

# 2-66 Enhanced Reductive Dechlorination Interim Measure – Second Semiannual Report

**Boeing Plant 2  
Seattle/Tukwila, Washington**

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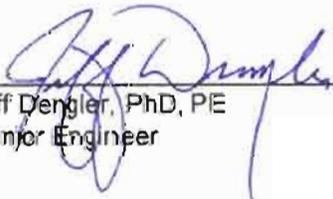
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## TABLE OF CONTENTS

<b>1.0 INTRODUCTION .....</b>	<b>1</b>
<b>2.0 INTERIM MEASURE IMPLEMENTATION.....</b>	<b>3</b>
<b>3.0 PERFORMANCE MONITORING METHODOLOGY .....</b>	<b>4</b>
<b>4.0 PERFORMANCE MONITORING RESULTS.....</b>	<b>5</b>
4.1 Third Quarter Sampling Results.....	5
4.2 Fourth Quarter Sampling Results .....	5
4.3 Data Trend Analysis.....	6
<b>5.0 CONCLUSIONS .....</b>	<b>8</b>
<b>6.0 SCHEDULE .....</b>	<b>9</b>
<b>7.0 REFERENCES .....</b>	<b>10</b>

### TABLES

Table 1 – 2-66 ERD IM Groundwater Field Parameter Summary
Table 2 – 2-66 ERD IM Third Quarter Groundwater Monitoring Analytical Results (July 2009)
Table 3 – 2-66 ERD IM Fourth Quarter Groundwater Monitoring Analytical Results (October 2009)
Table 4 – 2-66 ERD IM Groundwater Monitoring Analytical Data Summary

### FIGURES

Figure 1 – General Location – Boeing Plant 2
Figure 2 – Site Representation
Figure 3 – Plan View of the 2-66 ERD IM
Figure 4 – VOC Trend Plots for PL2-021A and PL2-035A

### ATTACHMENTS

Attachment A – Field Parameter Data
Attachment B – Groundwater VOC Analytical Data – All Detections
Attachment C – Field Notes
Attachment D – Data Validation Reports

## ACRONYMS

cells/ml	halorespirer bacterial cells per milliliter
COC	contaminant of concern
°C	degrees Celsius
DCE	dichloroethene
DDC	density-driven convection
DO	dissolved oxygen
DPT	direct-push technology
EPA	United States Environmental Protection Agency
EPI	Environmental Partners, Inc.
ERD	enhanced reductive dechlorination
IM	Interim Measure
mg/L	milligrams per liter
mS/cm	milliSiemens per centimeter
mV	millivolts
µg/L	micrograms per liter
NTU	nephelometric turbidity units
NO <sub>3</sub>	nitrate ion
ORP	oxidation-reduction potential
PCE	tetrachloroethene
PPM	priority pollutant metals
RT-PCR	real time polymerase chain reaction
SAP	Sampling and Analysis Plan
SO <sub>4</sub>	sulfate ion
TCE	trichloroethene
TOC	total organic carbon
VC	vinyl chloride
VOC	volatile organic compound

## 1.0 INTRODUCTION

This second semiannual report presents data and evaluations of third and fourth quarter sample results for the Enhanced Reductive Dechlorination (ERD) Interim Measure (IM) at the 2-66 Sheetpile in the 2-66 Area at Boeing Plant 2. The report covers data generated during the time period from May 2009 through October 2009.

In a letter dated August 18, 2008 from the United States Environmental Protection Agency Region X (EPA) to Boeing, EPA gave approval to implement the *Interim Measure Work Plan for 2-66 Sheetpile* (Environmental Partners, Inc. [EPI], 2008). This work plan presented details for continued groundwater remediation to be performed on groundwater impacted by chlorinated volatile organic compounds (VOCs) inside the 2-66 Sheetpile. Figure 1 presents a general location map of Plant 2 and Figure 2 is a site representation showing the location of the 2-66 Sheetpile at Plant 2.

In a letter to Boeing dated September 17, 2009, EPA required two modifications to the approved 2-66 ERD IM work plan. The modifications are:

- Quarterly sampling of all monitoring wells inside the 2-66 sheetpile for VOCs, metals, and pH; and
- Quarterly sampling of wells PL2-041AA, PP-2B-O, and PP-4B-O for VOCs, metals, and pH.

The letter also specified that Boeing was to continue with its plan to sequence analyses for other constituents at wells inside the sheetpile. In response to this letter, Boeing issued a revised *Interim Measure Work Plan for 2-66 Sheetpile* dated October 19, 2009 (EPI, 2009a). The work plan modifications added wells PL2-041AA (008A), PL2-008C, PP-2B-O, and PP-4B-O to the monitoring schedule effective the fourth quarter sampling event (October 2009). Well PP-3C-I may be added to the quarterly monitoring schedule, if required by EPA pending review of analytical results.

Two IMs were previously completed in this area. In 1994, the sheetpile structure was installed to contain the bulk of high-concentration VOCs and to prevent migration of VOC-impacted groundwater to the Duwamish Waterway. A 2001 study concluded that, based on hydraulic and contaminant concentration data, the 2-66 Sheetpile structure effectively contains the bulk of VOC impacted soil and groundwater in the area (Weston, 2001). In 2004, two density-driven convection (DDC) wells were installed inside the sheetpile to remediate vadose zone soil and groundwater within the 2-66 Sheetpile structure. Results of an evaluation in 2006 indicated that contaminant mass inside the sheetpile was reduced by approximately 98 percent in both soil and groundwater as reported in the *Interim Measure Evaluation and Completion Report at the Building 2-66 Sheetpile* (EPI, 2007a). This report concluded that continued operation of the DDC system to remediate the last few hundred pounds of VOCs would be inefficient and remediation could be more effectively performed using *in situ* ERD. Based on these results Boeing proposed and EPA approved the application of ERD as the next IM remediation step at the 2-66 Sheetpile.

Analytical results presented in the *2-66 Area Data Gap Investigation Report* (EPI, 2007b) indicate that the main contaminants of concern (COCs) inside the 2-66 Sheetpile are trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC). Figures showing the distribution and constituent concentrations of impacted groundwater within the sheetpile structure are presented in the *2-66 Area Data Gap Investigation Report* (EPI, 2007b) and in the IM Work Plan (EPI, 2009a). Figure 3 presents a detailed drawing of the 2-66 Sheetpile and vicinity showing direct-push injection points and monitoring wells associated with the ERD IM.

## 2.0 INTERIM MEASURE IMPLEMENTATION

ERD is an *in situ* chemical application that manipulates groundwater geochemistry to promote the growth of certain bacteria that are effective in the reductive degradation of chlorinated VOCs. Under appropriate conditions certain bacteria can metabolize chlorinated VOCs by successively removing chlorine atoms from the ethene backbone until only ethene or ethane gas remains.

Implementation of the 2-66 ERD IM consisted of the following steps, which were reported in *2-66 Enhanced Reductive Dechlorination Interim Measure – First Semiannual Report* (EPI, 2009b).

- Baseline groundwater monitoring
- Injection of the nutrient substrate solution
- Performance monitoring of the remedial technology

Baseline groundwater sampling was performed at 15 monitoring wells inside the 2-66 Sheetpile on August 27 and September 2 and 3, 2008. Baseline monitoring was conducted to provide initial COC concentrations and subsurface geochemical conditions prior to implementing ERD.

A nutrient substrate solution of approximately 6 percent sugar and 2,400 milligrams per liter (mg/L) of sodium bicarbonate buffer in potable water was injected by direct-push technology (DPT) into a grid of 26 locations spread uniformly inside of the 2-66 Sheetpile at the locations shown in Figure 3. The substrate injections took place from October 7 to 16, 2008. Because the B level of the aquifer is naturally more anaerobic at Plant 2, less nutrient substrate was injected to promote ERD in the B level. Approximately 9,500 pounds of sugar was injected throughout the 2-66 Sheetpile; 7,520 pounds (13,400 gallons) were injected into the A level and 1,980 pounds (3,500 gallons) were injected into the B level. A complete description of the nutrient substrate injection is presented in the *First Semiannual Report* (EPI, 2009b).

Groundwater pH was routinely monitored after injections. A buffer solution of sodium bicarbonate in potable water was added twice to a few 2-66 Sheetpile wells to raise groundwater pH to levels appropriate for bacterial growth. Significantly low pH measurements have not been noted in the wells associated with the 2-66 ERD IM.

Performance monitoring is done on a quarterly basis to evaluate the degree of success and effect of the ERD remedial treatment. Performance monitoring results are compared to baseline monitoring results and previous performance monitoring results to calculate changes in contaminant concentrations and trends in subsurface conditions. The first and second quarters of performance sampling took place on January 20 and 21, 2009 and April 20 and 21, 2009, respectively. Results for the first two quarters are presented in the *First Semiannual Report* (EPI, 2009b).

### 3.0 PERFORMANCE MONITORING METHODOLOGY

Groundwater samples were collected using the methods and procedures presented in Section 3.3 “Sampling Procedures” of the Sampling and Analysis Plan (SAP), found in Appendix A of the revised IM Work Plan (EPI, 2009a). Sampled wells are listed below and their locations are shown in Figure 3.

- |            |                     |            |
|------------|---------------------|------------|
| • PL2-010A | • PL2-035A          | • PP-2B-O* |
| • PL2-017A | • PL2-041AA* (008A) | • PP-3A-I  |
| • PL2-021A | • PL2-008B          | • PP-3B-I  |
| • PL2-021B | • PL2-008C*         | • PP-4B-I  |
| • PL2-021C | • PP-1B-I           | • PP-4B-O* |
| • PL2-031A | • PP-2B-I           | • PP-5B-I  |
| • PL2-032A |                     |            |

Wells marked with an asterisk were added to the performance monitoring network as directed by EPA in its September 17, 2009 letter to Boeing. These changes became effective the fourth quarter sampling event, October 2009. Well PP-3C-I may be added to the monitoring schedule at a latter date, if required by EPA, pending review of analytical results. Boeing will continue monitoring for other ERD-related constituents as indicated in the revised IM Work Plan.

Groundwater samples from all 19 wells are analyzed for VOCs by EPA Method 8260C and priority pollutant metals (PPM) arsenic and manganese by EPA Methods 200.8 and 6010B. Selected groundwater samples are also analyzed for the following:

- total organic carbon (TOC) by EPA Method 415.1
- dissolved gases (methane, ethane, and ethane) by EPA Method RSK-175 (modified)
- ferrous iron by Method 3500-FED
- anions (nitrate [NO<sub>3</sub>] and sulfate [SO<sub>4</sub>]) by EPA Method 300
- organic (fatty) acids by ion chromatography
- bacterial census of halorespirers by the Bio-Dechlor Census Test RT-PCR.

Tables in the SAP (Appendix A) of the revised IM Work Plan (EPI, 2009a) present the sampling and analysis schedule and specifications for analytical method reporting limits, containers, preservation, and holding times.

Some groundwater samples from 2-66 ERD IM wells effervesced when exposed to hydrochloric acid in preserved VOC sample vials. This reaction can adversely affect VOC analytical results by stripping VOCs from the sample. To reduce the impact of effervescing samples on analyses, these samples were collected using unpreserved (i.e., no hydrochloric acid) sample vials. This necessary deviation from the VOC sampling process in the 2-66 ERD IM work plan is consistent with approved VOC sampling procedures in data gap investigation work plans. The use of unpreserved sample vials does not adversely affect sample quality or the analytical reporting limits; however, laboratory holding time is reduced from 14 days to 7 days.

## **4.0 PERFORMANCE MONITORING RESULTS**

### **4.1 Third Quarter Sampling Results**

The third quarter of performance monitoring occurred on July 20 and 21, 2009. Field parameter measurements made during sampling are presented in Table 1 and Attachment A. Third quarter groundwater analytical data results are presented in Table 2 and Attachment B. Field notes for the third quarter monitoring event are presented in Attachment C. Data validation results are presented in Attachment D.

Concentrations of the four main chlorinated VOC constituents (tetrachloroethene [PCE], TCE, DCE, and VC) at wells PL2-021A and PL2-035A remain in the range of 1,000s micrograms per liter ( $\mu\text{g/L}$ ) with chlorinated VOC concentrations at PL2-010A and PP-4B-I in the range of 100s  $\mu\text{g/L}$ . With a few exceptions, most other chlorinated VOC results are generally less than 5  $\mu\text{g/L}$ .

TOC concentrations, which are indicative of nutrient substrate, range from non-detect at PL2-017A to 530 milligrams per liter ( $\text{mg/L}$ ) at PL2-021A. These concentrations are relatively small compared to the target injection concentrations of 900  $\text{mg/L}$  in the B level to 1,500  $\text{mg/L}$  in the A level. Microorganisms have likely consumed much nutrient substrate because the static groundwater conditions inside the sheetpile do not allow the nutrient substrate to be flushed away or diluted by groundwater flow. Due to the sheetpile structure there is no advective flow of groundwater to mix and distribute TOC throughout the sheetpile. Thus, after the initial induced circulation immediately following nutrient injection, limited dispersion caused by slight tidal pressure fluctuations and diffusion are the only mechanisms available to cause the nutrient substrate to mix with groundwater inside the sheetpile.

Detections of ethane and/or ethene dissolved gas concentrations at PL2-032A, PL2-035A, and PL2-021A indicate that the ERD process has destroyed some of the chlorinated VOCs in the vicinities of these wells. Field parameter measurements from these same wells and PL2-017A also indicate reducing conditions necessary for ERD due to methane dissolved gas and ferrous iron concentrations. Finally, bacterial census for halorespirers concentrations at PL2-017A and PL2-021A (the only wells analyzed for this variable) indicate the development of the population of microorganisms required for ERD.

Third quarter performance monitoring results demonstrated that the ERD process is working and is destroying chlorinated VOCs in groundwater inside the 2-66 Sheetpile.

### **4.2 Fourth Quarter Sampling Results**

The fourth quarter performance monitoring occurred October 19 to 22, 2009. Field parameter measurements made during sampling are presented in Table 1 and Attachment A. Fourth quarter groundwater analytical data results are presented in Table 3 and Attachment B. Wells

PL2-041AA, PL2-008C, PP-2B-O, and PP-4B-O and analyses of VOC and PPM metals at all wells were added during the fourth quarter monitoring as required by EPA. Field notes for the fourth quarter monitoring event are presented in Attachment C. Data validation results are presented in Attachment D.

Chlorinated VOC results for fourth quarter samples are similar to third quarter results with the greatest concentrations (1,000s µg/L) in samples from PL2-021A and PL2-035A and slightly lesser concentrations (100s µg/L) in samples from PL2-010A and PP-4B-I. Newly sampled well PL2-041AA also indicated chlorinated VOC concentrations in the 100s µg/L and newly sampled wells PP-2B-O and PP-4B-O, located just outside and at depths near the bottom of the sheetpile wall, had chlorinated VOCs concentrations between approximately 10 µg/L and 50 µg/L.

TOC, dissolved gases, ferrous iron, anion, and organic acid concentration results for fourth quarter samples were similar to third quarter results. The data trend evaluation discussion in the following section will provide additional insight into the fourth quarter data. The bacterial census of halorespirers at PL2-021A significantly increased from the third to the fourth quarter indicating that this location is responding well to the favorable subsurface conditions caused by the nutrient substrate injection.

In response to EPA's September 17<sup>th</sup> letter to Boeing, PPM metals arsenic and manganese were analyzed for in every well during the fourth quarter. The greatest concentrations of arsenic (13.2 µg/L) and manganese (1,530 µg/L) were in the sample from PL2-021A, which has also shown the greatest ERD response; however, the elevated metal concentrations may be related to the residual effect of acid injection associated with the previous DDC IM rather than the ERD IM. PL2-032A, PL2-035A, and PP-1B-I also have manganese concentrations greater than 1,000 µg/L, but have arsenic concentrations below 2.0 µg/L. The arsenic concentration of 13.2 µg/L at PL2-021A is the only concentration that exceeds the Plant 2 background concentration of 8 µg/L for arsenic and no manganese concentrations exceed the Plant 2 background concentration of 2,000 µg/L for manganese.

### **4.3 Data Trend Analysis**

Table 4 presents analytical results for baseline and the first four quarters of performance monitoring. Conclusions regarding ERD progress at the 2-66 Sheetpile, based on analytical results over the 1-year time period since nutrient substrate injection, are presented in the following paragraphs.

VOC trend data for PL2-021A presented in Table 4 indicate that concentrations of more-chlorinated VOC compounds (i.e., PCE and TCE) shifted over time to increasing concentrations of less-chlorinated VOCs (i.e., DCE and VC) and further shifted to decreasing concentrations of all VOCs, including less-chlorinated VOCs. These trends are apparent in the TCE, DCE, and VC data of PL2-021A, which are shown graphically in Figure 4. TCE concentrations at this well were relatively large for the baseline sampling event and decreased during successive quarters. DCE

concentrations initially increased, due to ERD conversion from TCE to DCE, and ultimately decreased in trend over the sampling events. VC data indicated a steady increase in concentrations as VC was produced from dechlorination of DCE. Future sampling events at PL2-021A will be evaluated for decreasing concentrations of VC and increasing concentrations of ethane and ethene dissolved gases, the final products of reductive dechlorination.

