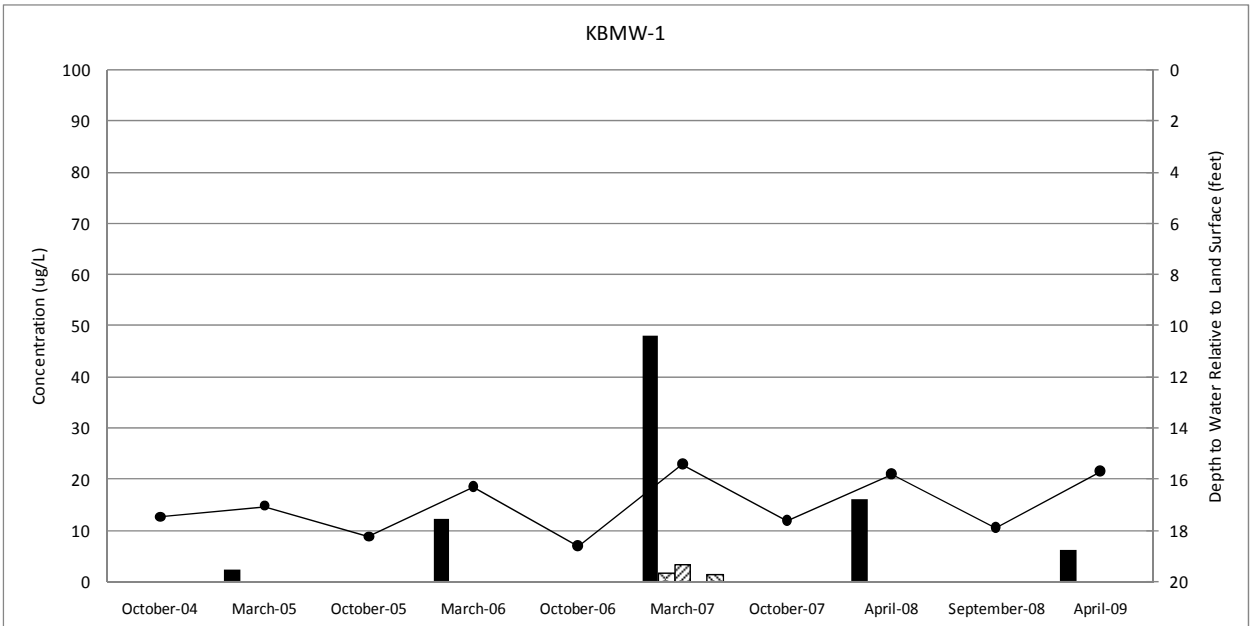
* MTCA Method A cleanup level for TPH-G is 1000 ug/L if benzene is not detectable in groundwater.
U – Analyte was not detected at or above the reported value.
J – Analyte was positively identified. The associated numerical result is an estimate.
E – Concentration of the associated value exceeds the known calibration range.
R – Result has been rejected because duplicate samples did not meet data quality objectives.
[a] – Analyzed by GC/MS SW8260.
-- Not Sampled.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.
Underline – Free-phase petroleum product present.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene					25	49	11	16	11	12
Toluene					2.1	70	4.7	5.7	2	2.8
Ethylbenzene					8.6	110	20	59	17	40
m-&p-Xylene					0	360	10	33	3	2.8
o-Xylene					0	110	3.6	1.9	0.5	0
DTW					18.15	14.45	16.83	15.06	17.23	15.29

0 - Analyte was not detected at or above the laboratory reporting value.
Blank - not sampled.

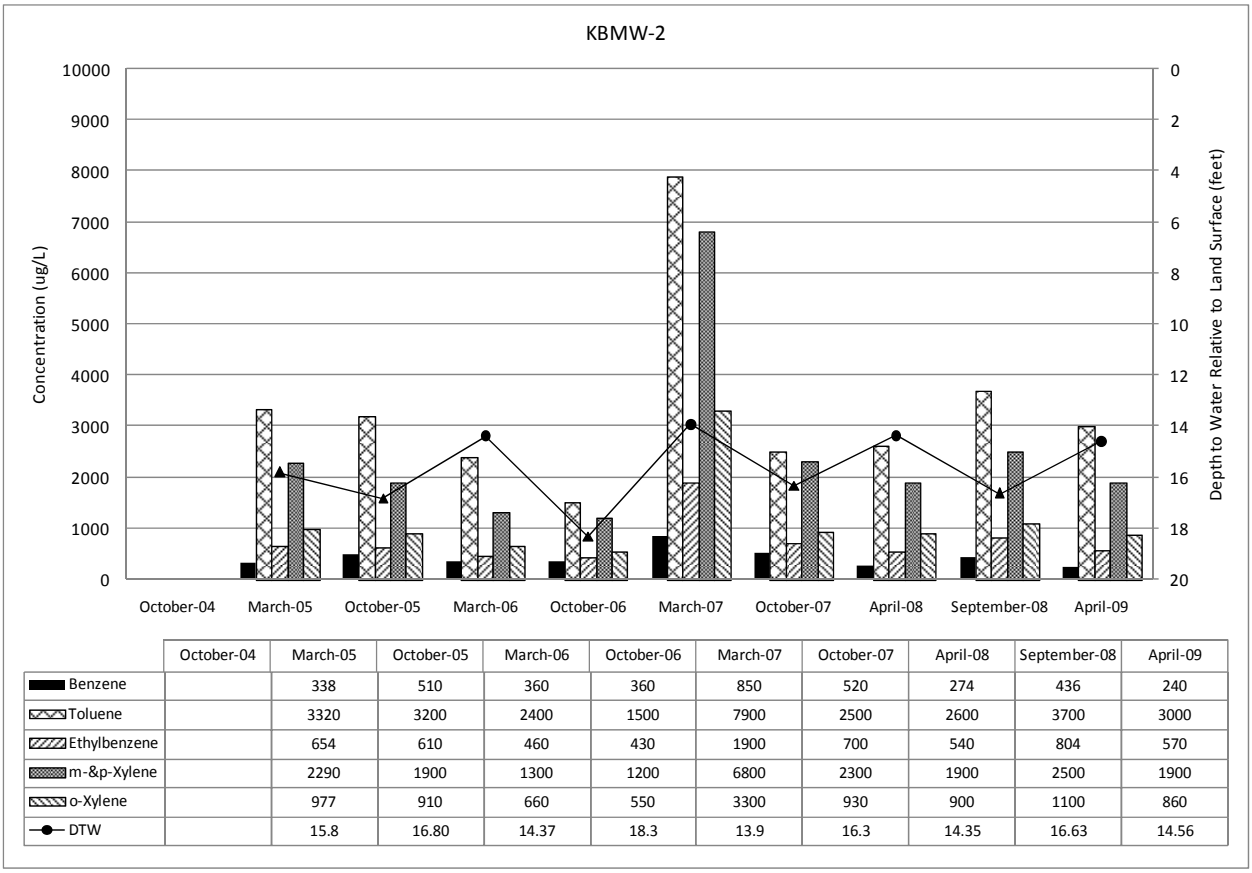
Figure B-1. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well ESMW-1, October 2006 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	0	2.2	0	12	0	48	0	16	0	6
Toluene	0	0	0	0	0	1.4	0	0	0	0
Ethylbenzene	0	0	0	0	0	3.1	0	0	0	0
m-&p-Xylene	0	0	0	0	0	0	0	0	0	0
o-Xylene	0	0	0	0	0	1.3	0	0	0	0
DTW	17.48	17.05	18.25	16.29	18.61	15.42	17.62	15.82	17.88	15.69

0 - Analyte was not detected at or above the laboratory reporting value.