A similar progression from more chlorinated VOCs to lesser chlorinated VOCs is demonstrated by the data for PL2-035A as presented in Figure 4. At this location the shift in chlorinated VOC concentrations is limited to DCE and VC data only because PCE was not detected and TCE was at very low concentrations in baseline data. Although it is more difficult to discern the data trends at lower concentrations, the ERD degradation process also appears to be demonstrated at PL2-008B, PL2-032A, PP-4B-I, and PP-2B-I as indicated by the data in Table 4. Data variability makes interpretation of data from wells with low VOC concentrations difficult.

The increasing trend of dissolved gases, ferrous iron, organic acids, and bacterial census of halorespirer concentrations at select wells indicates favorable responses to nutrient injections resulting in successful and ongoing ERD. Analytical data for manganese in samples from PL2-017A and PL2-021A indicate a decrease in manganese concentration from baseline to fourth quarter. Arsenic concentrations have increased at PL2-021A from baseline to fourth quarter, but show no trend at PL2-017A over the same period.

As indicated in Table 1, the lowest measured pH values in groundwater from 2-66 monitoring wells were generally noted during baseline sampling. The low baseline pH values measured in PL2-010A and PL2-021A were likely a localized artifact of the acid injection performed at the DDC wells to prevent fouling during the previous DDC IM. Over time pH values have moderated and the nutrient substrate injection at the 2-66 Sheetpile has not created any new low pH impacts that sometimes occur with ERD.

## **5.0 CONCLUSIONS**

Injection of a nutrient substrate solution inside the 2-66 Sheetpile has successfully initiated ERD and begun to decrease total chlorinated VOC concentrations. Metals concentrations appear not to have been impacted and undesirable decreases in pH that sometimes result from nutrient substrate injection have not been noted in the 2-66 ERD IM data.

TOC concentration trends appear to have peaked and are decreasing in most wells. In the year since the initial nutrient and buffer substrate injection it is likely that microorganisms have consumed much of the injected substrate and more nutrient solution is needed to maintain subsurface conditions favorable for ERD. Consistent with the work plan, Boeing plans to perform a second nutrient and buffer substrate injection in May 2010 to maintain and enhance the geochemically reducing conditions required for ERD using the same nutrient solution that was injected in the previous round.

## 6.0 SCHEDULE

The schedule below gives the dates of expected future performance monitoring and reporting events for the 2-66 ERD IM. Per the revised work plan, Boeing will conduct performance monitoring events on a quarterly schedule. EPA will be notified in advance of the planned field work dates for a future nutrient substrate injection.

**Schedule for 2-66 Sheetpile ERD IM**

5th Quarter	January 2010	Performance Monitoring
Reporting	January 2010	2nd Semiannual Report
6th Quarter	April 2010	Performance Monitoring
Injection	May 2010	Second Nutrient Substrate Injection
7th Quarter	July 2010	Performance Monitoring
Reporting	July 2010	3rd Semiannual Report

## 7.0 REFERENCES

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- EPI, 2007b Environmental Partners, Inc. “2-66 Area Data Gap Investigation Report.” Boeing Plant 2. The Boeing Company, Seattle/Tukwila, Washington. June 15, 2007.
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## **TABLES**

Table 1. 2-66 ERD IM Groundwater Field Parameter Summary

Well	Event	Date	Time	Depth to Water (feet)	Total Volume Purged (gallons)	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temperature (°C)	Turbidity (NTUs)	Specific Conductivity (mS/cm)	Comments
PL2-041AA	4th Quarter	10/20/09	10:15	8.50	3.1	7.44	0.89	-3.0	16.04	4.33	1.290	clear, yellow
PL2-008B	Baseline	9/2/08	14:03	10.55	3.3	5.91	0.07	-90.1	14.70	NM	3.416	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	14:09	11.21	1.5	7.55	0.14	-149.2	15.29	0.83	2.637	clear
	4th Quarter	10/20/09	12:26	9.88	2.3	6.85	0.85	-38.2	14.42	1.06	4.179	clear
PL2-008C	4th Quarter	10/20/09	11:01	9.40	1.6	7.88	0.89	17.3	14.15	0.79	5.781	clear
PL2-010A	Baseline	9/2/08	11:35	10.22	2.7	4.00	0.20	126.1	14.99	6.15	3.768	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	11:34	10.42	1.5	5.87	0.18	88.1	15.73	0.36	2.297	clear
	4th Quarter	10/21/09	11:10	9.59	2.3	5.68	0.68	89.3	15.20	1.14	2.709	clear
PL2-017A	Baseline	8/27/08	11:20	10.28	5.2	6.26	0.77	-117.9	16.90	45.80	15.71	clear
	1st Quarter	1/21/09	13:20	9.41	4.2	6.20	0.50	22	8.50	22.0	0.15	clear
	2nd Quarter	4/21/09	14:05	10.57	3.2	6.71	0.21	-37.0	9.87	1.10	1.582	clear
	3rd Quarter	7/21/09	8:24	10.30	3.5	7.03	0.31	-20.1	14.42	0.16	9.234	clear
	4th Quarter	10/19/09	14:11	9.33	1.9	6.37	0.50	-221.5	16.13	0.63	14.72	clear
PL2-021A	Baseline	8/27/08	10:13	11.09	4.5	4.02	0.65	930.7	16.58	8.21	4.026	clear
	1st Quarter	1/20/09	10:25	10.52	7.5	5.20	2.00	-117	13.50	30.0	0.42	amber color
	2nd Quarter	4/20/09	12:04	11.42	4.0	6.07	0.18	-124.3	14.12	7.85	4.783	clear
	3rd Quarter	7/21/09	11:46	11.01	5.0	8.23	0.11	-129.2	15.41	8.59	4.520	slightly cloudy
	4th Quarter	10/19/09	12:44	10.27	2.7	5.74	0.69	-108.3	15.89	2.45	3.902	clear, odor
PL2-021B	Baseline	9/2/08	9:50	10.84	3.5	5.65	0.17	-124.3	14.08	8.30	5.637	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/21/09	12:44	11.24	2.6	8.26	0.10	-52.0	15.27	1.08	4.926	clear
	4th Quarter	10/22/09	8:51	10.23	3.0	6.75	1.06	-55.6	13.94	1.02	9.293	clear
PL2-021C	Baseline	9/2/08	10:23	11.15	4.0	5.98	0.13	-215.3	14.61	9.87	23.94	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/21/09	13:20	11.99	2.1	8.79	0.05	-177.1	15.97	3.79	22.83	clear
	4th Quarter	10/22/09	9:46	10.02	3.0	7.65	0.96	-166.0	14.62	8.31	22.83	clear
PL2-031A	Baseline	8/27/08	12:45	10.51	3.9	6.91	0.79	-73.2	14.68	6.69	2.002	clear
	1st Quarter	1/21/09	15:10	9.01	2.5	6.90	0.60	-71	13.10	3.65	0.22	clear
	2nd Quarter	4/21/09	11:21	10.28	1.9	6.90	0.14	-162.5	12.60	8.88	2.508	clear
	3rd Quarter	7/21/09	10:05	10.13	2.3	7.77	0.23	-5.1	14.15	0.68	1.901	clear
	4th Quarter	10/19/09	15:54	8.94	2.1	6.75	0.28	-19.6	14.56	9.64	1.960	clear
PL2-032A	Baseline	8/27/08	8:14	10.86	4.0	4.79	0.67	587.6	15.68	7.48	2.598	clear
	1st Quarter	1/20/09	11:04	10.21	2.8	6.60	0.80	-103	12.20	14.39	0.26	amber color
	2nd Quarter	4/20/09	10:45	11.22	3.3	6.64	0.28	-121.1	14.08	7.54	2.624	clear
	3rd Quarter	7/20/09	8:52	10.84	4.0	6.78	0.35	-59.7	15.06	0.61	2.139	clear
	4th Quarter	10/19/09	11:07	10.02	4.3	6.26	0.62	-56.0	15.61	2.63	2.191	clear

Table 1. 2-66 ERD IM Groundwater Field Parameter Summary

Well	Event	Date	Time	Depth to Water (feet)	Total Volume Purged (gallons)	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temperature (°C)	Turbidity (NTUs)	Specific Conductivity (mS/cm)	Comments
PL2-035A	Baseline	9/2/08	12:55	10.40	6.0	6.31	0.07	-59.2	15.38	8.13	3.221	clear
	1st Quarter	1/20/09	12:49	9.82	2.8	6.60	0.90	-168	14.40	3.36	0.32	clear
	2nd Quarter	4/21/09	9:15	11.08	3.2	6.42	0.18	-118.8	14.46	9.84	3.824	clear
	3rd Quarter	7/20/09	10:25	10.81	2.0	6.97	0.14	-62.4	15.75	0.96	2.686	clear
	4th Quarter	10/20/09	15:16	9.75	3.3	6.68	0.79	-59.6	15.44	4.19	3.039	clear
PP-1B-I	Baseline	9/3/08	8:46	11.20	3.2	6.88	0.08	109.5	14.36	7.13	8.568	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/21/09	14:03	11.43	2.4	8.20	0.07	-36.5	16.26	1.02	7.495	clear
	4th Quarter	10/21/09	15:49	10.41	2.2	6.99	0.76	-205.4	14.62	2.99	13.84	clear
PP-2B-I	Baseline	9/3/08	10:03	10.10	4.5	7.05	0.05	29.9	15.55	9.43	5.037	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	11:04	12.34	2.2	6.96	0.11	-61.7	16.18	8.88	4.296	clear
	4th Quarter	10/20/09	14:17	9.39	3.0	6.98	0.8	-70.0	14.88	4.49	4.178	clear
PP-2B-O	4th Quarter	10/20/09	13:30	9.04	2.1	6.83	1.06	-49.4	15.24	2.83	3.732	clear, slightly gray
PP-3A-I	Baseline	9/2/08	15:15	10.92	4.3	6.05	0.04	-61.6	14.01	7.31	2.722	clear
	1st Quarter	1/21/09	14:25	9.52	2.8	6.40	0.60	7	13.80	1.5	0.19	clear
	2nd Quarter	4/21/09	9:56	10.78	2.2	6.29	0.16	-4.9	13.99	4.56	2.692	clear
	3rd Quarter	7/20/09	12:01	10.51	2.0	6.89	0.07	-23.8	14.63	1.75	2.238	clear
	4th Quarter	10/21/09	12:27	9.53	2.1	7.09	0.44	19.5	14.84	1.68	2.129	clear
PP-3B-I	Baseline	9/2/08	15:59	11.04	4.5	6.06	0.03	-95.4	14.11	22.70	9.979	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	13:13	10.75	3.3	8.01	0.20	-262.4	15.12	1.01	9.315	clear
	4th Quarter	10/21/09	13:41	9.44	5.1	7.54	0.35	-284.9	13.95	0.44	11.32	clear, gray
PP-4B-I	Baseline	9/3/08	11:00	10.25	4.1	6.85	0.06	42.3	16.28	8.68	3.749	clear
	1st Quarter	1/20/09	12:01	9.57	2.2	6.70	0.7	-134	14.00	3.38	0.54	clear
	2nd Quarter	4/21/09	10:45	11.49	2.6	6.96	0.11	-280.3	16.12	5.41	4.639	clear
	3rd Quarter	7/20/09	9:52	10.80	2.7	7.09	0.28	-52.1	15.83	0.09	2.997	clear
	4th Quarter	10/21/09	9:35	9.45	1.7	6.96	0.64	-60.3	15.43	1.01	3.411	clear
PP-4B-O	4th Quarter	10/21/09	9:03	9.09	2.4	6.76	0.82	-56.9	15.49	1.57	3.455	clear
PP-5B-I	Baseline	9/3/08	12:05	10.50	2.5	6.95	0.02	77.9	14.47	7.92	15.25	clear
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	13:40	10.88	1.5	8.40	0.13	-179.5	15.09	0.31	0.400	clear
	4th Quarter	10/21/09	14:41	9.50	2.5	8.16	0.42	-169.9	14.95	0.93	0.492	clear

Notes:

°C = degrees Celsius  
 mg/L = milligrams per liter  
 mS/cm = milliSiemens per centimeter  
 mV = millivolt

NM = not measured  
 NS = not sampled  
 NTU = nephelometric turbidity units  
 ORP = oxidation-reduction potential

**Table 2. 2-66 ERD IM Third Quarter Groundwater Monitoring Analytical Results (July 2009)**

Well	Date	VOCs (µg/L)				TOC (mg/L)	Dissolved Gases (µg/L)			Ferrous Iron (mg/L)	Anions (mg/L)		Metals (µg/L)		Organic Acids (mg/L)						Bacterial Census (cells/ml)	
		PCE	TCE	DCE	VC		Methane	Ethane	Ethene		NO <sub>3</sub>	SO <sub>4</sub>	Arsenic	Manganese	Pyruvic	Lactic	Formic	Acetic	Propionic	Butyric		
PL2-008B	7/20/09	<0.2	0.2	1.3	2.9	5.45	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PL2-008B (dup)	7/20/09	<0.2	0.2	1.2	2.9	5.45	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PL2-010A	7/20/09	<5.0	860	89	<5.0	1.88	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PL2-017A	7/21/09	<0.2	0.6	<0.2	<0.2	<1.50	4.6	<1.2	<1.1	3.98	<0.2	403	<1	102	<10	<25	ND	<1	<1	<1	18.6	
PL2-017 (dup)	7/21/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.70
PL2-021A	7/21/09	<20	<20	4,720	360	530	190	<1.2	10.2	479	<1.0	<0.5	14.0	1,930	<10	9.6	ND	380	66	260	6,800	
PL2-021B	7/21/09	<0.2	<0.2	3.4	3.0	14.1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PL2-021C	7/21/09	<0.2	<0.2	<0.2	0.7	43.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PL2-031A	7/21/09	<0.2	7.2	2.8	<0.2	7.39	11.8	<1.2	<1.1	1.91	<0.1	64.5	NS	NS	<10	2.4	ND	<1	<1	<1	NS	
PL2-032A	7/20/09	<0.2	<0.2	0.6	11	15.6	3,170	317	466	32.2	<0.1	0.2	NS	NS	<10	<25	ND	<1	<1	<1	NS	
PL2-032A (dup)	7/20/09	<0.2	<0.2	0.6	11	17.5	3,120	285	429	31.4	<0.1	0.2	NS	NS	<10	<25	ND	<1	<1	<1	NS	
PL2-035A	7/20/09	<100	<100	6,400	3,000	6.84	9,080	44.5	225	50.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-1B-I	7/21/09	<0.2	0.3	1.3	<0.2	4.94	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-2B-I	7/20/09	<0.2	<0.2	0.4	1.4	136	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-3A-I	7/20/09	<0.2	2.0	4.9	2.2	5.52	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-3B-I	7/20/09	<0.2	1.4	3.5	2.6	164	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-4B-I	7/20/09	<10	<10	150	360	3.81	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-5B-I	7/20/09	<0.2	0.3	0.7	<0.2	3.59	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