Figure B-2. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well KBMW-1, October 2004 to April 2009.



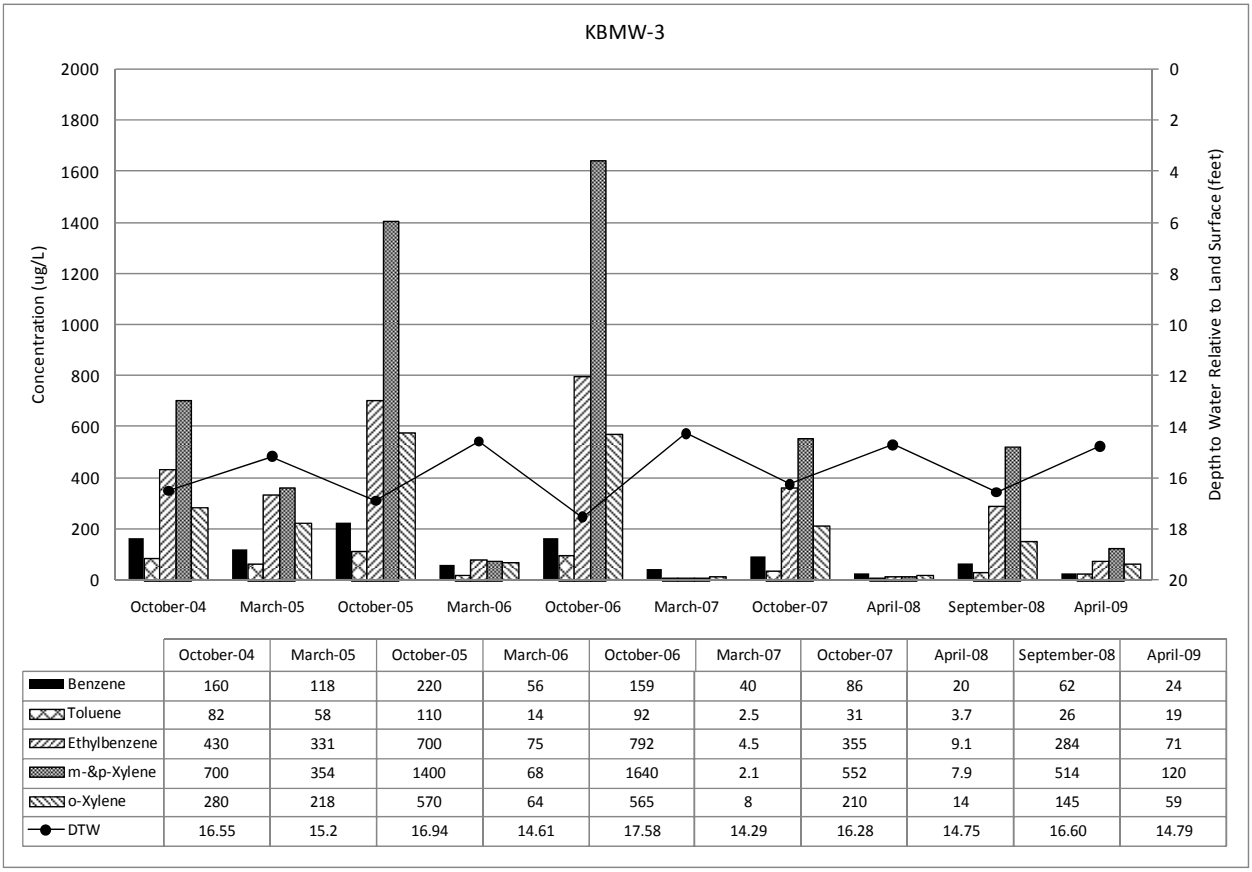
	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene		338	510	360	360	850	520	274	436	240
Toluene		3320	3200	2400	1500	7900	2500	2600	3700	3000
Ethylbenzene		654	610	460	430	1900	700	540	804	570
m-&p-Xylene		2290	1900	1300	1200	6800	2300	1900	2500	1900
o-Xylene		977	910	660	550	3300	930	900	1100	860
DTW		15.8	16.80	14.37	18.3	13.9	16.3	14.35	16.63	14.56

0 – Not sampled.

Blank - not sampled.

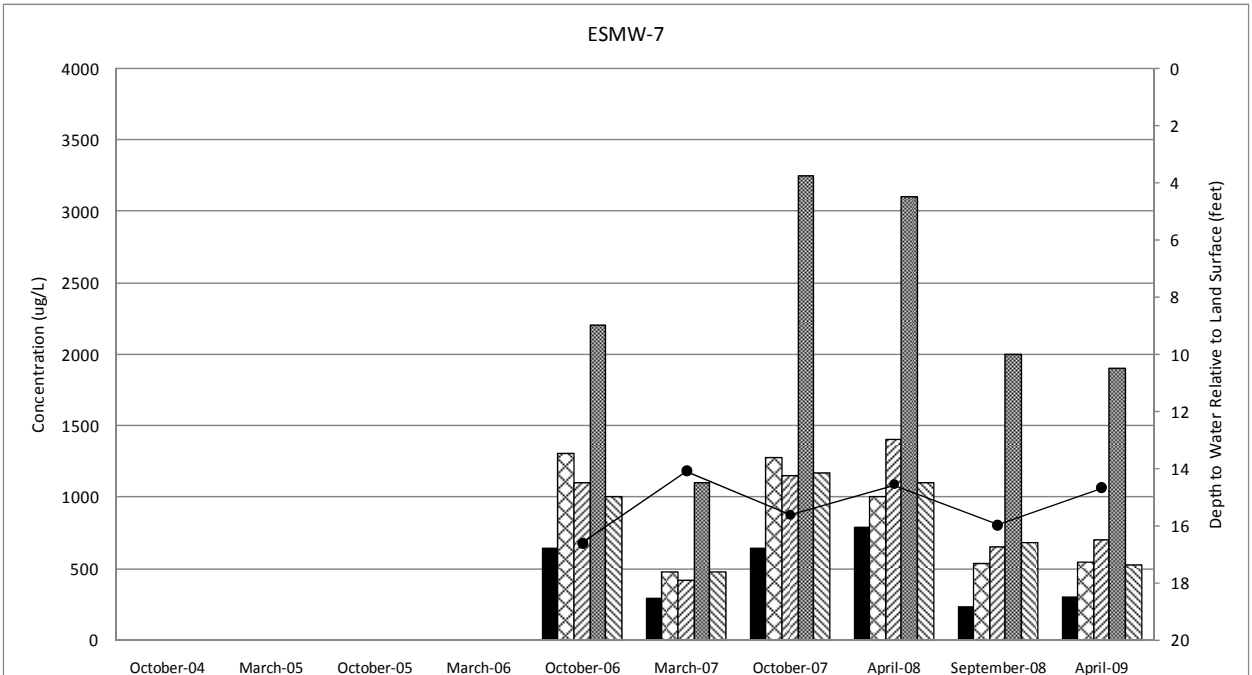
▲ - Free-phase petroleum product present. Depth-to-water is estimated.