**NOTES:**

< = not detected at the reporting limit indicated

J = estimated result

ND = no data reported

NS = no sample submitted for this analysis

cells/ml = cells per milliliter

mg/L = milligrams per liter

µg/L = micrograms per liter

DCE = sum of cis-1,2-, trans-1,2-, and 1,1-dichloroethene

PCE = tetrachloroethene

TCE = trichloroethene

TOC = total organic carbon

VC = vinyl chloride

VOCs = volatile organic compounds

NO<sub>3</sub> = nitrate ion

SO<sub>4</sub> = sulfate ion

**Table 3. 2-66 ERD IM Fourth Quarter Groundwater Monitoring Analytical Results (October 2009)**

Well	Date	VOCs (µg/L)				TOC (mg/L)	Dissolved Gases (µg/L)			Ferrous Iron (mg/L)	Anions (mg/L)		Metals (µg/L)		Organic Acids (mg/L)						Bacterial Census (cells/ml)
		PCE	TCE	DCE	VC		Methane	Ethane	Ethene		NO <sub>3</sub>	SO <sub>4</sub>	Arsenic	Manganese	Pyruvic	Lactic	Formic	Acetic	Propionic	Butyric	
PL2-041AA	10/20/09	<1.2	220	277.3	4.0	NS	NS	NS	NS	NS	NS	NS	4.1	48	NS	NS	NS	NS	NS	NS	NS
PL2-008B	10/20/09	<0.2	0.4	1.1	1.9	3.59	NS	NS	NS	NS	NS	NS	0.6	724	NS	NS	NS	NS	NS	NS	NS
PL2-008C	10/20/09	<0.2	<0.2	0.4	0.9	NS	NS	NS	NS	NS	NS	NS	1	45	NS	NS	NS	NS	NS	NS	NS
PL2-010A	10/21/09	<6.0	520	86	6.6	<1.50	NS	NS	NS	NS	NS	NS	<0.5	747	NS	NS	NS	NS	NS	NS	NS
PL2-017A	10/19/09	<0.2	0.9	0.2	<0.2	1.94	9.7	<1.2	<1.1	0.702	<1.0	576	<1	30	<0.070 M	0.066 J	ND	0.050 J	<0.070	<0.070	17.5
PL2-017A (dup)	10/19/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.50
PL2-021A	10/19/09	<20	<20	1,000	11,000	473	253	<1.2	76.5	396	<0.5	0.8	13.2	1,530	6.6	2.2	ND	410	60	220	372,000
PL2-021B	10/22/09	<0.2	<0.2	0.8	0.5	<1.50	NS	NS	NS	NS	NS	NS	<1	481	NS	NS	NS	NS	NS	NS	NS
PL2-021C	10/22/09	<0.2	<0.2	<0.2	0.7	46.4	NS	NS	NS	NS	NS	NS	<2	359	NS	NS	NS	NS	NS	NS	NS
PL2-031A	10/19/09	<0.2	1.2	1.7	0.5	5.86	32.8	<1.2	<1.1	0.878	<0.5	75.5	7.0	65	<0.070 M	0.091 J	ND	0.030 J	<0.070	<0.070	NS
PL2-031A (dup)	10/19/09	<0.2	1.0	1.5	0.6	6.11	39.0	<1.2	<1.1	0.907	<0.5	74.6	7.3	65	<0.070 M	0.087 J	ND	0.038 J	<0.070	<0.070	NS
PL2-032A	10/19/09	<0.2	<0.2	0.9	14	14.4	4,380	306	323	30.3	<0.1	0.7	1.4	1,370	<0.070 M	0.100 J	ND	0.020 J	<0.070	<0.070	NS
PL2-035A	10/20/09	<12	<12	2,124	2,800	3.98	10,300	41.2	230	41.8	NS	NS	0.7	1,390	NS	NS	NS	NS	NS	NS	NS
PP-1B-I	10/21/09	<0.2	<0.2	12	3.0	78.0	NS	NS	NS	NS	NS	NS	<2	1,210	NS	NS	NS	NS	NS	NS	NS
PP-1B-I (dup)	10/21/09	<0.2	<0.2	13	4.0	77.6	NS	NS	NS	NS	NS	NS	<2	1,180	NS	NS	NS	NS	NS	NS	NS
PP-2B-I	10/20/09	<0.2	0.4	0.3	1.1	18.2	NS	NS	NS	NS	NS	NS	<0.5	397	NS	NS	NS	NS	NS	NS	NS
PP-2B-O	10/20/09	<0.2	<0.2	0.5	39	NS	NS	NS	NS	NS	NS	NS	<0.5	597	NS	NS	NS	NS	NS	NS	NS
PP-3A-I	10/21/09	<0.2	2.0	12.1	0.2	4.76	NS	NS	NS	NS	NS	NS	2.7	321	NS	NS	NS	NS	NS	NS	NS
PP-3B-I	10/21/09	<0.2	0.6	1.5	1.3	48.0	NS	NS	NS	NS	NS	NS	<1	553	NS	NS	NS	NS	NS	NS	NS
PP-4B-I	10/21/09	<1.0	<1.0	70	130	3.27	NS	NS	NS	NS	NS	NS	<0.5	548	NS	NS	NS	NS	NS	NS	NS
PP-4B-O	10/21/09	<0.2	2.0	14	45	NS	NS	NS	NS	NS	NS	NS	<0.5	217	NS	NS	NS	NS	NS	NS	NS
PP-5B-I	10/21/09	<0.2	0.3	1.0	<0.2	<1.5	NS	NS	NS	NS	NS	NS	<0.5	56	NS	NS	NS	NS	NS	NS	NS

**NOTES:**

< = not detected at the reporting limit indicated

J = estimated result

M = recovery/relative percent difference poor for matrix spike/matrix spike duplicate

ND = no data reported

NS = no sample submitted for this analysis

cells/ml = cells per milliliter

mg/L = milligrams per liter

µg/L = micrograms per liter

DCE = sum of cis-1,2-, trans-1,2-, and 1,1-dichloroethene

PCE = tetrachloroethene

TCE = trichloroethene

TOC = total organic carbon

VC = vinyl chloride

VOCs = volatile organic compounds

NO<sub>3</sub> = nitrate ion

SO<sub>4</sub> = sulfate ion

Table 4. 2-66 ERD IM Groundwater Monitoring Analytical Data Summary

Well	Event	Date	VOCs (µg/L)				TOC (mg/L)	Dissolved Gases (µg/L)			Ferrous Iron (mg/L)	Anions (mg/L)		Metals (µg/L)		Organic Acids (mg/L)					Bacterial Census (cells/ml)		
			PCE	TCE	DCE	VC		Methane	Ethane	Ethene		NO <sub>3</sub>	SO <sub>4</sub>	Arsenic	Manganese	Pyruvic	Lactic	Formic	Acetic	Propionic		Butyric	
PL2-041AA	4th Quarter	10/20/09	<1.2	220	277.3	4.0	NS	NS	NS	NS	NS	NS	NS	4.1	48	NS	NS	NS	NS	NS	NS	NS	NS
PL2-008B	Baseline	9/2/08	<1.0	<1.0	5.8	46	3.07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<0.2	0.2	1.3	2.9	5.45	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/20/09	<0.2	0.4	1.1	1.9	3.59	NS	NS	NS	NS	NS	NS	0.6	724	NS	NS	NS	NS	NS	NS	NS	NS
PL2-008C	4th Quarter	10/20/09	<0.2	<0.2	0.4	0.9	NS	NS	NS	NS	NS	NS	NS	1	45	NS	NS	NS	NS	NS	NS	NS	NS
PL2-010A	Baseline	9/2/08	<5.0	590	106.8	<5.0	<1.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<6.0	520	86	6.6	<1.50	NS	NS	NS	NS	NS	NS	<0.5	747	NS	NS	NS	NS	NS	NS	NS	NS
PL2-017A	Baseline	8/27/08	<0.2	1.6	0.3	<0.2	1.66	3.5	<1.2	<1.1	6.84	<10.0	655	<2	126	<4	<1	<1	<1	<1	<1	<1	3.99
	Baseline	8/27/08	<0.2	1.5	0.2	<0.2	1.51	3.1	<1.2	<1.1	6.84	<10.0	655	<2	125	<4	<1	<1	<1	<1	<1	<1	NS
	1st Quarter	1/21/09	<0.2	2.1	0.2	<0.2	3.34	6.9	<1.2	<1.1	1.50	<0.1	52.7	<0.5	16	<4	<1	<1	<1	<1	<1	<1	NS
	2nd Quarter	4/20/00	<0.2	0.7	<0.2	<0.2	3.39	<0.7	<1.2	<1.1	0.51	<0.1	49.5	0.5	6	<4	<1	<1	<1	<1	<1	<1	NS
	3rd Quarter	7/21/09	<0.2	0.6	<0.2	<0.2	<1.50	4.6	<1.2	<1.1	3.98	<0.2	403	<1	102	<10	<25	ND	<1	<1	<1	<1	18.6
	3rd Quarter	7/21/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7.70
	4th Quarter	10/19/09	<0.2	0.9	0.2	<0.2	1.94	9.7	<1.2	<1.1	0.702	<1.0	576	<1	30	<0.070 M	0.066 J	ND	0.050 J	<0.070	<0.070	<0.070	17.5
4th Quarter	10/19/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.50	
PL2-021A	Baseline	8/27/08	4.0	2,700	870	35	9.40	6.6	<1.2	1.2	96.0	<5.0	73.0	0.9	2,840	<4	<1	<1	<1	<1	<1	<1	0.245 J
	1st Quarter	1/21/09	<300	310	3,800	<300	680	25.3	<1.2	2.6	560	<0.5	110	8.6	2,240	<4	33.1	2.4	346.9	43.3	501.6	NS	
	2nd Quarter	4/20/09	<0.2	14	5,013	22	542	15.7	<1.2	<1.1	505	<0.5	1.3	15.9	2,250	<4	<1	<1	396.4	68.3	318.7	NS	
	4th Quarter	10/19/09	<20	<20	4,720	360	530	253	<1.2	76.5	479	<1.0	<0.5	14.0	1,930	<10	9.6	ND	380	66	260	6,800	
PL2-021B	Baseline	9/2/08	<0.2	<0.2	1.2	0.6	3.21	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/22/09	<0.2	<0.2	0.8	0.5	<1.50	NS	NS	NS	NS	NS	NS	<1	481	NS	NS	NS	NS	NS	NS	NS	NS
PL2-021C	Baseline	9/2/08	<0.2	<0.2	0.3	0.4	48.8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/22/09	<0.2	<0.2	<0.2	0.7	46.4	NS	NS	NS	NS	NS	NS	<2	359	NS	NS	NS	NS	NS	NS	NS	NS
PL2-031A	Baseline	8/27/08	<0.2	3.0	1.3	2.1	5.92	12.1	<1.2	<1.1	1.03	<1.0	73.7	NS	NS	<4	<1	<1	<1	<1	<1	<1	NS
	1st Quarter	1/21/09	<0.2	2.0	2.3	1.5	6.26	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	4/21/09	<0.2	5.9	1.1	3.5	6.50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/21/09	<0.2	7.2	2.8	<0.2	7.39	11.8	<1.2	<1.1	1.91	<0.1	64.5	NS	NS	<10	2.4	ND	<1	<1	<1	NS	
	4th Quarter	10/19/09	<0.2	1.2	1.7	0.5	5.86	32.8	<1.2	<1.1	0.878	<0.5	75.5	7.0	65	<0.070 M	0.091 J	ND	0.030 J	<0.070	<0.070	NS	
4th Quarter	10/19/09	<0.2	1.0	1.5	0.6	6.11	39.0	<1.2	<1.1	0.907	<0.5	74.6	7.3	65	<0.070 M	0.087 J	ND	0.038 J	<0.070	<0.070	NS		
PL2-032A	Baseline	8/27/08	<10	<10	<10	900	10.8	3,190	295	557	28.6	<1.0	6.3	NS	NS	<4	<1	<1	<1	<1	<1	<1	88.3
	1st Quarter	1/20/09	<0.2	<0.2	1.0	41	13.9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	1/20/09	<1.0	<1.0	<1.0	43	12.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	4/20/09	<0.2	<0.2	0.6	13	23.0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	4/20/09	<0.2	<0.2	0.6	13	20.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<0.2	<0.2	0.6	11	15.6	3,170	317	466	32.2	<0.1	0.2	NS	NS	<10	<25	ND	<1	<1	<1	<1	NS
	4th Quarter	10/19/09	<0.2	<0.2	0.9	14	14.4	4,380	306	323	30.3	<0.1	0.7	1.4	1,370	<0.070 M	0.100 J	ND	0.020 J	<0.070	<0.070	NS	

Table 4. 2-66 ERD IM Groundwater Monitoring Analytical Data Summary

Well	Event	Date	VOCs (µg/L)				TOC (mg/L)	Dissolved Gases (µg/L)			Ferrous Iron (mg/L)	Anions (mg/L)		Metals (µg/L)		Organic Acids (mg/L)						Bacterial Census (cells/ml)		
			PCE	TCE	DCE	VC		Methane	Ethane	Ethene		NO <sub>3</sub>	SO <sub>4</sub>	Arsenic	Manganese	Pyruvic	Lactic	Formic	Acetic	Propionic	Butyric			
PL2-035A	Baseline	9/2/08	<100	<100	10,000	2,900	4.63	745	9.0	43.5	8.20	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
	1st Quarter	1/20/09	<250	<250	7,200	6,200	7.74	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
	2nd Quarter	4/21/09	<0.2	4.2	9,950	6,200	6.04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<100	<100	6,400	3,000	6.84	9,080	44.5	225	50.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/20/09	<12	<12	2,124	2,800	3.98	10,300	41.2	230	41.8	NS	NS	0.7	1,390	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-1B-I	Baseline	9/3/08	<0.2	<0.2	1.0	<0.2	3.12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/21/09	<0.2	0.3	1.3	<0.2	4.94	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<0.2	<0.2	12	3.0	78.0	NS	NS	NS	NS	NS	NS	<2	1,210	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-2B-I	Baseline	9/3/08	<0.2	0.3	6.6	140	1.76	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<0.2	<0.2	0.4	1.4	136	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/20/09	<0.2	0.4	0.3	1.1	18.2	NS	NS	NS	NS	NS	NS	<0.5	397	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-2B-O	4th Quarter	10/20/09	<0.2	<0.2	0.5	39	NS	NS	NS	NS	NS	NS	<0.5	597	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-3A-I	Baseline	9/2/08	<0.2	1.6	19.4	0.8	3.29	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	1/21/09	<0.2	4.2	11.2	0.7	3.78	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	4/21/09	<0.2	2.6	5.4	0.5	4.73	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<0.2	2.0	4.9	2.2	5.52	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<0.2	2.0	12.1	0.2	4.76	NS	NS	NS	NS	NS	NS	2.7	321	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-3B-I	Baseline	9/2/08	<0.2	2.0	1.2	<0.2	2.14	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<0.2	1.4	3.5	2.6	164	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<0.2	0.6	1.5	1.3	48.0	NS	NS	NS	NS	NS	NS	<1	553	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-4B-I	Baseline	9/3/08	<0.2	5.9	1,300	830	1.97	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	1/20/09	<1.0	<1.0	17	51	41.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	4/21/09	<0.2	2.5	37	120 E	84.8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	3rd Quarter	7/20/09	<10	<10	150	360	3.81	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<1.0	<1.0	70	130	3.27	NS	NS	NS	NS	NS	NS	<0.5	548	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-4B-O	4th Quarter	10/21/09	<0.2	2.0	14	45	NS	NS	NS	NS	NS	NS	<0.5	217	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
PP-5B-I	Baseline	9/3/08	<0.2	0.4	4.9	<0.2	1.77	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Baseline	9/3/08	<0.2	0.4	4.8	<0.2	1.78	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	1st Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	2nd Quarter	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	4th Quarter	10/21/09	<0.2	0.3	1.0	<0.2	<1.50	NS	NS	NS	NS	NS	NS	<0.5	56	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:

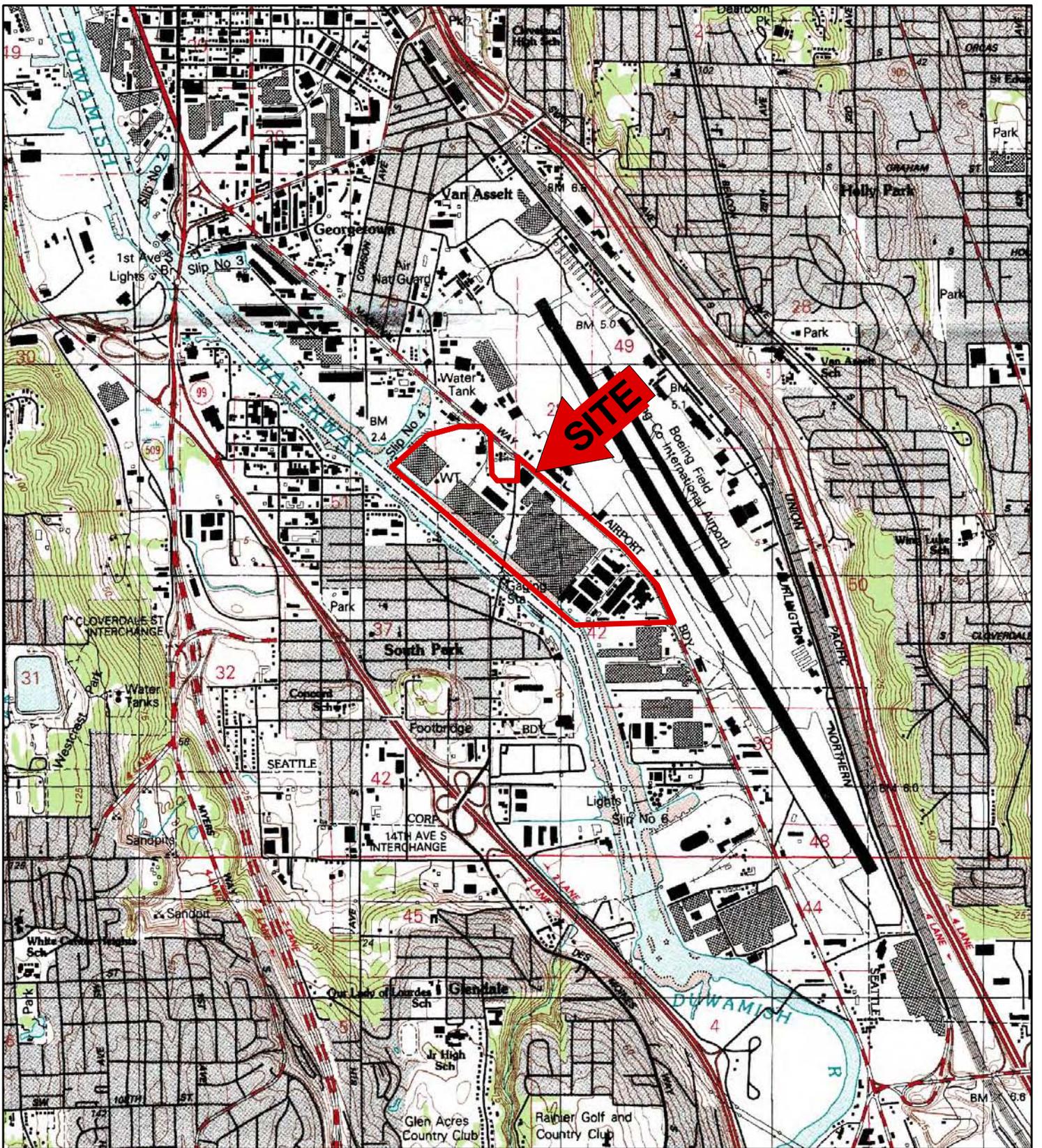
< = not detected at the value indicated  
 E = value greater than the linear range of the detector; sample dilution required  
 J = estimated result  
 M = recovery/relative percent difference poor for matrix spike/matrix spike duplicate  
 ND = no data reported  
 NS = no sample submitted for this analysis

cells/ml = cells per milliliter  
 mg/L = milligrams per liter  
 µg/L = micrograms per liter