Figure B-3. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well KBMW-2, March 2005 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	160	118	220	56	159	40	86	20	62	24
Toluene	82	58	110	14	92	2.5	31	3.7	26	19
Ethylbenzene	430	331	700	75	792	4.5	355	9.1	284	71
m-&p-Xylene	700	354	1400	68	1640	2.1	552	7.9	514	120
o-Xylene	280	218	570	64	565	8	210	14	145	59
DTW	16.55	15.2	16.94	14.61	17.58	14.29	16.28	14.75	16.60	14.79

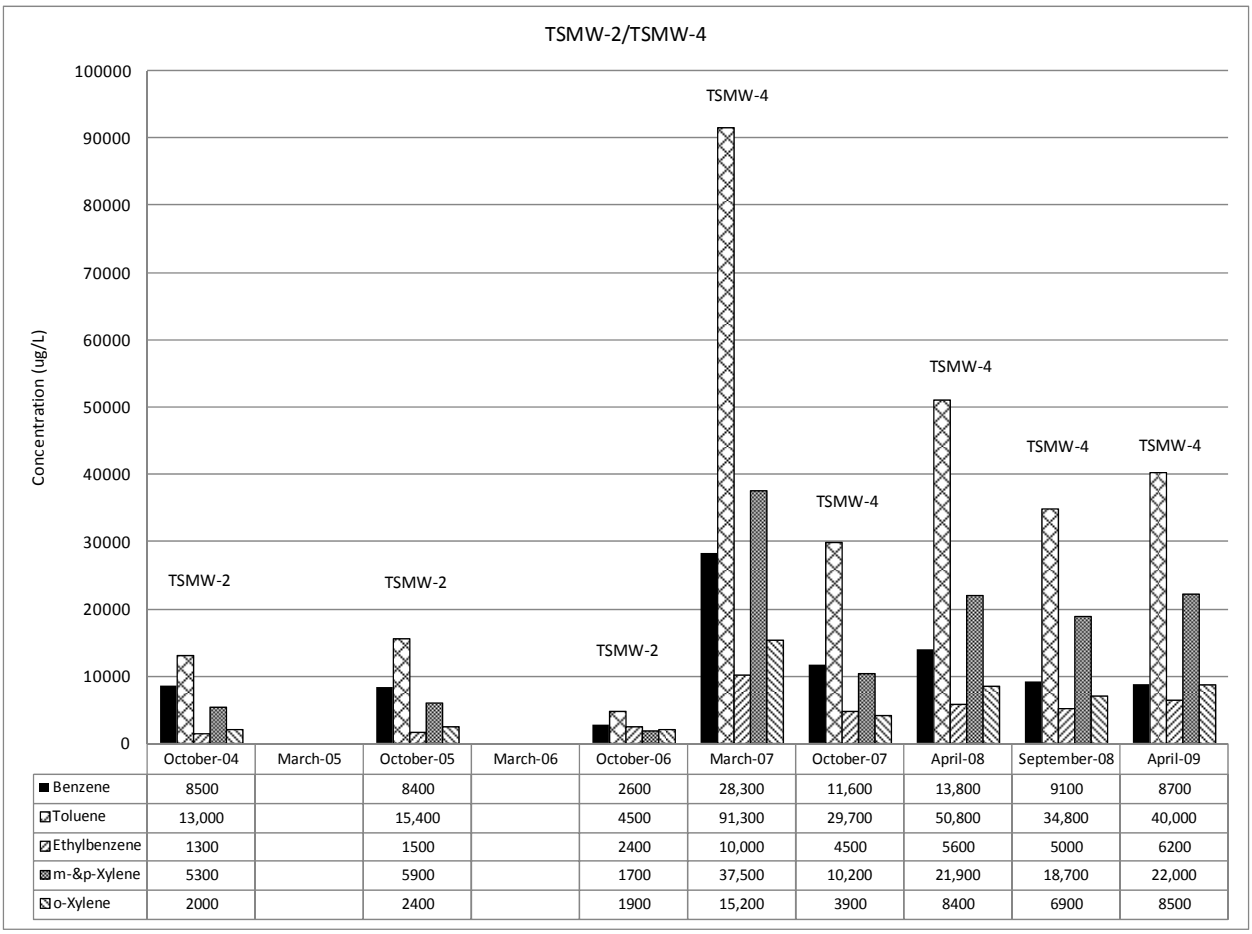
Figure B-4. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well KBMW-3, October 2004 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene					640	290	648	789	232	300
Toluene					1300	470	1270	1000	534	540
Ethylbenzene					1100	410	1150	1400	648	700
m-&p-Xylene					2200	1100	3240	3100	2000	1900
o-Xylene					1000	470	1170	1100	682	520
DTW					16.61	14.09	15.62	14.56	15.96	14.69

Blank - not sampled.

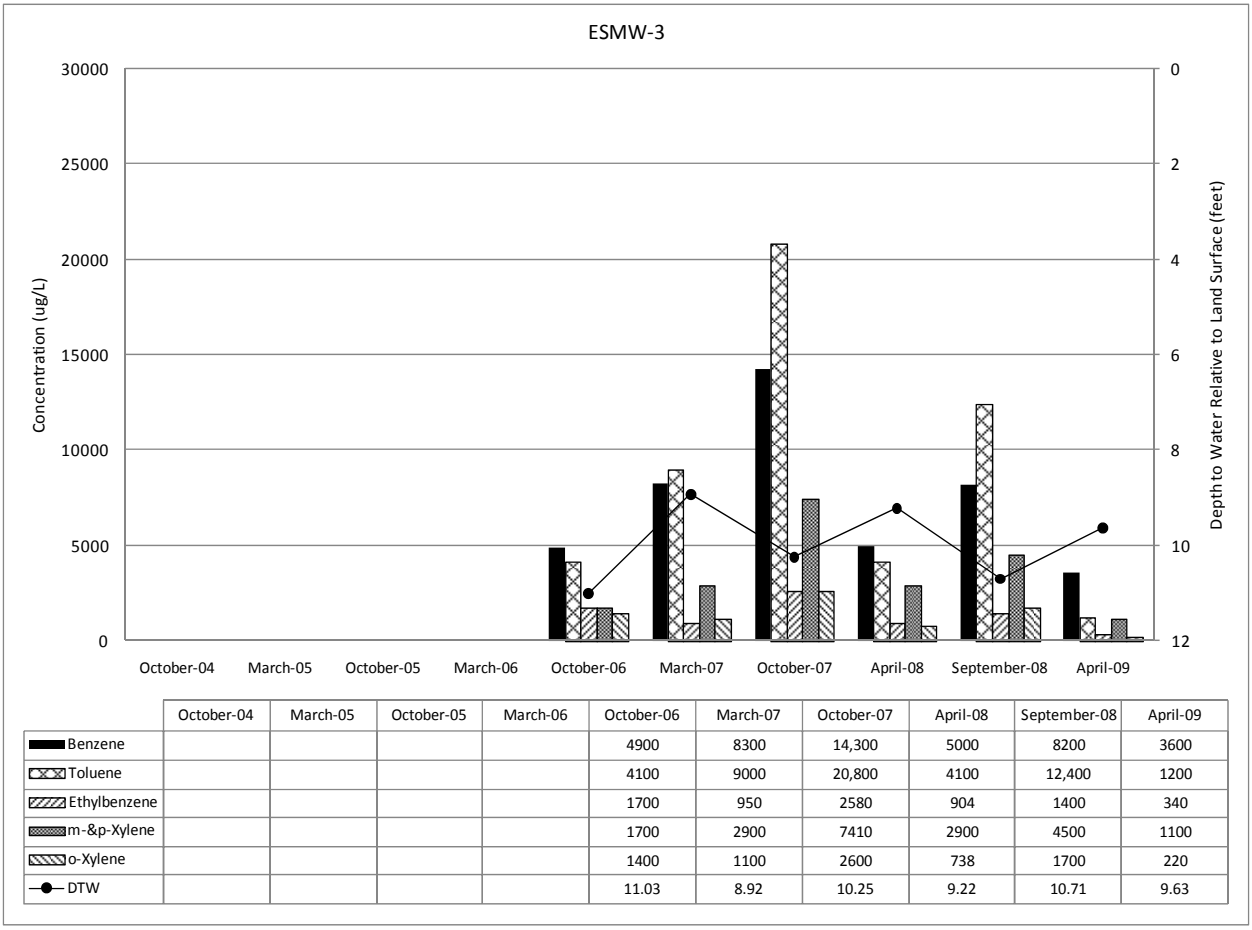
Figure B-5. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well ESMW-7, October 2006 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	8500		8400		2600	28,300	11,600	13,800	9100	8700
Toluene	13,000		15,400		4500	91,300	29,700	50,800	34,800	40,000
Ethylbenzene	1300		1500		2400	10,000	4500	5600	5000	6200
m-&p-Xylene	5300		5900		1700	37,500	10,200	21,900	18,700	22,000
o-Xylene	2000		2400		1900	15,200	3900	8400	6900	8500

Blank - not sampled.

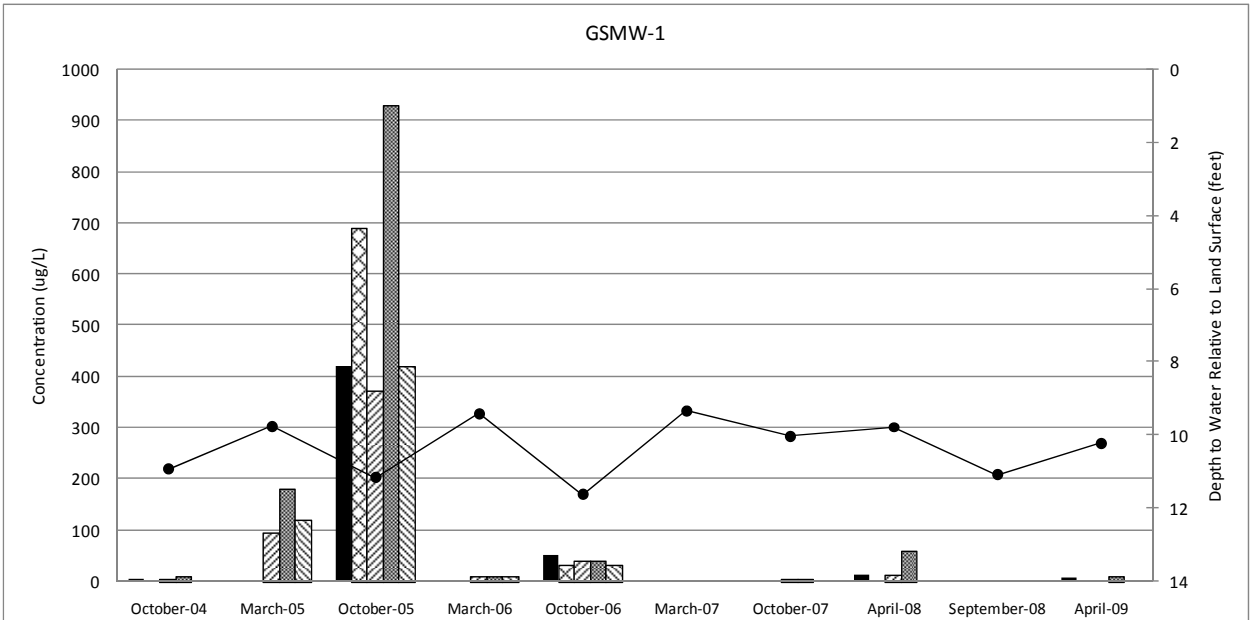
Figure B-6. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Wells TSMW-2/ TSMW-4, October 2004 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene					4900	8300	14,300	5000	8200	3600
Toluene					4100	9000	20,800	4100	12,400	1200
Ethylbenzene					1700	950	2580	904	1400	340
m-&p-Xylene					1700	2900	7410	2900	4500	1100
o-Xylene					1400	1100	2600	738	1700	220
DTW					11.03	8.92	10.25	9.22	10.71	9.63

Blank - not sampled.