DCE = sum of cis-1,2-, trans-1,2-, and 1,1-dichloroethene  
 PCE = tetrachloroethene  
 TCE = trichloroethene  
 TOC = total organic carbon  
 VC = vinyl chloride  
 VOCs = volatile organic compounds

NO<sub>3</sub> = nitrate ion  
 SO<sub>4</sub> = sulfate ion

## FIGURES



KEY:



SOURCE: USGS 7.5 MINUTE QUADRANGLE  
(TOPOGRAPHIC)

SEATTLE SOUTH  
1983

SCALE = 1:25,000



**ENVIRONMENTAL  
PARTNERS INC**

295 NE Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

FIGURE 1

BOEING PLANT 2  
GENERAL LOCATION

PROJECT	2-66 ERD IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	ARM	JLD	01/13/10



KING COUNTY  
INTERNATIONAL  
AIRPORT

16TH AVENUE SOUTH

EAST MARGINAL WAY SOUTH

PLANT 2

DUWAMISH WATERWAY

2-66  
SHEETPILE

KEY:



— 2-66 SHEETPILE LOCATION

— PLANT 2 BOUNDARY



APPROXIMATE SCALE: 1" = 400'



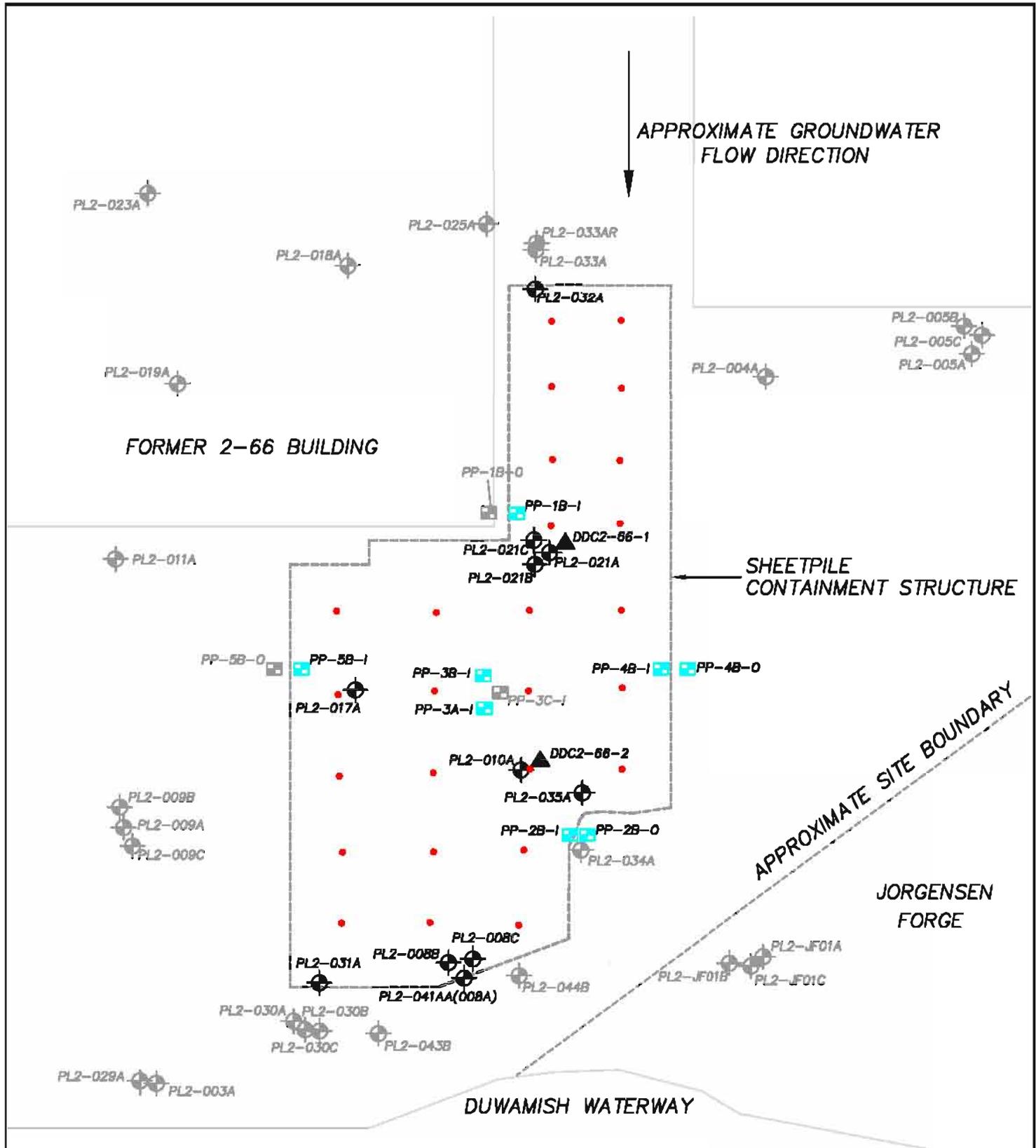
**ENVIRONMENTAL  
PARTNERS INC**

295 NB Gilman Boulevard, Suite 201  
Issaquah, Washington 98027

FIGURE 2

SITE REPRESENTATION

<b>PROJECT</b>	2-66 ERD IM SEMIANNUAL REPORT		
<b>PREPARED FOR</b>	THE BOEING COMPANY		
<b>LOCATION</b>	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
<b>SHEET</b>	<b>DRAWN BY</b>	<b>REVIEWED BY</b>	<b>DATE</b>
1 of 1	ARM	JLD	08/17/08



**KEY:**

- SUBSTRATE INJECTION LOCATION
- ⊕ PERFORMANCE MONITORING WELLS
- ⊖ OTHER MONITORING WELLS
- ▲ DDC WELL LOCATIONS
- PIEZOMETER/MONITORING WELL LOCATIONS
- SHEETPILE CONTAINMENT STRUCTURE

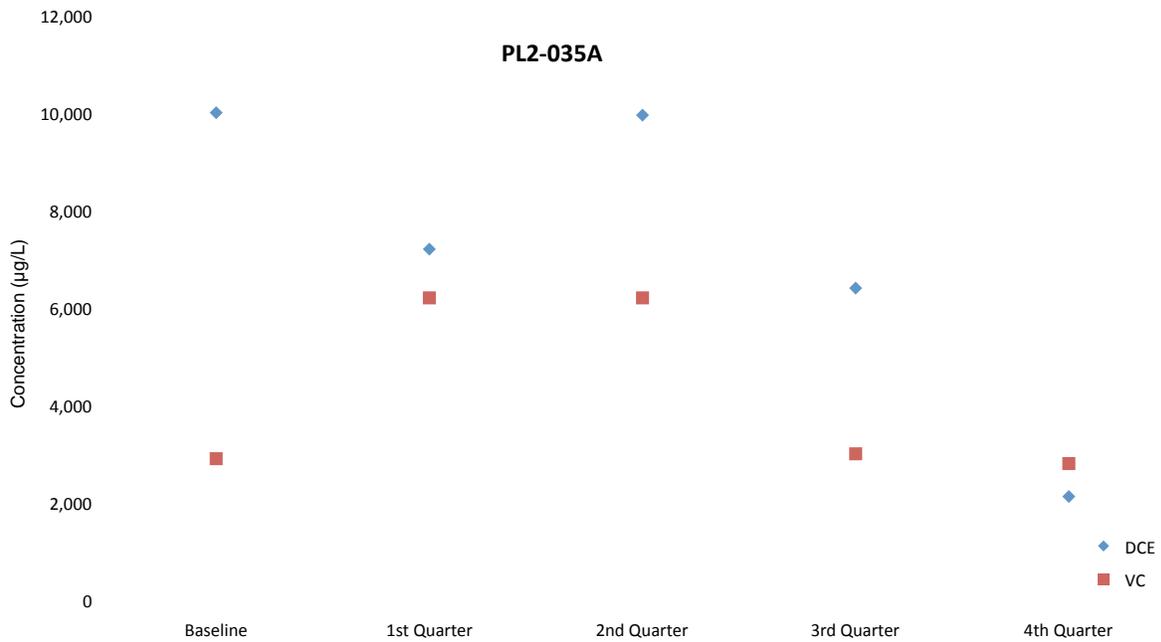
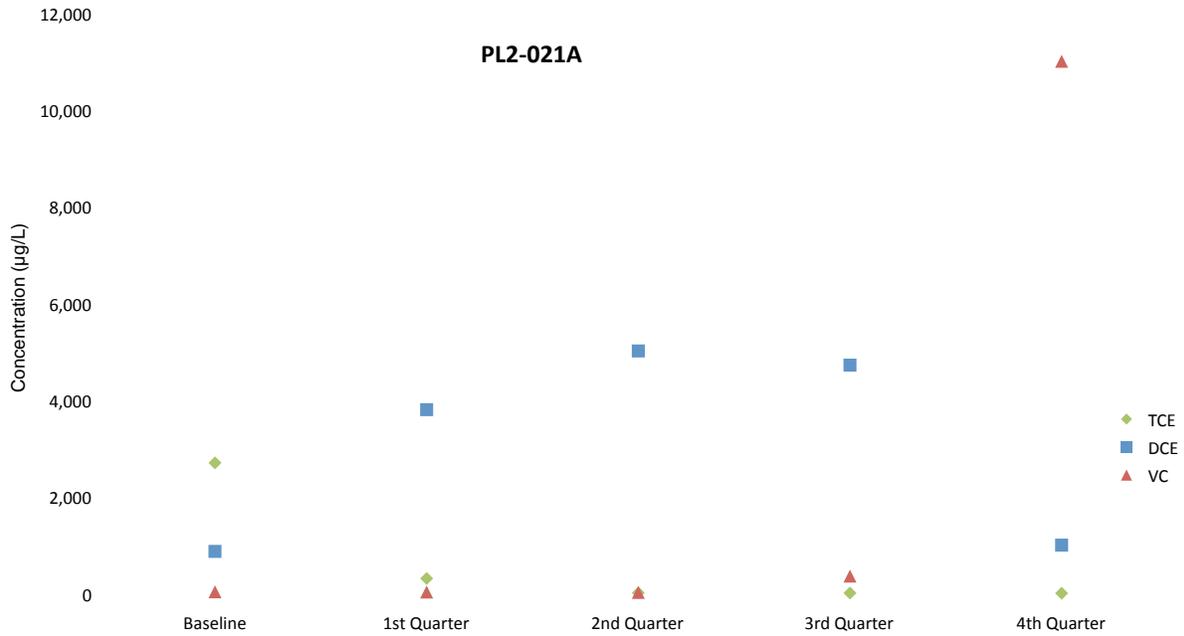
0 7.5 15 30  
SCALE: 1" = 30'

**epl ENVIRONMENTAL PARTNERS INC**  
 295 NE Gibson Boulevard, Suite 201  
 Issaquah, Washington 98027

**FIGURE 3**

PLAN VIEW OF THE 2-66 ERD IM

<b>PROJECT</b>	2-66 ERD IM SEMIANNUAL REPORT		
<b>PREPARED FOR</b>	THE BOEING COMPANY		
<b>LOCATION</b>	BOEING PLANT 2 SEATTLE / TUKWILA, WA		
<b>SHEET</b> 1 of 1	<b>DRAWN BY</b> ARM	<b>REVIEWED BY</b> JLD	<b>DATE</b> 12/03/09



**KEY:**

- Trichloroethene
  - Dichloroethene
  - Vinyl chloride
- µg/L = micrograms per liter



**FIGURE 4**

VOC TREND PLOTS FOR  
PL2-021A AND PL2-035A

**PROJECT** 2-66 ERD IM SEMIANNUAL REPORT

**PREPARED FOR** THE BOEING COMPANY

**LOCATION** BOEING PLANT 2  
SEATTLE/TUKWILA, WA

**SHEET** 1 of 1     **DRAWN BY** JLD     **REVIEWED BY** DCK     **DATE** 11/30/09

**ATTACHMENT A**  
**FIELD PARAMETER DATA**

**Table A1. Performance Monitoring - 3rd Quarter Field Parameter Measurements (7/2009)**  
**2-66 Sheetpile ERD IM**

Well ID	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (ft)
PL2-008B	7.55	0.14	-149.2	15.29	0.83	2.637	11.21
PL2-010A	5.87	0.18	88.1	15.73	0.36	2.297	10.42
PL2-017A	7.03	0.31	-20.1	14.42	0.16	9.234	10.30
PL2-021A	8.23	0.11	-129.2	15.41	8.59	4.520	11.01
PL2-021B	8.26	0.10	-52.0	15.27	1.08	4.926	11.24
PL2-021C	8.79	0.05	-177.1	15.97	3.79	22.83	11.99
PL2-031A	7.77	0.23	-5.1	14.15	0.68	1.901	10.13
PL2-032A	6.78	0.35	-59.7	15.06	0.61	2.139	10.84
PL2-035A	6.97	0.14	-62.4	15.75	0.96	2.686	10.81
PP-1B-I	8.20	0.07	-36.5	16.26	1.02	7.495	11.43
PP-2B-I	6.96	0.11	-61.7	16.18	8.88	4.296	12.34
PP-3A-I	6.89	0.07	-23.8	14.63	1.75	2.238	10.51
PP-3B-I	8.01	0.20	-262.4	15.12	1.01	9.315	10.75
PP-4B-I	7.09	0.28	-52.1	15.83	0.09	2.997	10.80
PP-5B-I	8.40	0.13	-179.5	15.09	0.31	0.400	10.88

Notes:

ORP = oxidation-reduction potential, mv = millivolts

NTU = nephelometric turbidity units

mS/cm - milliSiemens per centimeter

ND = no data

NS = not sampled

**Table A2. Performance Monitoring - 4th Quarter Field Parameter Measurements (10/2009)**  
**2-66 Sheetpile ERD IM**

Well ID	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (ft)
PL2-041AA	7.44	0.89	-3.0	16.04	4.33	1.29	8.50
PL2-008B	6.85	0.85	-38.2	14.42	1.06	4.179	9.88
PL2-008C	7.88	0.89	17.3	14.15	0.79	5.781	9.40
PL2-010A	5.68	0.68	89.3	15.20	1.14	2.709	9.59
PL2-017A	6.37	0.50	-221.5	16.13	0.63	14.72	9.33
PL2-021A	5.74	0.69	-108.3	15.89	2.45	3.902	10.27
PL2-021B	6.75	1.06	-55.6	13.94	1.02	9.293	10.23
PL2-021C	7.65	0.96	-166.0	14.62	8.31	22.83	10.02
PL2-031A	6.75	0.28	-19.6	14.56	9.64	1.960	8.94
PL2-032A	6.26	0.62	-56.0	15.61	2.63	2.191	10.02
PL2-035A	6.68	0.79	-59.6	15.44	4.19	3.039	9.75
PP-1B-I	6.99	0.76	-205.4	14.62	2.99	13.84	10.41
PP-2B-I	6.98	0.80	-70.0	14.88	4.49	4.178	9.39
PP-2B-O	6.83	1.06	-49.4	15.24	2.83	3.732	9.04
PP-3A-I	7.09	0.44	19.5	14.84	1.68	2.129	9.53
PP-3B-I	7.54	0.35	-284.9	13.95	0.44	11.32	9.44
PP-4B-I	6.96	0.64	-60.3	15.43	1.01	3.411	9.45
PP-4B-O	6.76	0.82	-56.9	15.49	1.57	3.455	9.09
PP-5B-I	8.16	0.42	-169.9	14.95	0.93	0.492	9.50

Notes:

ORP = oxidation-reduction potential, mv = millivolts

NTU = nephelometric turbidity units

mS/cm - milliSiemens per centimeter

ND = no data

NS = not sampled

**ATTACHMENT B**  
**GROUNDWATER VOC ANALYTICAL DATA – ALL DETECTIONS**

Table B1. Groundwater VOC Analytical Data, Fourth Quarter – All Detections

Fourth Quarter (October 2009)

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-041AA 10/20/2009	PL2-008B 10/20/2009	PL2-008C 10/20/2009	PL2-010A 10/21/2009	PL2-017A 10/19/2009	PL2-021A 10/19/2009	PL2-021B 10/22/2009	PL2-021C 10/22/2009	PL2-031A 10/19/2009	PL2-031A (dup) 10/19/2009	PL2-032A 10/19/2009
<b>Volatile Organic Compounds (VOCs)</b>														
Vinyl chloride	EPA 8260C	0.731	0.2	4.0	1.9	0.9	6.6	<0.2	11,000	0.5	0.7	0.5	0.6	14
Chloroethane	EPA 8260C	NA	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
Acetone	EPA 8260C	NA	5.0	<30	<5.0	<5.0	<150	9.6	1,100	<5.0	<5.0	9.9	6.0	7.6
Carbon Disulfide	EPA 8260C	NA	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
1,1-Dichloroethene	EPA 8260C	0.382	0.2	1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
1,1-Dichloroethane	EPA 8260C	NA	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	16
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	6.1	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	270	1.1	0.4	86	0.2	1,000	0.8	<0.2	1.7	1.5	0.9
Chloroform	EPA 8260C	56.1	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
1,2-Dichloroethane	EPA 8260C	11.7	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
2-Butanone	EPA 8260C	NA	5.0	<30	<5.0	<5.0	<150	<5.0	1,600	<5.0	<5.0	<5.0	<5.0	<5.0
Trichloroethene	EPA 8260C	0.302	0.2	220	0.4	<0.2	520	0.9	<20	<0.2	<0.2	1.2	1.0	<0.2
Benzene	EPA 8260C	4.48	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	0.3
Tetrachloroethene	EPA 8260C	0.822	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	EPA 8260C	NA	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	<0.2
Chlorobenzene	EPA 8260C	NA	0.2	<1.2	<0.2	<0.2	<6.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2	1.4

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-035A 10/20/2009	PP-1B-I 10/21/2009	PP-1B-I (dup) 10/21/2009	PP-2B-I 10/20/2009	PP-2B-O 10/20/2009	PP-3A-I 10/21/2009	PP-3B-I 10/21/2009	PP-4B-I 10/21/2009	PP-4B-O 10/21/2009	PP-5B-I 10/21/2009
<b>Volatile Organic Compounds (VOCs)</b>													
Vinyl chloride	EPA 8260C	0.731	0.2	2,800	3.0	4.0	1.1	39	0.2	1.3	130	45	<0.2
Chloroethane	EPA 8260C	NA	0.2	<12	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2
Acetone	EPA 8260C	NA	5.0	<300	100	100	14	<5.0	<5.0	71	<25	<5.0	<5.0
Carbon Disulfide	EPA 8260C	NA	0.2	<12	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	<1.0	<0.2	<0.2
1,1-Dichloroethene	EPA 8260C	0.382	0.2	<12	<0.2	<0.1	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2
1,1-Dichloroethane	EPA 8260C	NA	0.2	<12	0.3	0.3	0.9	2.4	0.5	<0.2	<1.0	0.9	<0.2
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	24	<0.2	<0.2	<0.2	<0.2	1.1	0.2	<1.0	<0.2	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	2,100	12	13	0.3	0.5	11	1.3	70	14	1.0
Chloroform	EPA 8260C	56.1	0.2	<12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2
1,2-Dichloroethane	EPA 8260C	11.7	0.2	<12	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<1.0	<0.2	<0.2
2-Butanone	EPA 8260C	NA	5.0	<300	35	36	<5.0	<5.0	<5.0	15	<25	<5.0	<5.0
Trichloroethene	EPA 8260C	0.302	0.2	<12	<0.2	<0.2	0.4	<0.2	2.0	0.6	<1.0	2.0	0.3
Benzene	EPA 8260C	4.48	0.2	<12	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<1.0	<0.2	<0.2
Tetrachloroethene	EPA 8260C	0.822	0.2	<12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2
Toluene	EPA 8260C	NA	0.2	<12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0	<0.2	<0.2
Chlorobenzene	EPA 8260C	NA	0.2	<12	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	<1.0	0.2	<0.2

Notes:

< = not detected at the listed reporting limit

µg/L= micrograms per liter

NA = not applicable

Table B2. Groundwater VOC Analytical Data, Third Quarter – All Detections

Third Quarter (July 2009)

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-008B 7/20/2009	PL2-008 (dup) 7/20/2009	PL2-010A 7/20/2009	PL2-017A 7/21/2009	PL2-021A 7/21/2009	PL2-021B 7/21/2009	PL2-021C 7/21/2009	PL2-031A 7/21/2009	PL2-032A 7/20/2009
<b>Volatile Organic Compounds (VOCs)</b>												
Vinyl chloride	EPA 8260C	0.731	0.2	2.9	2.9	<5.0	<0.2	360	3.0	0.7	<0.2	11
Acetone	EPA 8260C	NA	5.0	<5.0	<5.0	<5.0	<5.0	<500	6.3	<5.0	<5.0	<5.0
1,1-Dichloroethane	EPA 8260C	NA	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	18
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	<0.2	<0.2	<5.0	<0.2	20	<0.2	<0.2	<0.2	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	1.3	1.2	89	<0.2	4,700	3.4	<0.2	2.8	0.6
Chloroform	EPA 8260C	56.1	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2
2-Butanone	EPA 8260C	NA	5.0	<5.0	<5.0	<25	5.3	920	<5.0	<5.0	<5.0	<5.0
Trichloroethene	EPA 8260C	0.302	0.2	0.2	0.2	860	0.6	<20	<0.2	<0.2	7.2	<0.2
Benzene	EPA 8260C	4.48	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	0.3
Tetrachloroethene	EPA 8260C	0.822	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	<0.2
Toluene	EPA 8260C	NA	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	0.2
Chlorobenzene	EPA 8260C	NA	0.2	<0.2	<0.2	<5.0	<0.2	<20	<0.2	<0.2	<0.2	1.5

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-032A (dup) 7/20/2009	PL2-035A 7/20/2009	PP-1B-I 7/21/2009	PP-2B-I 7/20/2009	PP-3A-I 7/20/2009	PP-3B-I 7/20/2009	PP-4B-I 7/20/2009	PP-5B-I 7/20/2009
<b>Volatile Organic Compounds (VOCs)</b>											
Vinyl chloride	EPA 8260C	0.731	0.2	11	3,000	<0.2	1.4	2.2	2.6	360	<0.2
Acetone	EPA 8260C	NA	5.0	<5.0	<1,000	<5.0	75	<5.0	92	<100	<5.0
1,1-Dichloroethane	EPA 8260C	NA	0.2	18	<100	0.2	0.6	0.7	<0.2	<10	<0.2
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	<0.2	<100	<0.2	<0.2	1.4	0.3	<10	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	0.6	6,400	1.3	0.4	3.5	3.2	150	0.7
Chloroform	EPA 8260C	56.1	0.2	<0.2	<100	<0.2	<0.2	<0.2	<0.2	<10	<0.2
2-Butanone	EPA 8260C	NA	5.0	<5.0	1,200	<5.0	15 Q	<5.0	27 Q	<50	<5.0
Trichloroethene	EPA 8260C	0.302	0.2	<0.2	<100	0.3	<0.2	2.0	1.4	<10	0.3
Benzene	EPA 8260C	4.48	0.2	0.3	<100	<0.2	<0.2	<0.2	<0.2	<10	<0.2
Tetrachloroethene	EPA 8260C	0.822	0.2	<0.2	<100	<0.2	<0.2	<0.2	<0.2	<10	<0.2
Toluene	EPA 8260C	NA	0.2	0.2	<100	<0.2	<0.2	<0.2	<0.2	<10	<0.2
Chlorobenzene	EPA 8260C	NA	0.2	1.6	<100	<0.2	<0.2	<0.2	<0.2	<10	<0.2

**Notes:**

< = not detected at the listed reporting limit

µg/L= micrograms per liter

NA = not applicable

Q = continuing calibration (CCAL) was out of control high

Table B3. Groundwater VOC Analytical Data, Second Quarter – All Detections

Second Quarter (April 2009)

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-017A 4/20/2009	PL2-021A 4/20/2009	PL2-031A 4/21/2009	PL2-032A 4/20/2009	PL2-032A (dup) 4/20/2009	PL2-035A 4/21/2009	PP-3A-I 7/20/2009	PP-4B-I 7/20/2009
<b>Volatile Organic Compounds (VOCs)</b>											
Chloromethane	EPA 8260C	26.3	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2
Vinyl chloride	EPA 8260C	0.731	0.2	<0.2	22	3.5	13	13	6,200	0.5	120 E
Methylene chloride	EPA 8260C	190	0.5	<0.5	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acetone	EPA 8260C	NA	2.5	<2.5	620	2.8	<2.5	2.5	<2.5	<2.5	36
Carbon disulfide	EPA 8260C	NA	0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
1,1-Dichloroethene	EPA 8260C	0.382	0.2	<0.2	4.4	<0.2	<0.2	<0.2	3.6	<0.2	<0.2
1,1-Dichloroethane	EPA 8260C	NA	0.2	<0.2	3.1	<0.2	20	20	15	0.8	0.9
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	<0.2	8.1	<0.2	<0.2	<0.2	49	1.4	1.0
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	<0.2	5,000	1.1	0.6	0.6	9,900	4.0	36
Chloroform	EPA 8260C	56.1	0.2	<0.2	1.0	<0.2	<0.2	<0.02	<0.2	<0.2	<0.2
2-Butanone	EPA 8260C	NA	2.5	<2.5	1,300	<2.5	<2.5	<2.5	<2.5	<2.5	5.6
1,1,1-Trichloroethane	EPA 8260C	NA	0.2	<0.2	3.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trichloroethene	EPA 8260C	0.302	0.2	0.7	14	5.9	<0.2	<0.2	4.2	2.6	2.5
1,1,2-Trichloroethane	EPA 8260C	5.00	0.2	<0.2	0.6	<0.2	<0.2	<0.2	1.0	<0.2	<0.2
Benzene	EPA 8260C	4.48	0.2	<0.2	<0.2	<0.2	0.4	0.3	0.4	<0.2	<0.2
Tetrachloroethene	EPA 8260C	0.822	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	EPA 8260C	NA	0.2	<0.2	<0.2	<0.2	0.2	0.2	0.3	<0.2	<0.02
Chlorobenzene	EPA 8260C	NA	0.2	<0.2	<0.2	<0.2	1.5	1.5	1.3	<0.2	0.2
o-Xylene	EPA 8260C	NA	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	<0.2

**Notes:**

< = not detected at the listed reporting limit

µg/L= micrograms per liter

NA = not applicable

E = estimated result

Table B4. Groundwater VOC Analytical Data, First Quarter – All Detections

First Quarter (January 2009)

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-017A 1/21/2009	PL2-021A 1/21/2009	PL2-031A 1/21/2009	PL2-032A 1/20/2009	PL2-032A (dup) 1/20/2009	PL2-035A 1/20/2009	PP-3A-I 1/21/2009	PP-4B-I 1/20/2009
<b>Volatile Organic Compounds (VOCs)</b>											
Vinyl chloride	EPA 8260C	0.731	0.2	<0.2	<300	1.5	41	43	6,200	0.7	51
Acetone	EPA 8260C	NA	3.0	<3.0	<1,500	<3.0	<3.0	<5.0	<1,200	<3.0	5.3
1,1-Dichloroethane	EPA 8260C	NA	0.2	<0.2	<300	<0.2	16	17	<250	0.6	<1.0
trans-1,2-Dichloroethene	EPA 8260C	NA	0.2	<0.2	<300	<0.02	<0.2	<1.0	<250	1.2	<1.0
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	0.2	3,800	2.3	1.0	<1.0	7,200	10	17
Chloroform	EPA 8260C	56.1	0.2	<0.2	<300	<0.2	<0.2	<1.0	<250	<0.2	<1.0
2-Butanone	EPA 8260C	NA	2.5	<2.5	<1,500	<2.5	<2.5	<5.0	<1,200	<2.5	<5.0
Trichloroethene	EPA 8260C	0.302	0.2	2.1	310	2.0	<0.2	<1.0	<250	4.2	<1.0
Benzene	EPA 8260C	4.48	0.2	<0.2	<300	<0.2	0.2	<1.0	<250	<0.2	<1.0
Tetrachloroethene	EPA 8260C	0.822	0.2	<0.2	<300	<0.2	<0.2	<1.0	<250	<0.2	<1.0
Toluene	EPA 8260C	NA	0.2	<0.2	<300	<0.2	<0.2	<1.0	<250	<0.2	<1.0
Chlorobenzene	EPA 8260C	NA	0.2	<0.2	<300	<0.2	1.0	<1.0	<250	<0.2	<1.0

**Notes:**

< = not detected at the listed reporting limit

µg/L= micrograms per liter

NA = not applicable

**ATTACHMENT C**  
**FIELD NOTES**

Boeing Plant Z  
2-66 JM ERD 3rd Quarter  
7/20/09

Sampling

- 0637 K. Addis onsite  
0700 M. Mogg onsite  
0705 Discuss Health & Safety Procedures  
& PPE Requirements.  
0715 Calibrate equipment, Conduct  
water level measurements  
See Sampling Booklet for  
calibration information  
0820 Begin purging at PL2-032A  
\* All samples were placed in  
an iced cooler immediately  
after being double bagged in  
explos. See sampling booklet for info  
Last samples collected  
1409 Decon all equipment.  
1415 All purgewater was transferred to the  
treatment tank in building 2-49  
to await treatment.  
1435 Leave site, transfer samples to lab.  
1450 Arrive at ARI.  
1535 At office.

~~Kristin Addis~~  
7/20/09

Boeing Plant Z  
2-66 ERD 3rd Quarter Sampling  
7/21/09

- 0715 K. Addis, M. Mogg onsite  
0720 Fill ice chests  
0730 Calibrate equipment  
See sampling booklet for  
calibration & sampling  
information.  
0753 Begin purging at PL2-017A  
1230 Jennifer Parsons onsite  
to check-in on progress  
1300 J-Parsons offsite.  
1411 Last sample collected  
1420 Decon all equipment  
All Purgewater was transferred  
to the treatment tank in  
Building 2-49.  
1440 M. Mogg offsite, K. Addis offsite - to  
ARI to deliver samples  
1450 Arrive at ARI  
1456 K. Addis leaves ARI, to storage.  
1320 At storage unit (K. Addis). Offload  
equipment.  
1400 At office. Unload VSE & personal  
equipment.  
1410 Completed  
Kristin Addis 7/21/09

Location Boeing Plant Z Date 10/19/09

Project / Client 2-66 ERD  
4th Quarter GW Monitoring 50°60° Cloudy

0745	K. Addin onsite
0810	Arrive at 2-66 Sheetpile to conduct 4th Qtr GW sampling. Calibrate YSI
0818	Calibrate Turbidity meter
0835	Deliver report (EPI) to Will Ernst's desk
0840	Open wells. Allow minimum of 15 minutes to let water levels equilibrate.
<u>Water Levels</u>	
Time	Well
0918	PL2-032A
0922	PP-1B-I
0924	PP-4B-0
0926	PP-2B-0
0927	PP-2B-I
0932	PL2-035A
0930	PP-4B-I
0934	PL2-010A
0937	PL2-008C
0941	PL2-008B
0944	PL2-041AA
0945	PL2-031A
	Depth to Water
	10.02
	10.41
	9.09
	9.04
	9.39
	9.75
	9.45
	9.59
	9.40
	9.88
	8.50
	8.94

Location Boeing Plant Z Date 10/19/09

Project / Client 2-66 ERD

4th Qtr GW Sampling

Time	Well	DTW
0949	PP-5B-II	9.50
0951	PLA-017A	9.33
0953	PP-3B-I	9.44
0955	PP-3A-I	9.53
0957	PLA-021C	10.02
0959	PLA-021B	10.23
1000	PLA-021A	10.27
1007	Begin purge @ PLA-032A For all groundwater parameters & sample information see 2-66 ERD Sampling Booklet.	
1411	MS/MSD collected at PLA-017A	
1554	Duplicate sample at PLA-031A All wells sample today were chosen b/c the VFA & census samples need to be shipped together to Tennessee for analysis.	
1630	Decontaminate equipment All purge water was transferred to 2-49 treatment tank.	
1730	Deliver samples to ARI	
1740	K. Addis offsite	
1815	At office. Kristin & Addis 10/19/09	

Location Boeing Plant Z Date 10/20/09

Project / Client 2-66 ERD

4th Qtr GW Sampling

0830	K. Addis onsite
0850	Calibrate equipment Will collect samples next to the Duwamish today so Boeing truck drivers can have parking area for the rest of week. Begin purge at PLA-041AA See 2-66 ERD Sampling Booklet for all sampling details Recheck pH calibration 7.0 = 7.03
0935	Decide to use non-preserved VOA's for both B & C level wells due to bubbly reaction with HCl and inability to get zero headspace in preserved VOAs. All samples collected were immediately packed in an iced cooler.
1030	Last sample collected.
1050	No duplicates collected today All purge water transferred to the water treatment
1532	
1550	

Location Boeing Plant Z Date 10/20/09

Project / Client 2-66 ERD

4th Qtr Sampling

1616 tank located in the 2-49 building.  
 All equipment decontaminated using alcohol with deionized rinse water.  
 1630 Deliver samples to lab.  
 1710 K-Addis offsite.  
 1710 At office.