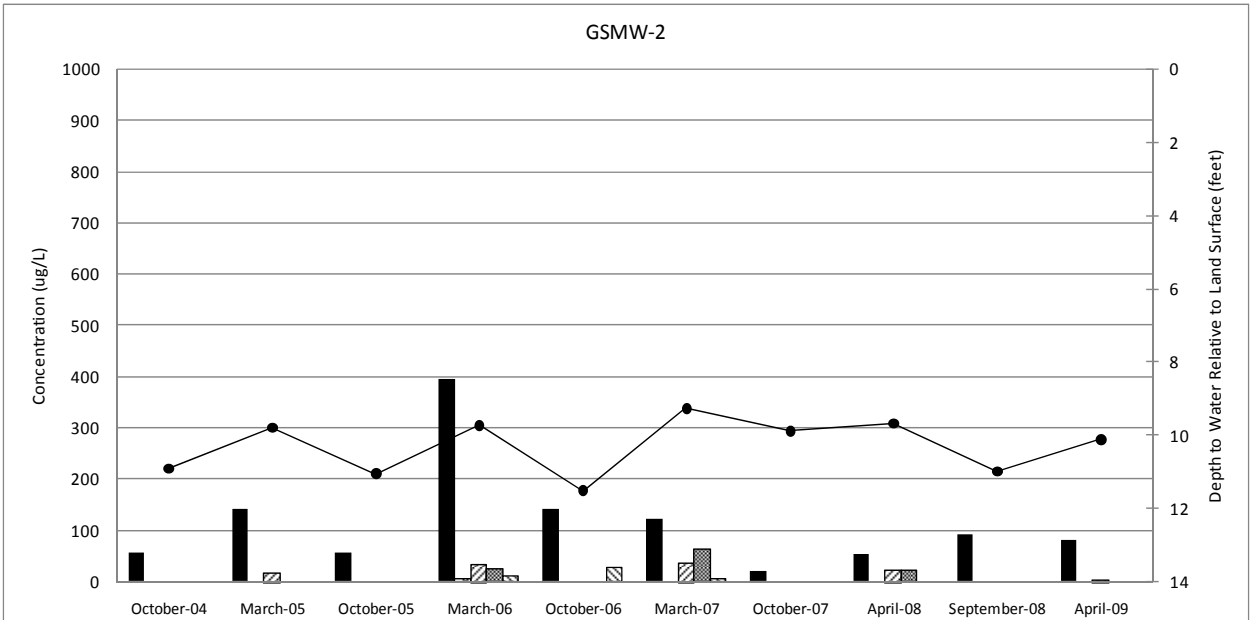
Figure B-7. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well ESMW-3, October 2006 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	5.1	0	420	0	51	0	0	11	1.1	7.9
Toluene	0	0	690	0	33	0	0	0	0	0
Ethylbenzene	1.3	91	370	6.3	37	0	1.4	9.7	0	0
m-&p-Xylene	9.6	180	930	11	39	0	2.9	59	0	10
o-Xylene	0	120	420	9.1	32	0	0	0	0	0
DTW	10.93	9.76	11.17	9.41	11.64	9.32	10.02	9.78	11.09	10.22

0 - Analyte was not detected at or above the laboratory reporting value.

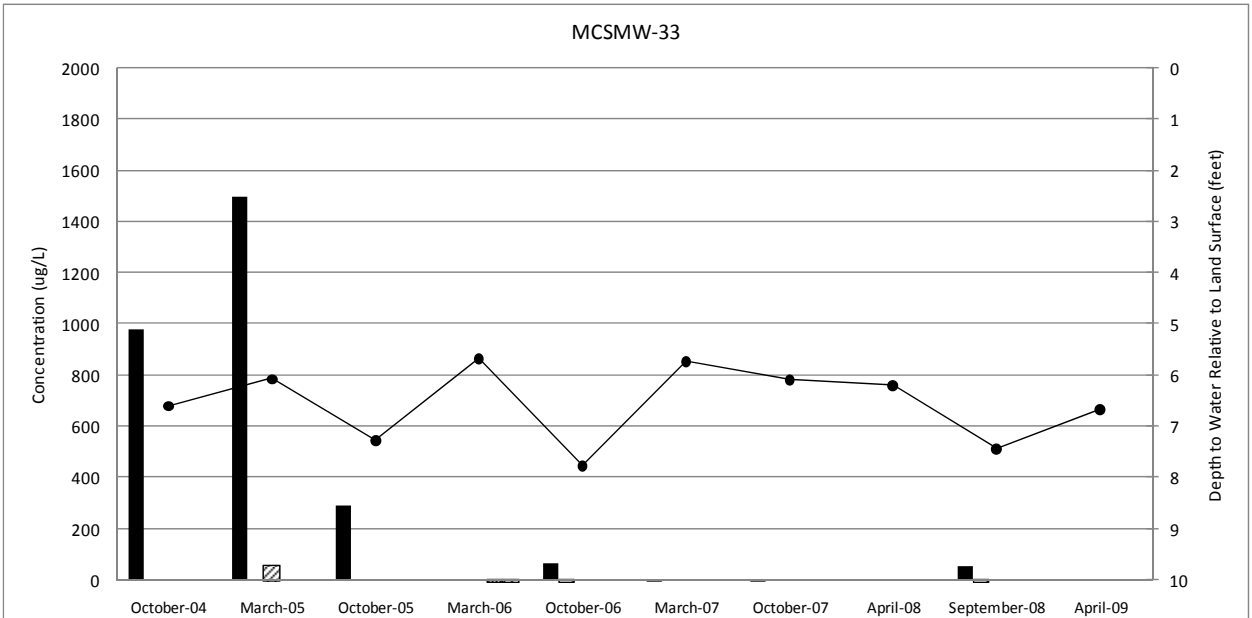
Figure B-8. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well GSMW-1, October 2004 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	54	140	54	394	140	120	18	51	91	80
Toluene	0	0	0	4.6	0	0	0	0	0	0
Ethylbenzene	0	15	0	33	0	34	0	22	0	2.1
m-&p-Xylene	0	0	0	23	0	63	0	22	0	0
o-Xylene	0	0	0	11	26	5.5	0	0	0	0
DTW	10.92	9.79	11.06	9.73	11.54	9.26	9.89	9.67	11.01	10.12

0 - Analyte was not detected at or above the laboratory reporting value.

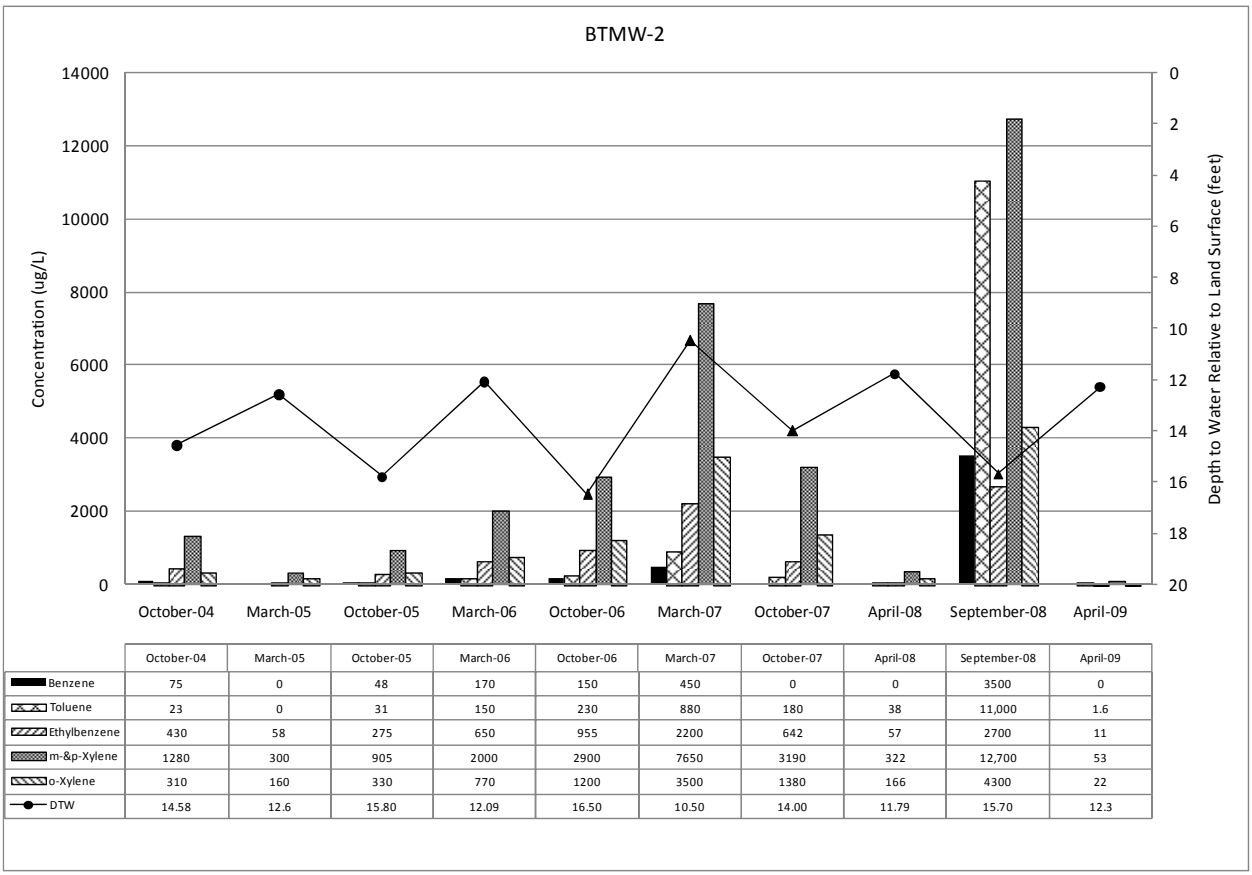
Figure B-9. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well GSMW-2, October 2004 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	980	1500	294	0	67	3	2.2	0	59	0
Toluene	0	0	0	0	1.9	0	0	0	1.8	0
Ethylbenzene	0	56	0	0	0	0	0	0	0	0
m-&p-Xylene	0	0	0	2.2	0	0	0	0	0	0
o-Xylene	0	0	0	1.1	0	0	0	0	0	0
DTW	6.59	6.06	7.26	5.66	7.76	5.72	6.08	6.19	7.43	6.66

0 - Analyte was not detected at or above the laboratory reporting value.

Figure B-10. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well MCSMW-33, October 2004 to April 2009.

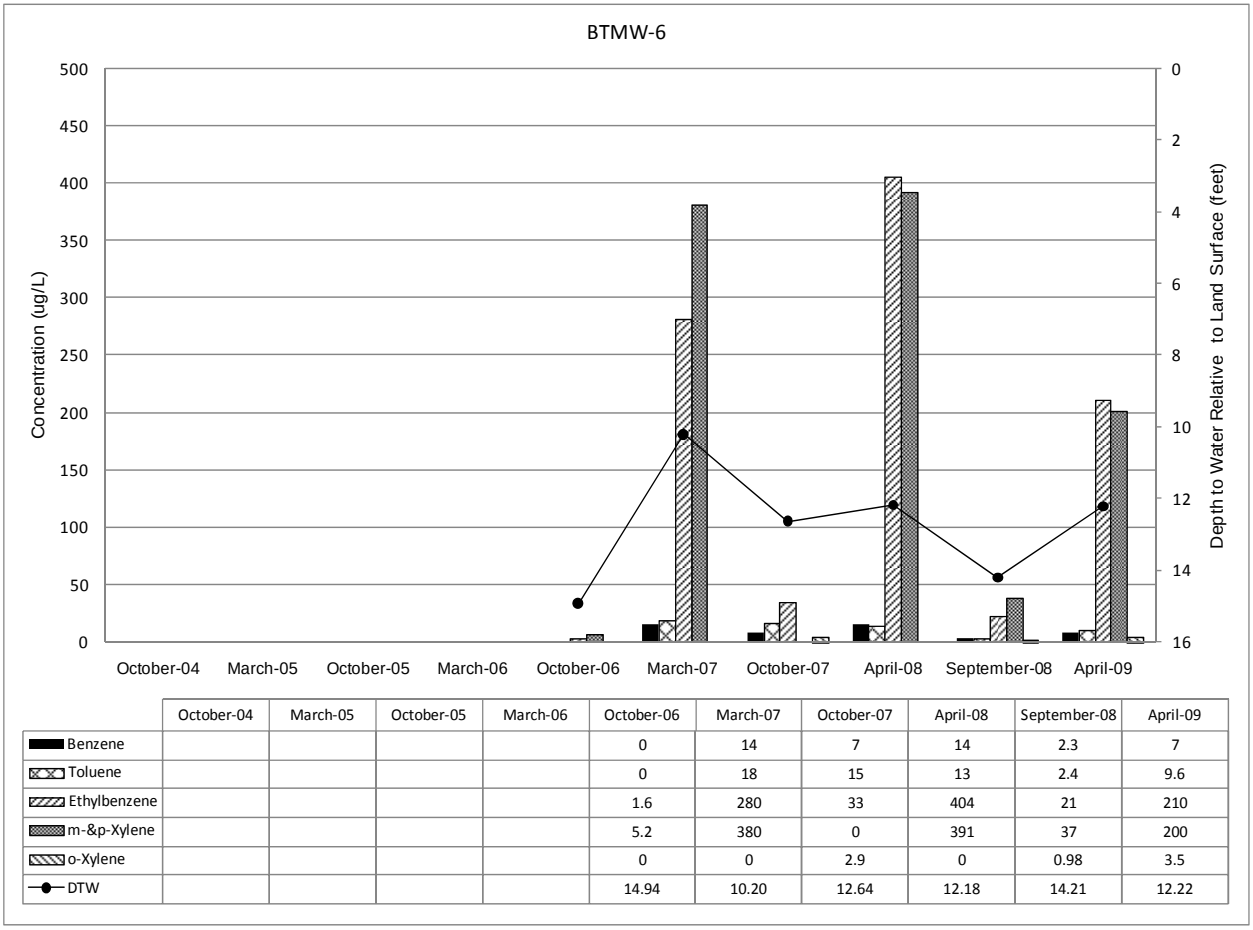


	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene	75	0	48	170	150	450	0	0	3500	0
Toluene	23	0	31	150	230	880	180	38	11,000	1.6
Ethylbenzene	430	58	275	650	955	2200	642	57	2700	11
m-&p-Xylene	1280	300	905	2000	2900	7650	3190	322	12,700	53
o-Xylene	310	160	330	770	1200	3500	1380	166	4300	22
DTW	14.58	12.6	15.80	12.09	16.50	10.50	14.00	11.79	15.70	12.3

0 - Analyte was not detected at or above the laboratory reporting value.

▲ - Free-phase petroleum product present. Depth-to-water is estimated.