Kristin L. Addis 10/20/09

Location Boeing Plant Z Date 10/21/09

Project / Client 2-66 ERD

4th Qtr Sampling

0740 K-Addis onsite  
 0805 Calibrate equipment <sup>before</sup> <sub>start</sub>  
 See 2-66 ERD for all information pertaining to sampling.  
 0837 Begin purge of PP-4B-O.  
 All B & C level wells will be collected using Non-preserved VOA's.  
 1020 Position van in between P12-010A & the PP-3(A,B,C)-I well cluster.  
 Using candlesticks cones to surround van.  
 1130 Short lunch break  
 1200 PP-3A-I  
 1317 Parameters at PP-3B-I not being consistent. Will continue to monitor parameters. Moderate sulfur-like odor.  
 1613 Finished with hot sample. Decon equipment. Empty purgator in treatment tank in 2-49  
 1640 Deliver samples to ARI  
 1710 K-Addis offsite  
 1745 At office

Kristin L. Addis 10/21/09

Location Boeing Plant Z Date 10/22/09

Project / Client 2-66 ERD  
4th Qtr Sampling partly  
150°F & Cloudy

0745 K. Adlis onsite  
 0750 Calibrate equipment  
 0813 Begin pumping of PL2-021B.  
 0851 Sample (Non-preserved VOA's)  
 0913 Begin purge of PL2-021C.  
 0946 Sample (Non-preserved VOA's)  
 1010 Decan all equipment in alconex +  
 tap water. Use double rinseate in  
 deionized water.  
 All decan + purgewater were  
 transferred to 2-49 water  
 treatment tank.  
 1120 Deliver samples to lab.  
 1140 K. Adlis offsite.  
 1300 to storage to unbad equipment  
 At office.

*Kristin L. Adlis*  
 10/22/09

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-032A	Date	7/20/09
Sample: ID	GW-090720-PL2-032A-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	29.7		Bladder Pump
Initial Depth to Water (ft.)	10.84		<b>Peristaltic Pump</b>
Depth of Water Column	18.86	Other: :	
3 Casing Volumes	9.05	Start Time	0820
1 Casing Volume	3.02	End Time	0915
		Total Gallons Purged	4.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0825	0.8	6.58	2.191	2.03	1.25	15.20	-44.7	clear
0828	1.0	6.61	2.167	1.02	1.20	15.17	-48.3	clear
0831	1.2	6.65	2.158	0.91	0.81	15.15	-51.7	clear
0835	1.5	6.69	2.152	0.48	0.59	15.12	-53.6	clear
0838	1.7	6.71	2.146	0.94	0.49	15.15	-54.3	clear
0841	1.9	6.74	2.143	1.26	0.42	15.11	-56.9	clear
0844	2.1	6.76	2.139	0.85	0.38	15.12	-58.3	clear
0847	2.3	6.78	2.138	0.55	0.36	15.09	-59.2	clear
0850	2.5	6.78	2.139	0.61	0.35	15.06	-59.7	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0852	(3) 40-mL VOA	HCl, cool to 4°C	Dupl.
TOC (415.1)	0852	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	Dupl.
Dissolved gasses (MEE) (RSK-175)	0852	(3) 40-mL VOA	cool to 4°C	Dupl.
Ferrous Iron (SM3500 Fe B-97)	0852	250 mL amber	cool to 4°C Do NOT filter	Dupl.
Anions (EPA 300.0)	0852	(1) 500 mL HDPE	cool to 4°C	Dupl.
Organics Acids (VFA)	0852	2xVOAs (1) 500 mL poly	field filter 0.45-micron-filter, HNO <sub>3</sub> to pH <2, cool to 4°C	Dupl.
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 0915

### Comments / Exceptions:

Presence of floating product? YES /  NO      Presence of sinking product? YES /  NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-4B-E	Date	7/20/09
Sample: ID	GW-090720-PP-4B-1-D	Field Team: (Initials)	KA MM
Field Conditions	Sunny Warm		

## Purge Information

Well Diameter (in.)	2	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	10.80	<b>Peristaltic Pump</b>	
Depth of Water Column	39.7	Other: :	
3 Casing Volumes	19.06	Start Time	0924
1 Casing Volume	6.35	End Time	0956
		Total Gallons Purged	2.7

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0932	0.7	7.22	3.107	0.33	0.28	15.95	-48.3	Clear
0935	0.9	7.18	3.043	0.64	0.25	15.92	-48.7	Clear
0938	1.2	7.17	3.030	0.70	0.27	15.87	-49.7	Clear
0941	1.4	7.15	3.041	0.04	0.33	15.83	-50.9	Clear
0944	1.7	7.13	3.001	0.00	0.47	15.87	-51.5	Clear
0947	1.9	7.10	3.007	0.09	0.40	15.84	-51.2	Clear
0950	2.2	7.09	2.997	0.09	0.28	15.83	-52.1	Clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0952	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	0952	250 mL amber	H <sub>2</sub> SO <sub>4</sub> , to pH <2, cool to 4°C	
Dissolved gases (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> , to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 0956

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-035A	Date	7/20/09
Sample: ID	GW-090720-PL2-035A-0	Field Team: (Initials)	KA MM
Field Conditions	sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method : Submersible pump	
Well Depth (ft.)	29.8	Bladder Pump	
Initial Depth to Water (ft.)	10.81	<b>Peristaltic Pump</b>	
Depth of Water Column	18.99	Other: :	
3 Casing Volumes	9.12	Start Time	0959
1 Casing Volume	3.04	End Time	1030
		Total Gallons Purged	2.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1008	0.7	7.13	2.662	6.34	0.11	15.81	-60.5	Clear
1011	0.9	7.10	2.679	7.74	0.14	15.65	-61.5	Clear
1014	1.1	7.07	2.670	2.39	0.16	15.81	-63.5	Clear
1017	1.3	7.03	2.685	2.17	0.15	15.69	-62.2	Clear
1020	1.5	7.00	2.685	1.15	0.15	15.71	-61.9	Clear
1023	1.8	6.97	2.686	0.96	0.14	15.75	-62.4	Clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1025	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1025	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1025	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1025	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1030

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-2B-I	Date	7/20/09
Sample: ID	GW-090720-PP-2B-I-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	12.34	<b>Peristaltic Pump</b>	
Depth of Water Column	38.16	Other: :	
3 Casing Volumes	18.32	Start Time	1032
1 Casing Volume	6.11	End Time	1104
		Total Gallons Purged	2.2

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1038	0.5	7.08	4.104	40.9	0.16	15.98	-42.5	slightly cloudy
1041	0.7	6.99	4.224	34.2	0.14	16.00	-48.2	slightly cloudy
1044	1.0	6.96	4.257	26.9	0.15	15.97	-54.4	slightly cloudy
1047	1.2	6.94	4.282	17.8	0.15	15.99	-57.7	clearing
1050	1.4	6.93	4.290	15.0	0.13	16.07	-58.8	clear
1053	1.6	6.93	4.289	12.4	0.13	16.10	-60.9	clear
1056	1.8	6.94	4.291	12.1	0.12	16.11	-61.4	clear
1059	2.0	6.95	4.286	12.9	0.12	16.19	-62.2	clear
1102	2.2	6.96	4.296	10.27	0.11	16.18	-61.7	clear
1102				8.88*	Taken directly from tubing, not from flow-thru cell.			

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1104	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1104	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	—	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1104

### Comments / Exceptions:

Presence of floating product?	YES / NO	Presence of sinking product?	YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-010A	Date	7/20/09
Sample: ID	GW-090720-PL2-010A-0	Field Team: (Initials)	KAMM
Field Conditions	Sunny Breezy		

## Purge Information

Well Diameter (in.)	4	Purge Method :	Submersible pump
Well Depth (ft.)	20.8		Bladder Pump
Initial Depth to Water (ft.)	10.42		<b>Peristaltic Pump</b>
Depth of Water Column	10.38	Other: :	
3 Casing Volumes	4.98	Start Time	1113
1 Casing Volume	1.66	End Time	1141
		Total Gallons Purged	1.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1120	0.5	6.04	2.344	1.04	0.19	15.62	80.4	clear
1123	0.75	5.96	2.322	0.70	0.17	15.60	86.0	clear
1126	1.1	5.90	2.310	0.85	0.18	15.64	88.6	clear
1129	1.3	5.88	2.303	0.73	0.18	15.70	88.5	clear
1132	1.5	5.87	2.297	0.36	0.18	15.73	88.1	clear

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1134	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1134	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1141

### Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-3A-I	Date	7/20/09
Sample: ID	GW-090720-PP-3A-I-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method : Submersible pump	
Well Depth (ft.)	20.5	Bladder Pump	
Initial Depth to Water (ft.)	10.51	<b>Peristaltic Pump</b>	
Depth of Water Column	9.99	Other: .	
3 Casing Volumes	4.8	Start Time	1141
1 Casing Volume	1.6	End Time	1205
		Total Gallons Purged	2.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1147	0.6	7.04	2.385	3.82	0.09	14.72	-48.5	Clear
1150	0.8	6.90	2.337	3.93	0.08	14.62	-28.5	Clear
1153	1.1	6.87	2.294	2.91	0.07	14.63	-23.7	Clear
1156	1.4	6.88	2.264	2.59	0.07	14.58	-23.0	Clear
1159	1.7	6.89	2.238	1.75	0.07	14.63	-23.8	Clear

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1201	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1201	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1205

### Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-3B-I	Date	7/20/09
Sample: ID	GW-090720-PP-3B-I-D	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	50.5		Bladder Pump
Initial Depth to Water (ft.)	10.75		<u>Peristaltic Pump</u>
Depth of Water Column	39.75		Other: :
3 Casing Volumes	19.08	Start Time	1232
1 Casing Volume	6.36	End Time	3:30pm 1318
		Total Gallons Purged	3.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1241	0.5	8.57	10.23	1.21	0.53	15.15	-166.4	Slightly cloudy
1244	0.7	8.48	10.21	1.08	0.98	14.97	-214.0	Slightly cloudy
1247	1.0	8.35	10.18	0.94	0.57	15.09	-228.8	Slightly cloudy
1250	1.2	8.25	10.14	1.04	0.81	15.06	-237.1	Slightly cloudy
1253	1.5	8.19	10.07	0.78	0.22	14.94	-243.6	Clear
1256	1.7	8.16	10.03	1.41	0.21	14.93	-248.0	Clear
1259	2.0	8.15	9.912	1.29	0.20	15.04	-252.9	Clear
1302	2.2	8.11	9.799	1.37	0.20	15.05	-258.6	Clear
1305	2.5	8.08	9.568	1.12	0.19	15.04	-260.5	Clear
1308	2.8	8.04	9.426	1.02	0.20	15.03	-261.4	Clear
1311	3.0	8.01	9.315	1.01	0.20	15.12	-262.4	Clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1313	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1313	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1318

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-5B-I	Date	7/20/09
Sample: ID	GW-09070-PP-5B-I-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	10.88	<u>Peristaltic Pump</u>	
Depth of Water Column	39.62	Other.:	
3 Casing Volumes	19.0	Start Time	1321
1 Casing Volume	6.3	End Time	1345
		Total Gallons Purged	1.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1329	0.5	8.42	0.412	0.61	0.16	14.99	-178.8	Clear
1332	0.7	8.40	0.410	0.73	0.14	15.09	-179.4	Clear
1335	0.9	8.40	0.406	0.38	0.14	15.07	-179.7	Clear
1338	1.2	8.40	0.400	0.31	0.13	15.09	-179.5	Clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1340	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1340	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1345

### Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-0088	Date	7/20/09
Sample: ID	GW-D9070-PL2-0088-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm, breezy		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	49.8		Bladder Pump
Initial Depth to Water (ft.)	11.21		<u>Peristaltic Pump</u>
Depth of Water Column	38.59	Other: :	
3 Casing Volumes	18.5	Start Time	1347
1 Casing Volume	6.2	End Time	1413
		Total Gallons Purged	1.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1355	0.5	7.94	2.599	0.70	0.17	15.22	-149.5	Clear
1358	0.7	7.73	2.598	0.65	0.14	15.32	-150.3	Clear
1401	1.0	7.64	2.610	0.71	0.14	15.32	-148.9	Clear
1404	1.2	7.69	2.628	0.87	0.14	15.25	-150.6	Clear
1407	1.4	7.55	2.637	0.83	0.14	15.29	-149.2	Clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1409	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
TOC (415.1)	1409	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	Duplicate
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1413

### Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: \_\_\_\_\_ Standard \_\_\_\_\_  
 Turn-around Requested: \_\_\_\_\_  
 ARI Client Company: **Boeing** Phone: \_\_\_\_\_  
 Client Contact: **Will Ernst**



Page: 1 of 2  
 Date: 7/20/09  
 No. of Coolers: \_\_\_\_\_  
 Ice Present? \_\_\_\_\_  
 Cooler Temps: \_\_\_\_\_

Client Project Name: **2-66 ERD IM Performance Sampling**  
 Client Project #: EPI # 17511.2 2-66  
 Samplers: K. Addis, M. Mogg

Sample ID	Date	Time	Matrix	Number of Containers	Analysis Requested								Notes/Comments	
					VOCs EPA 8260B	TOC EPA 415.1	MEE RSK-175	Ferrous Iron 3500-FED	Metals (dissolved)** As & Mn only	Anions EPA 300.0 (NO <sub>3</sub> & SO <sub>4</sub> )	VFA organic acids (by MI)	qDHC bacterial census (by MI)		
GW-090720-PL2-032A-0	7/20/09	0852	GW	11	X	X	X	X	X	X	X	X		
GW-090720-PL2-032A-1		0852		11	X	X	X	X	X	X	X	X		
GW-090720-PP-4B-I-0		0952		4	X	X	X	X	X	X	X	X		
GW-090720-PP-2B-I-0		1104		4	X	X	X	X	X	X	X	X		
GW-090720-PL2-035A-0		1025		8	X	X	X	X	X	X	X	X		
GW-090720-PL2-010A-0		1134		4	X	X	X	X	X	X	X	X		
GW-090720-PP-3A-I-0		1201		4	X	X	X	X	X	X	X	X		
GW-090720-PP-3B-I-0		1313		4	X	X	X	X	X	X	X	X		
Trip Blank		-		2	X	X	X	X	X	X	X	X		
GW-090720-PP-5B-I-0		1340		4	X	X	X	X	X	X	X	X		
Comments/Special Instructions	Relinquished by: <u>Kristin L. Addis</u> (Signature) Printed Name: <u>Kristin L. Addis</u> Company: <u>EPI</u>				Relinquished by: <u>Kelly Bolt</u> (Signature) Printed Name: <u>Kelly Bolt</u> Company: <u>EPI</u>				Received by: _____ (Signature) Printed Name: _____ Company: _____ Date & Time: _____					

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.



# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-017A	Date	7/21/09
Sample: ID	GW-190721-PL2-017A-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, cool		

## Purge Information

Well Diameter (in.)	4	Purge Method : Submersible pump	
Well Depth (ft.)	20.8	Bladder-Pump	
Initial Depth to Water (ft.)	10.30	<u>Peristaltic Pump</u>	
Depth of Water Column	10.5	Other: :	
3 Casing Volumes	5.04	Start Time	0753
1 Casing Volume	1.68	End Time	0927
		Total Gallons Purged	3.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0804	0.9	7.30	9.293	2.05	0.30	14.16	-59.0	Clear
0810	1.8	7.07	9.099	0.95	0.37	14.31	-29.4	Clear
0813	1.6	7.04	9.106	0.60	0.44	14.35	-25.5	Clear
0816	1.9	7.05	9.122	0.43	0.45	14.47	-23.9	Clear
0819	2.2	7.05	9.154	0.59	0.38	14.40	-23.0	Clear
0822	2.5	7.03	9.234	0.16	0.31	14.42	-20.1	Clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0824	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
TOC (415.1)	0824	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	MS/MSD
Dissolved gasses (MEE) (RSK-175)	0824	(3) 40-mL VOA	cool to 4°C	MS/MSD
Ferrous Iron (SM3500 Fe B-97)	0824	250 mL amber	cool to 4°C Do NOT filter	MS/MSD
Anions (EPA 300.0)	0824	(1) 500 mL HDPE	cool to 4°C	MS/MSD
Organics Acids (VFA)	0824	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	MS/MSD
Metals (200.8&6010B)	0824	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	MS/MSD
Census	0824	bio-flo&MI falcon tube	4°C	Dup

End Time 0927

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PU2-031A	Date	7/21/09
Sample: ID	GW-090721-PU2-031A-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	28.9		Bladder Pump
Initial Depth to Water (ft.)	10.13		<u>Peristaltic Pump</u>
Depth of Water Column	18.77		Other: :
3 Casing Volumes	9.0	Start Time	1003
1 Casing Volume	3.0	End Time	1017
		Total Gallons Purged	2.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0942	0.5	7.84	1.908	12.8	0.32	13.50	24.5	clear
0945	0.7	7.72	1.910	2.51	0.27	14.73	14.2	clear
0948	0.9	7.73	1.899	1.03	0.27	14.70	9.1	clear
0951	1.1	7.72	1.896	0.67	0.25	14.54	6.0	clear
0954	1.3	7.71	1.892	0.36	0.24	14.39	4.4	clear
0957	1.6	7.74	1.874	0.24	0.24	14.24	-0.5	clear
1000	1.8	7.75	1.878	0.58	0.23	14.17	-3.9	clear
1003	2.1	7.77	1.901	0.68	0.23	14.15	-5.1	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1005	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1005	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1005	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1005	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	1005	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	1005	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1017

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021A	Date	7/21/09
Sample: ID	GW-090721-PL2-021A-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, warm		

## Purge Information

Well Diameter (in.)	4	Purge Method : Submersible pump	
Well Depth (ft.)	19.9	Bladder Pump	
Initial Depth to Water (ft.)	11.01	<u>Peristaltic Pump</u>	
Depth of Water Column	8.89	Other: :	
3 Casing Volumes	4.27	Start Time	1043
1 Casing Volume	1.42	End Time	1213
		Total Gallons Purged	50

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1056	0.9	8.62	7.357	12.3	0.54	15.21	-139.5	Slightly cloudy
1059	1.1	8.56	6.991	12.7	0.39	15.22	-138.8	Slightly cloudy
1102	1.3	8.52	6.781	10.26	0.29	15.19	-139.6	Slightly cloudy
1105	1.6	8.47	6.361	10.12	0.23	15.16	-138.3	Slightly cloudy
1108	1.9	8.41	5.924	12.1	0.21	15.26	-133.5	Slightly cloudy
1114	2.4	8.34	5.464	13.1	0.18	15.25	-130.3	Slightly cloudy
1117	2.6	8.31	5.262	9.97	0.16	15.19	-129.6	Slightly cloudy
1120	2.8	8.30	5.132	9.23	0.15	15.21	-129.5	Slightly cloudy
1123	3.0	8.29	5.018	9.75	0.14	15.26	-129.1	Slightly cloudy
1126	3.2	8.28	4.927	9.47	0.14	15.29	-129.2	Slightly cloudy
1129	3.6	8.28	4.853	8.68	0.13	15.34	-131.5	Slightly cloudy
1132	3.9	8.27	4.733	8.15	0.11	15.32	-131.7	Slightly cloudy

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1146	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1146	250 mL amber	H <sub>2</sub> SO <sub>4</sub> , to pH <2, cool to 4°C	
Dissolved gases (MEE) (RSK-175)	1146	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1146	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	1146	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	1146	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	1146	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	1146	bio-flo&MI falcon tube	4°C	

End Time 1213

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021A	Date	7/21/09
Sample: ID	GW-020721-PL2-021A-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny, hot		

## Purge Information

Well Diameter (in.)	2 in	Purge Method :	Submersible pump
Well Depth (ft.)			Bladder Pump
Initial Depth to Water (ft.)	11.24 m		<b>Peristaltic Pump</b>
Depth of Water Column		Other: :	
3 Casing Volumes		Start Time	Continued
1 Casing Volume		End Time	See previous page
		Total Gallons Purged	

Continued:

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1135	4.1	8.25	4.639	10.45	0.12	15.35	-130.9	Slightly cloudy
1138	4.3	8.26	4.579	7.07	0.12	15.37	-130.5	Slightly cloudy
1141	4.5	8.24	4.544	9.40	0.12	15.43	-130.0	Slightly cloudy
1144	4.7	8.23	4.520	8.59	0.11	15.41	-129.2	Slightly cloudy

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1146	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1146	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1146	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1146	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	1146	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	1146	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	1146	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	1146	bio-flo&MI falcon tube	4°C	

End Time 1213

### Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

Continued from previous page.

\* Odor - similar to barn/manure odor

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021B	Date	7/21/09
Sample: ID	BW-090711-PL2-021B-0	Field Team: (Initials)	KA MM
Field Conditions	Sunny HOT		

## Purge Information

Well Diameter (in.)	2	Purge Method :	Submersible pump
Well Depth (ft.)	48.6		Bladder Pump
Initial Depth to Water (ft.)	<del>11.99</del> 11.24		<u>Peristaltic Pump</u>
Depth of Water Column	37.36	Other: :	
3 Casing Volumes	17.93	Start Time	1216
1 Casing Volume	5.98	End Time	1248
		Total Gallons Purged	2.6

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1224	0.6	8.45	4.616	1.78	0.22	15.26	-45.6	Clear
1227	0.9	8.39	4.737	1.06	0.17	15.26	-45.0	Clear
1230	1.2	8.35	4.807	1.15	0.15	15.26	-46.3	Clear
1233	1.5	8.33	4.859	1.38	0.12	15.25	-49.0	Clear
1236	1.8	8.31	4.883	1.03	0.11	15.29	-49.9	Clear
1239	2.1	8.28	4.919	1.23	0.10	15.28	-51.1	Clear
1242	2.4	8.26	4.926	1.08	0.10	15.27	-52.0	Clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1244	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1244	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1248

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	<del>PP-10</del> <u>EMM P2-021C</u>	Date	<u>7/21/09</u>
Sample: ID	<u>GW 09FA21-P2-021C</u>	Field Team: (Initials)	<u>KA MM</u>
Field Conditions	<u>Sunny, hot</u>		

## Purge Information

Well Diameter (in.)	<u>2</u>	Purge Method : Submersible pump	
Well Depth (ft.)	<u>91.7</u>	Bladder Pump	
Initial Depth to Water (ft.)	<u>11.99</u>	<u>Peristaltic Pump</u>	
Depth of Water Column	<u>79.71</u>	Other: :	
3 Casing Volumes	<u>38.3</u>	Start Time	<u>1251</u>
1 Casing Volume	<u>12.8</u>	End Time	<u>1331</u>
		Total Gallons Purged	<u>2.1</u>

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
<u>1259</u>	<u>0.5</u>	<u>9.26</u>	<u>22.78</u>	<u>3.48</u>	<u>0.06</u>	<u>16.03</u>	<u>-180.4</u>	<u>Clear</u>
<u>1303</u>	<u>0.8</u>	<u>9.07</u>	<u>22.82</u>	<u>3.46</u>	<u>0.06</u>	<u>16.04</u>	<u>-181.5</u>	<u>Clear</u>
<u>1306</u>	<u>1.0</u>	<u>8.99</u>	<u>22.86</u>	<u>6.30</u>	<u>0.05</u>	<u>15.96</u>	<u>-181.9</u>	<u>Clear</u>
<u>1309</u>	<u>1.2</u>	<u>8.91</u>	<u>22.90</u>	<u>6.59</u>	<u>0.05</u>	<u>16.04</u>	<u>-177.9</u>	<u>Clear</u>
<u>1312</u>	<u>1.5</u>	<u>8.86</u>	<u>22.88</u>	<u>2.42</u>	<u>0.06</u>	<u>16.00</u>	<u>-179.5</u>	<u>Clear</u>
<u>1315</u>	<u>1.8</u>	<u>8.81</u>	<u>22.81</u>	<u>4.62</u>	<u>0.05</u>	<u>15.94</u>	<u>-177.4</u>	<u>Clear</u>
<u>1318</u>	<u>2.1</u>	<u>8.79</u>	<u>22.83</u>	<u>3.79</u>	<u>0.05</u>	<u>15.97</u>	<u>-177.1</u>	<u>Clear</u>

## Sample Information

Sample Method(s)  Peristaltic pump /  Submersible pump /  Bladder Pump /  Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	<u>1320</u>	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	<u>1320</u>	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1331

### Comments / Exceptions:

Presence of floating product? YES /  NO      Presence of sinking product? YES /  NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-1B-I	Date	7/21/07
Sample: ID	GW-090721-PP-1B-I-0	Field Team: (Initials)	MM, KA
Field Conditions	Sunny, HOT		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	11.43	<b>Peristaltic Pump</b>	
Depth of Water Column	39.07	Other: :	
3 Casing Volumes	18.8	Start Time	1330
1 Casing Volume	6.25	End Time	1411
		Total Gallons Purged	2.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1340	0.5	8.35	7.446	5.35	0.15	16.10	-25.9	clear
1343	0.8	8.30	7.469	1.61	0.13	16.13	-30.2	clear
1346	1.1	8.25	7.477	1.21	0.12	16.19	-32.8	clear
1349	1.4	8.23	7.478	0.93	0.10	16.26	-34.4	clear
1352	1.7	8.22	7.485	1.02	0.09	16.21	-35.3	clear
1355	1.9	8.23	7.487	1.15	0.08	16.34	-35.0	clear
1358	2.1	8.22	7.499	1.10	0.07	16.24	-36.7	clear
1401	2.3	8.20	7.495	1.02	0.07	16.26	-36.5	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1403	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1403	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)		(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)		250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)		(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)		(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)		(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census		bio-flo&MI falcon tube	4°C	

End Time 1411

### Comments / Exceptions:

Presence of floating product?	YES / <b>NO</b>	Presence of sinking product?	YES / <b>NO</b>

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# Chain of Custody Record & Laboratory Analysis Request

Analytical Resources, Incorporated  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)



Page: 1 of 1  
 Date: 7/21/09  
 No. of Coolers: 4  
 Ice Present? Y  
 Cooler Temps:

Turn-around Requested: Standard  
 Phone:  
 Client Company: Boeing  
 Client Contact: Will Ernst  
 Client Project Name: 2-66 ERD IM Performance  
 Client Project #: LPI # 175112 2-66  
 Samplers: M. Moss & Addis

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested						Notes/Comments	
					VOC EPA 2260C	TOC EPA 415.1	MEE RSK-175	Ferrous Iron 3500-FED	Dissolved Metals As, Mn only	Anions EPA 300.0 NO <sub>3</sub> + SO <sub>4</sub>		VFA organic acids (MI)
GW-090721-PL2-0170-0	7/21/09	0824	GW	37	X	X	X	X	X	X	X	MS/MSP
GW-090721-PL2-017A-1		0924		1								
GW-090721-PL2-031A-0		1005		11	X	X	X	X				
GW-090721-PL2-021A-0		1146		13	X	X	X					
GW-090721-PL2-021B-0		1244		4	X							
GW-090721-PL2-021C-0		1320		4	X	X	X					Also preserved VOCs
GW-090721-PP-1BEO		1403		4	X	X	X					
Trip Blank				2	X							
Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)										
	Printed Name: Kristin L. Addis	Printed Name: A. Volgardsen										
	Company: EPI	Company: ARI										
	Date & Time: 7/21/07 1450	Date & Time: 7/21/09 1450										

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-032A	Date	10/19/09
Sample: ID	GW-091019-PL2-032A-0	Field Team: (Initials)	KA
Field Conditions	Cloudy		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	29.7	Bladder Pump	
Initial Depth to Water (ft.)	10.02 @ 0918	<b>Peristaltic Pump</b>	
Depth of Water Column	19.68	Other: :	
3 Casing Volumes	9.3	Start Time	1007
1 Casing Volume	3.1	End Time	1150
		Total Gallons Purged	4.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1023	1.2	6.06	2.136	9.13	2.12	15.87	-24.9	clear
1026	1.4	6.29	2.136	8.24	3.10	15.86	-36.1	clear
1029	1.6	6.15	2.144	5.71	3.56	15.84	-41.8	clear
1032	2.0	6.23	2.151	5.08	3.34	15.80	-44.9	clear
1037	2.5	6.22	2.156	4.12	2.30	15.77	-48.2	clear
1040	2.7	6.23	2.166	4.85	2.07	15.75	-48.9	clear
1043	2.9	6.27	2.174	4.18	1.66	15.73	-50.7	clear
1050	3.2	6.26	2.182	2.69	1.50	15.63	-54.2	clear
1053	3.5	6.26	2.185	2.33	1.18	15.65	-54.6	"
1056	3.7	6.26	2.188	2.67	0.91	15.67	-55.6	"
1059	3.9	6.26	2.189	3.12	0.78	15.65	-56.2	"
1102	4.1	6.27	2.189	3.16	0.66	15.65	-56.5	"
1105	4.3	6.26	2.191	2.63	0.62	15.61	-56.0	"

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1107	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1107	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1107	(3) 40-mL VOA	HCl cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1107	250 mL amber	HCl cool to 4°C Do NOT filter	
Anions (EPA 300.0)	1107	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	1107	2-40mL VOA (1) 500-mL poly	field-filter-0.45-micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	1107	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1150

### Comments / Exceptions:

Presence of floating product? YES /  NO Presence of sinking product? YES /  NO

\* All water levels were collected on 10/19/09 at \*  
 the times listed for each well, for 4<sup>th</sup> quarter sampling.

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

## 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021A	Date	10/29/09
Sample: ID	GW-091019-PL2-021A-0	Field Team: (Initials)	KA
Field Conditions	Cloudy		

### Purge Information

Well Diameter (in.)	4"	Purge Method :	Submersible pump
Well Depth (ft.)	19.9		Bladder Pump
Initial Depth to Water (ft.)	10.27 @ 1000		<u>Peristaltic Pump</u>
Depth of Water Column	9.63	Other: :	
3 Casing Volumes	18.8	Start Time	1203
1 Casing Volume	6.3	End Time	1315
		Total Gallons Purged	2.7

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1224	1.6	5.87	3.971	4.59	0.78	15.54	-121.9	clear, odor
1227	1.8	5.85	3.954	5.10	0.81	15.56	-118.9	clear, odor
1230	2.0	5.81	3.941	3.21	0.68	15.59	-117.0	clear, odor
1233	2.2	5.80	3.914	4.38	0.79	15.76	-111.6	clear, odor
1236	2.3	5.78	3.899	2.39	0.69	15.79	-109.6	clear, odor
1239	2.5	5.75	3.906	5.00	0.69	15.88	-108.5	clear, odor
1242	2.7	5.74	3.902	2.45	0.69	15.89	-108.3	clear, odor

### Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1244	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1244	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1244	(3) 40-mL VOA	HCl cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1244	250 mL amber	HCl cool to 4°C Do NOT filter	
Anions (EPA 300.0)	1244	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	1244	2-40 mL VOA (1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	1244	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	1244	bio-flo&MI falcon tube	4°C	850 mL Filtered

End Time 1315

### Comments / Exceptions:

Presence of floating product? YES / NO / NA Presence of sinking product? YES / NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-017A	gDHC only	Date	10/19/09
Sample: ID	GW-091019-PL2-017A-02		Field Team: (Initials)	KA
Field Conditions	Cloudy			

## Purge Information

Well Diameter (in.)	4"		Purge Method : Submersible pump
Well Depth (ft.)	20.8		Bladder Pump
Initial Depth to Water (ft.)	9.33 @ 0951		<b>Peristaltic Pump</b>
Depth of Water Column	11.47		Other: _____
3 Casing Volumes	22.4		Start Time
1 Casing Volume	7.4		End Time
			Total Gallons Purged

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1400	1.2	6.42	14.83	0.78	0.52	16.01	-219.6	clear
1403	1.4	6.39	14.77	0.44	0.47	16.05	-221.8	clear
1406	1.6	6.41	14.73	0.39	0.47	16.09	-223.6	clear
1409	1.9	6.37	14.72	0.63	0.50	16.13	-221.5	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1411	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
TOC (415.1)	1411	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	MS/MSD
Dissolved gasses (MEE) (RSK-175)	1411	(3) 40-mL VOA	HCl cool to 4°C	MS/MSD
Ferrous Iron (SM3500 Fe B-97)	1411	250 mL amber	HCl cool to 4°C Do NOT filter	MS/MSD
Anions (EPA 300.0)	1411	(1) 500 mL HDPE	cool to 4°C	MS/MSD
Organics Acids (VFA)	1411	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	MS/MSD
Metals (200.8&6010B)	1411	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	MS/MSD
Census	1411	bio-flo&MI falcon tube	4°C	x Duplicate

1 Liter Filtered for both samples

End Time 1501

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-031A	Date	10/19/09
Sample: ID	GW-091019-PL2-031A-0 <sub>1</sub>	Field Team: (Initials)	KA
Field Conditions			