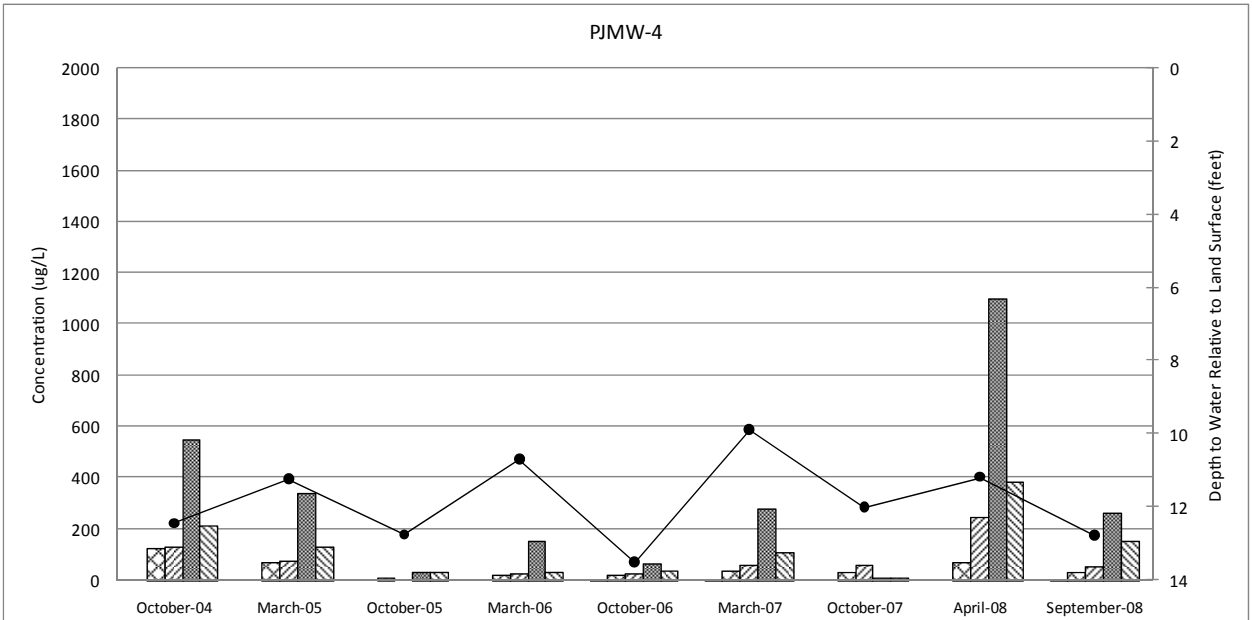
Figure B-11. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well BTMW-2, October 2004 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08	April-09
Benzene					0	14	7	14	2.3	7
Toluene					0	18	15	13	2.4	9.6
Ethylbenzene					1.6	280	33	404	21	210
m-&p-Xylene					5.2	380	0	391	37	200
o-Xylene					0	0	2.9	0	0.98	3.5
DTW					14.94	10.20	12.64	12.18	14.21	12.22

0 - Analyte was not detected at or above the laboratory reporting value.
Blank - not sampled.

Figure B-12. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well BTMW-6, October 2006 to April 2009.



	October-04	March-05	October-05	March-06	October-06	March-07	October-07	April-08	September-08
Benzene	0	0	0	0	1.1	1.4	0	0	1.9
Toluene	120	65	3.5	12	14	28	25	66	25
Ethylbenzene	130	73	0	26	25	58	57	243	53
m-&p-Xylene	550	340	33	151	62	280	9.9	1100	260
o-Xylene	210	130	33	28	37	110	11	383	150
DTW	12.45	11.23	12.76	10.69	13.52	9.88	12.01	11.18	12.77

0 - Analyte was not detected at or above the laboratory reporting value.

Figure B-13. BTEX Results (ug/L) and Depth-to-Water Measurements (feet) for Well PJMW-4, October 2004 to September 2008.

This page is purposely left blank

Appendix C. VOC Results, March 2005 to April 2009

Table C-1. VOC Results (µg/L), March 2005 to April 2009.

Analyte:	Tetrachloroethene								
MTCA Method A Cleanup Level:	5 ug/L								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	2 U	**0.34 J**	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	2 U	1 U	1 U	1 U
KBMW-1	**0.69 J**	2 U	**8.7**	1 U	**14 J**	2 U	**9**	**0.32 J**	**4**
KBMW-2	**8.1 J**	**9.2 J**	**8.1**	--	20 U	--	--	--	--
KBMW-3	1 UJ	20 UJ	1 U	1 U	1 U	20 U	1 U	1 U	1 U
TSMW-2	--	40 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	**1 J**	**0.51 J**	**1.2**	**0.62 J**	**1.5 J**	**0.34 J**	**0.4 J**	**0.98 J**
GSMW-2	--	**1 J**	**1.2**	**2**	**1 J**	**1.5 J**	**0.35 J**	**0.62 J**	**1.5**
ESMW-1	--	--	--	--	2 U	2 U	1 U	**0.36 J**	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	200 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	200 U	1 U	100 U	1 U
BF-1	--	--	--	--	1 U	2 U	1 U	--	1 U
BF-5	--	--	--	--	--	2 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	2 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	2 U	1 U	--	1 U

Analyte:	Trichloroethene								
MTCA Method A Cleanup Level:	5 ug/L								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	2 U	1 U	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-1	1 U	2 U	**0.44 J**	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-2	1 UJ	40 UJ	1 U	--	20 U	--	--	--	--
KBMW-3	1 UJ	20 UJ	**4**	**1.7**	1 U	10 U	**1.3**	1 U	1 U
TSMW-2	--	40 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	40 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	4 U	**0.26 J**	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	2 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	**1.4**	100 U	1 U
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the approximate reported quantitation limit.
J – Analyte was positively identified. The associated numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.
Shade – Values are greater than MTCA cleanup levels.

Table C-1 (continued).

Analyte:	Cis-1,2-Dichloroethene								
MTCA Method A Cleanup Level:	70 ug/L								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	2 U	1 U	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-1	1 U	2 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-2	1 UJ	40 UJ	1 U	--	20 U	--	--	--	--
KBMW-3	**4.2 J**	**8 J**	**3.4**	**5.8**	**5.9**	**5.8 J**	**5.6**	**4.4**	**5**
TSMW-2	--	40 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	40 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	4 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	2 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	**1.4**	100 U	**1.1**
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

Analyte:	1,2-Dichloroethane								
MTCA Method A Cleanup Level:	5 ug/L								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	2 U	1 U	1 U	5 U	--	--	--	--
BTMW-6	--	--	--	1 U	**1.6 J**	1 U	1 U	1 U	1 U
KBMW-1	**0.99 J**	**1.1 J**	**0.92 J**	**0.87 J**	**2.3 J**	**0.66 J**	**0.73 J**	1 U	1 U
KBMW-2	**3.5 J**	40 UJ	**2.7**	--	20 U	--	--	--	--
KBMW-3	**1.4 J**	20 UJ	**1.2**	**2.3**	**0.98 J**	10 U	1 U	1 U	1 U
TSMW-2	--	40 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	40 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	4 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	5 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	5 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	**2**	100 U	**6.5**
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the approximate reported quantitation limit.
J – Analyte was positively identified. The associated numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.

Table C-1 (continued).

Analyte:	1,1,1-Trichloroethane								
MTCA Method A Cleanup Level:	200 ug/L								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	5 U	1 U	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-1	1 U	5 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-2	1 UJ	100	1 U	--	20 U	--	--	--	--
KBMW-3	1 UJ	50 UJ	1 U	1 U	1 U	10 U	1 U	1 U	1 U
TSMW-2	--	100	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	100 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	10 U	**0.38 J**	1 U	**0.45 J**	1 U	1 U	1 U	**0.79 J**
ESMW-1	--	--	--	--	2 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	1 U	100 U	1 U
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

Analyte:	1,1-Dichloroethane								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	1 U	1 U	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-1	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-2	1 UJ	20 UJ	1 U	--	20 U	--	--	--	--
KBMW-3	1 UJ	10 U	1 U	1 U	1 U	10 U	1 U	1 U	1 U
TSMW-2	--	20 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	20 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	2 UJ	**0.37 J**	**0.48 J**	**0.46 J**	1 U	**0.51 J**	1 U	1 U
ESMW-1	--	--	--	--	2 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	1 U	100 U	1 U
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the approximate reported quantitation limit.
J – Analyte was positively identified. The associated numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.

Table C-1 (continued).

Analyte:	Trans-1,2-Dichloroethene								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	1 U	1 U	1 U	2 U	--	--	--	--
BTMW-6	--	--	--	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-1	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U
KBMW-2	1 UJ	20 UJ	1 U	--	20 U	--	--	--	--
KBMW-3	0.33 UJ	10 U	**0.50 J**	**0.69 NJ**	**0.42 J**	10 U	1 U	1 U	1 U
TSMW-2	--	20 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	1000 U	--	--	--	--
GSMW-1	--	20 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
GSMW-2	--	2 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	2 U	1 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	2 U	--	--	--	--
ESMW-3	--	--	--	--	20 U	100 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	20 U	100 U	1 U	100 U	1 U
BF-1	--	--	--	--	1 U	1 U	1 U	--	1 U
BF-5	--	--	--	--	--	1 U	1 U	--	1 U
BF-9	--	--	--	--	5 U	1 U	1 U	--	1 U
BF-12	--	--	--	--	10 U	1 U	1 U	--	1 U

Analyte:	4-Methyl-2-Pentanone								
Date:	3/05	10/05	3/06	10/06	**3/07**	10/07	4/08	9/08	4/09
BTMW-3	--	10 U	2 U	2 U	4 U	--	--	--	--
BTMW-6	--	--	--	2 U	4 U	2 U	1 U	1 U	1 U
KBMW-1	2 U	10 U	**0.73 J**	2 U	4 UJ	2 U	1 U	1 U	1 U
KBMW-2	2 UJ	200 UJ	**11**	--	**20 J**	--	--	--	--
KBMW-3	**3.6 J**	100 UJ	**0.57 J**	**2.1**	2 U	20 U	1 U	1 U	1 U
TSMW-2	--	200 UJ	--	--	--	--	--	--	--
TSMW-4	--	--	--	--	2000 U	--	--	--	--
GSMW-1	--	200 U	2 U	2 U	2 U	2 U	1 U	1 U	1 U
GSMW-2	--	20 UJ	2 U	2 U	2 U	2 U	1 U	1 U	1 U
ESMW-1	--	--	--	--	**5**	2 U	1 U	1 U	1 U
ESMW-2	--	--	--	--	4 U	--	--	--	--
ESMW-3	--	--	--	--	40 U	200 U	1 U	200 U	1 U
ESMW-7	--	--	--	--	40 U	200 U	**4.3**	100 U	1 U
BF-1	--	--	--	--	2 U	2 U	1 U	--	1 U
BF-5	--	--	--	--	--	2 U	1 U	--	1 U
BF-9	--	--	--	--	10 U	2 U	1 U	--	1 U
BF-12	--	--	--	--	20 U	2 U	1 U	--	1 U

U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the approximate reported quantitation limit.
J – Analyte was positively identified. The associated numerical result is an estimate.
NJ – Analyte is tentatively identified. The associate numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.

Table C-1 (continued).

Analyte:	Acetone								
Date:	3/05	10/05	3/06	10/06	3/07	10/07	4/08	9/08	4/09
BTMW-3	--	4 U	10 U	4 U	4 UJ	--	--	--	--
BTMW-6	--	--	--	4 U	4 UJ	4 U	**36 NJ**	2 U	5 U
KBMW-1	10 U	4 U	**12**	4 U	4 UJ	4 U	**21 NJ**	2 U	5 UJ
KBMW-2	**73 J**	80 UJ	10 U	--	200 U	--	--	--	--
KBMW-3	**55 J**	40 U	**42**	4 U	10 U	40 U	5 UJ	**23**	**16 NJ**
TSMW-2	--	80 UJ	--	--	--	--	--	--	--
TSMW-3	--	--	--	--	10,000 UJ	--	--	--	--
GSMW-1	--	80 U	10 U	4 U	10 U	4 U	5 UJ	2 U	5 UJ
GSMW-2	--	8 UJ	10 U	4 U	10 U	4 U	5 UJ	2 U	5 U
ESMW-1	--	--	--	--	4 UJ	4 U	**16 NJ**	**10**	5 UJ
ESMW-2	--	--	--	--	4 UJ	--	--	--	--
ESMW-3	--	--	--	--	20 UJ	400 U	**73 J**	400 U	**87 J**
ESMW-7	--	--	--	--	200 U	400 U	**93 NJ**	200 U	**36 NJ**
BF-1	--	--	--	--	10 U	4 U	5 U	--	5 U
BF-5	--	--	--	--	--	4 U	**9.9 J**	--	5 U
BF-9	--	--	--	--	50 U	4 U	**11 J**	--	**2.5 J**
BF-12	--	--	--	--	100 U	4 U	**11 J**	--	5 U

U – Analyte was not detected at or above the reported value.
UJ – Analyte was not detected at or above the approximate reported quantitation limit.
J – Analyte was positively identified. The associated numerical result is an estimate.
NJ – Analyte is tentatively identified. The associate numerical result is an estimate.
-- Not Sampled.
Bold – Analyte was detected.

This page is purposely left blank

Appendix D. Acronyms and Abbreviations

BTEX	Benzene, toluene, ethylbenzene, and xylene
DNAPL	Dense non-aqueous phase liquid
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
feet/msl	Feet relative to mean sea level
GC/MS	Gas chromatography – mass spectrometry
LNAPL	Light non-aqueous phase liquid
MTCA	Model Toxic Control Act
PVC	Polyvinyl chloride
RPD	Relative percent difference
SOP	Standard operating procedure
TPH-G	Total petroleum hydrocarbons as gasoline
USGS	U.S. Geological Survey
VOC	Volatile organic compounds
WAC	Washington Administrative Code