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	28.9		Bladder Pump
Initial Depth to Water (ft.)	8.94 @ 0945		<u>Peristaltic Pump</u>
Depth of Water Column	19.96	Other: :	
3 Casing Volumes	9.6	Start Time	1524
1 Casing Volume	3.2	End Time	1629
		Total Gallons Purged	2.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1537	1.1	6.73	1.936	45.8	1.38	14.93	-27.7	clear
1540	1.3	6.72	1.963	29.1	0.51	14.76	-27.7	clear
1543	1.5	6.73	1.968	21.7	0.36	14.68	-26.2	clear
1546	1.7	6.72	1.968	15.2	0.37	14.65	-23.3	clear
1549	1.9	6.73	1.964	10.43	0.33	14.58	-21.2	clear
1552	2.1	6.75	1.960	9.64	0.28	14.56	-19.6	clear

## Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1554	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
TOC (415.1)	1554	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	Duplicate
Dissolved gasses (MEE) (RSK-175)	1554	(3) 40-mL VOA	HCl cool to 4°C	Duplicate
Ferrous Iron (SM3500 Fe B-97)	1554	250 mL amber	HCl cool to 4°C Do NOT filter	Duplicate
Anions (EPA 300.0)	1554	(1) 500 mL HDPE	cool to 4°C	Duplicate
Organics Acids (VFA)	1554	2-40 mL VOA (1) 500 mL poly-	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	Duplicate
Metals (200.8&6010B)	1554	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	Duplicate
Census	✓	bio-flo&MI falcon tube	4°C	

End Time 1629

### Comments / Exceptions:

Presence of floating product?	YES / <u>NO</u>	Presence of sinking product?	YES / <u>NO</u>

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# Chain of Custody Record & Laboratory Analysis Request

*4th Quarter*  
**Analytical Resources, Incorporated**  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)



Page: 1 of 1  
 Date: 10/19/09  
 No. of Coolers: 2  
 No. of Coolers Present: 17  
 No. of Coolers Temp: 58

ARI Assigned Number: PT20  
 Turn-around Requested: Standard  
 ARI Client Company: Boeing  
 Phone: \_\_\_\_\_  
 Client Contact: Will Ernst

Client Project Name: 2-66 ERD IM Performance Sampling

Client Project #: 175112 2-666  
 Samplers: K. Addis

Sample ID	Date	Time	Matrix	Number of Containers
GW-091019-PL2-032A-0	10/19/09	1107	GW	12
GW-091019-PL2-021A-0	1244			13
GW-091019-PL2-017A-0	1411			37
GW-091019-PL2-017A-1	1411			1
GW-091019-PL2-032A-0	1554			12
GW-091019-PL2-031A-1	1554			12
Trip Blank			↓	2

Analysis Requested	Notes/Comments
VOCs EPA 8260C	
TOC EPA 415.1	
MEE RSK-175	
Ferrous Iron 3500-FED	
Metals (dissolved)** As & Mn only	
Anions EPA 300.0 (NO <sub>3</sub> & SO <sub>4</sub> )	
VFA organic acids (by MI)	
qDHC bacterial census (by MI)	
** dissolved metals are field filtered	O = No MS/MSD

Comments/Special Instructions: No more qDHC or VFA samples to follow.

Relinquished by: [Signature]  
 Printed Name: Kristin L. Addis  
 Company: EPI  
 Date & Time: 10/19/09 1720

Received by: [Signature]  
 Printed Name: Jonathon Walter  
 Company: ARI  
 Date & Time: 10/19/09 1720

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSD/DA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-041AA	Date	10/20/09
Sample: ID	GW-091020-PL2-041AA-0	Field Team: (Initials)	KA
Field Conditions	Cloudy, Fussy		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)		Bladder Pump	
Initial Depth to Water (ft.)	8.50 @ 0944	<b>Peristaltic Pump</b>	
Depth of Water Column		Other: :	
3 Casing Volumes		Start Time	0935
1 Casing Volume		End Time	1029
		Total Gallons Purged	3.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0949	1.2	7.40	1.236	6.99	0.67	16.02	80.2	clear, yellow-brown tint
0952	1.4	7.44	1.260	4.31	0.76	16.02	68.1	clear, yellow-brown
0955	1.6	7.45	1.275	4.47	0.83	16.03	50.2	clear, yellow-br
0958	1.8	7.45	1.276	4.25	0.94	16.02	38.0	clear, yellow-br
1001	2.0	7.47	1.285	5.32	1.08	16.01	22.1	clear, yellow-br
1004	2.2	7.46	1.280	4.90	1.04	16.02	17.3	clear, yellow-br
1007	2.5	7.46	1.289	4.39	1.11	16.03	7.2	clear, yellow-br
1010	2.8	7.45	1.291	4.20	0.93	16.04	2.5	clear, yellow-br
1013	3.1	7.44	1.290	4.33	0.89	16.04	-3.0	clear, yellow-br

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1015	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	—	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1015	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1029

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-008C	Date	10/20/09
Sample: ID	GW-091020-PL2-008C-0	Field Team: (Initials)	KA
Field Conditions	Cloudy ~50°F		

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)			Bladder Pump
Initial Depth to Water (ft.)	9.40 @ 0937		<u>Peristaltic Pump</u>
Depth of Water Column			Other: :
3 Casing Volumes		Start Time	1040
1 Casing Volume		End Time	1106
		Total Gallons Purged	1.6

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1047	0.5	7.81	5.777	0.98	0.66	14.25	32.7	clear, slight yellow
1050	0.7	7.89	5.782	0.93	0.55	14.20	30.8	clear, slight yellow
1053	1.0	7.87	5.780	0.90	0.62	14.17	27.0	clear, slight yellow
1056	1.3	7.87	5.781	0.61	0.77	14.15	20.0	clear
1059	1.6	7.88	5.781	0.79	0.89	14.15	17.3	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1101	(3) 40-mL VOA	HCl, cool to 4°C Non-Preserved	
TOC (415.1)	—	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1101	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1106

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

Double checked pH before pumping  
7.0 ~ 7.03

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-008B	Date	10/20/09
Sample: ID	GW-091020-PL2-008B.0	Field Team: (Initials)	KA
Field Conditions	Cloudy ~ 60°F occasional sun breaks		

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	49.8		Bladder Pump
Initial Depth to Water (ft.)	9.88 @0941		<b>Peristaltic Pump</b>
Depth of Water Column	39.92	Other: :	
3 Casing Volumes	12.2	Start Time	1150
1 Casing Volume	6.4	End Time	1236
		Total Gallons Purged	2.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1200	0.8	6.78	4.000	1.55	2.54	14.27	-45.3	clear
1203	1.0	6.80	4.037	1.43	1.82	14.25	-41.4	clear
1206	1.2	6.81	4.069	1.40	1.47	14.21	-36.3	clear
1209	1.5	6.88	4.096	1.27	1.26	14.24	-34.7	clear
1212	1.7	6.84	4.115	1.48	1.16	14.28	-35.0	clear
1215	1.9	6.84	4.131	1.40	1.06	14.26	-35.8	clear
1218	2.1	6.82	4.159	1.31	0.95	14.46	-36.9	clear
1221	2.3	6.83	4.177	1.39	0.89	14.47	-39.3	clear
1224	2.5	6.85	4.179	1.06	0.85	14.42	-38.2	clear

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1226	(3) 40-mL VOA	HCl, cool to 4°C	
✓ TOC (415.1)	1226	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1226	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1236

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-ZB-0-0	Date	10/20/09
Sample: ID	GW-091020-PP-ZB-0-0	Field Team: (Initials)	KA
Field Conditions	Partly Sunny ~60°F		

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	50.5		Bladder Pump
Initial Depth to Water (ft.)	9.04 @ 0926		<u>Peristaltic Pump</u>
Depth of Water Column	41.46	Other :	
3 Casing Volumes	19.9	Start Time	1304
1 Casing Volume	6.6	End Time	1340
		Total Gallons Purged	2.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1310	0.6	6.80	3.683	1.28	0.40	15.47	-29.8	clear slightly gray
1313	0.9	6.81	3.678	1.41	0.51	15.32	-39.3	clear slight gray
1316	1.2	6.81	3.690	1.79	0.84	15.45	-43.5	clear slight gray
1319	1.4	6.81	3.698	2.06	0.97	15.42	-45.9	clear slightly gray
1322	1.6	6.82	3.700	1.40	1.00	15.32	-47.5	clear " "
1325	1.9	6.82	3.721	1.85	1.03	15.29	-48.0	clear slightly gray
1328	2.1	6.83	3.732	2.83	1.06	15.24	-49.4	clear

## Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	<del>1107</del>	(3) 40-mL VOA	NO, cool to 4°C	
TOC (415.1)	---	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	---	(3) 40-mL VOA	HCl cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	---	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	---	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	---	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1330	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	---	bio-flo&MI falcon tube	4°C	

End Time 1340

## Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-2B-I-0	Date	10/20/09
Sample: ID	GW-091020-PP-2B-I-0	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	9.39 @ 0927	<b>Peristaltic Pump</b>	
Depth of Water Column	41.1	Other: :	
3 Casing Volumes	19.7	Start Time	1040-1340
1 Casing Volume	6.6	End Time	1429
		Total Gallons Purged	3.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1348	0.7	6.90	4.270	13.6	0.98	14.98	24.9	clear
1351	0.9	6.87	4.269	10.79	0.85	14.94	22.8	clear
1354	1.2	6.87	4.235	6.77	0.80	14.88	4.6	clear
1357	1.5	6.91	4.204	4.76	0.75	14.87	-15.8	clear
1400	1.7	6.93	4.184	4.29	0.80	14.85	-32.4	clear
1403	1.9	6.95	4.165	3.12	0.80	14.83	-45.4	clear
1406	2.2	6.96	4.148	2.97	0.76	14.86	-55.2	clear
1409	2.5	6.95	4.164	4.17	0.76	14.86	-60.6	clear
1412	2.7	6.97	4.192	3.64	0.78	14.93	-65.7	clear
1415	3.0	6.98	4.178	4.49	0.80	14.88	-70.0	clear

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1417	(3) 40-mL VOA	cool to 4°C	
✓ TOC (415.1)	1417	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1417	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1429

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-035A-0	Date	10/20/09
Sample: ID	GW-091020-PL2-035A-0	Field Team: (Initials)	KA
Field Conditions	E Mostly Cloudy with occasional sun breaks		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump Bladder Pump <b>Peristaltic Pump</b> Other: :	
Well Depth (ft.)	29.8		
Initial Depth to Water (ft.)	9.75 @ 0932		
Depth of Water Column	20.05		
3 Casing Volumes	9.6		
1 Casing Volume	3.2	Start Time	1438
		End Time	1532
		Total Gallons Purged	3.25

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1450	1.25	6.57	2.939	17.0	0.57	15.79	-9.1	clear
1453	1.5	6.56	2.948	15.4	0.60	15.73	-13.0	clear
1456	1.75	6.57	2.954	14.9	0.85	15.69	-21.6	clear
1459	2.0	6.60	2.980	8.27	0.97	15.63	-31.3	clear
1502	2.25	6.62	2.999	11.4	0.89	15.57	-40.7	clear
1505	2.5	6.65	3.013	6.11	0.86	15.53	-47.9	clear
1508	2.75	6.66	3.023	4.59	0.84	15.50	-52.5	clear
1511	3.00	6.68	3.035	3.90	0.81	15.46	-58.7	clear
1514	3.25	6.68	3.039	4.19	0.79	15.44	-59.6	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1516	(3) 40-mL VOA	HCl, cool to 4°C	
TOC (415.1)	1516	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	1516	(3) 40-mL VOA	HCl cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	1516	250 mL amber	HCl cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
Metals (200.8&6010B)	1516	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1532

## Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# Chain of Custody Record & Laboratory Analysis Request

42 QTR  
**Analytical Resources, Incorporated**  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)



Page: 1 of 1  
 Date: 10/20/09  
 No. of Containers: 24  
 Ice Present?   
 Cooler Temp: 24

ARI Assigned Number: P142  
 Turn-around Requested: Standard  
 ARI Client Company: Boeing  
 Client Contact: Will Ernst  
 Phone:

Client Project Name: 2-66 ERD IM Performance Sampling  
 Client Project #: 17511.2 2-66  
 Samplers: R. Addis

Sample ID	Date	Time	Matrix	Number of Containers	Analysis Requested						Notes/Comments		
					VOCs EPA 8260C	TOC EPA 415.1	MEE RSK-175	Ferrous Iron 3500-FED	Metals (dissolved)** As & Mn only	Anions EPA 300.0 (NO <sub>3</sub> & SO <sub>4</sub> )		VFA organic acids (by MI)	qDHC bacterial census (by MI)
GW-091020-PL2-041A-0	10/20/09	1015	GW	4	X				X				** dissolved metals are field filtered ⊗ = Nonreserved VOA's
GW-091020-PL2-008C-0		1101		4	⊗				X				
GW-091020-PL2-008B-0		1226		5	⊗	X			X				
GW-091020-PP-28-0-0		1330		4	⊗				X				
GW-091020-PP-28-I-0		1429		5	⊗	X			X				
GW-091020-PL3-035A-0		1516		9	X	X			X				
Trip Blank			N	2	X								

Comments/Special Instructions

Relinquished by: Kristin L Addis  
 Printed Name: Kristin L Addis  
 Company: EPI  
 Date & Time: 10/20/09 1616

Received by: Kristin L Addis  
 Printed Name: Kristin L Addis  
 Company: ARI  
 Date & Time: 10/20/09 1614

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSD/DAP/SEP/ISMS protocol will be stored frozen for up to one year and then discarded.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-4B-0	Date	10/21/09
Sample: ID	GW-091021-PP-4B-0-0	Field Team: (Initials)	KA
Field Conditions	Raining		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	9.09 @ 0924	<b>Peristaltic Pump</b>	
Depth of Water Column	41.4	Other: :	
3 Casing Volumes	19.8	Start Time	0837
1 Casing Volume	6.6	End Time	0908
		Total Gallons Purged	2.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0849	1.4	6.72	3.446	5.00	1.15	15.65	-43.6	clear
0852	1.6	6.73	3.452	4.76	1.06	15.56	-47.7	clear
0855	1.8	6.74	3.447	4.86	0.98	15.52	-50.7	clear
0858	2.1	6.75	3.453	1.52	0.88	15.55	-55.0	clear
0901	2.4	6.76	3.455	1.57	0.82	15.49	-56.9	clear

## Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	0903	(3) 40-mL VOA	cool to 4°C	Non-preserved VOAs
TOC (415.1)	—	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	0903	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 0908

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-4B-I-0	Date	10/21/09
Sample: ID	GW-091021-PP-4B-I-0	Field Team: (Initials)	KA
Field Conditions	Raining		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	9.45 @ 0930	<u>Peristaltic Pump</u>	
Depth of Water Column	41.1	Other: :	
3 Casing Volumes	19.7	Start Time	0910
1 Casing Volume	6.6	End Time	0950
		Total Gallons Purged	1.7

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0918	0.5	6.97	3,191	1.14	0.54	15.48	-39.3	clear
0924	1.0	6.96	3,361	0.83	0.56	15.43	-53.4	clear
0927	1.2	6.96	3,428	0.90	0.61	15.42	-55.8	clear
0930	1.4	6.96	3,418	0.92	0.68	15.42	-58.8	clear
0933	1.7	6.96	3,411	1.01	0.64	15.43	-60.3	clear

## Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	0935	(3) 40-mL VOA	HCl, cool to 4°C	
✓ TOC (415.1)	0935	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	0935	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 0950

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

## 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-010A	Date	10/21/09
Sample: ID	GW-091021-PL2-010A-0	Field Team: (Initials)	KA
Field Conditions	Raining		

### Purge Information

Well Diameter (in.)	4"
Well Depth (ft.)	20.8
Initial Depth to Water (ft.)	9.59 @0934
Depth of Water Column	11.21
3 Casing Volumes	22.0
1 Casing Volume	7.3

Purge Method : Submersible pump  
 Bladder Pump  
 **Peristaltic Pump**  
 Other: \_\_\_\_\_

Start Time	1043
End Time	1120
Total Gallons Purged	2.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1048	0.5	6.18	3.540	2.55	2.89	14.83	62.5	clear
1051	0.7	6.13	3.432	2.12	1.83	14.92	64.6	clear
1053	0.9	6.07	3.247	2.94	1.21	14.95	68.1	clear
1056	1.1	5.96	3.084	1.71	0.80	14.98	71.5	clear
1059	1.4	5.86	2.909	2.34	0.71	15.11	76.1	clear
1102	1.7	5.75	2.780	1.39	0.73	15.16	81.3	clear
1105	2.0	5.71	2.720	1.50	0.71	15.19	85.6	clear
1108	2.3	5.68	2.709	1.14	0.68	15.20	89.3	clear

### Sample Information

Sample Method(s)  **Peristaltic pump** /  Submersible pump /  Bladder Pump /  Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1110	(3) 40-mL VOA	HCl, cool to 4°C	
✓ TOC (415.1)	1110	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1110	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1120

#### Comments / Exceptions:

Presence of floating product? YES /  NO      Presence of sinking product? YES /  NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-3A-I-0	Date	10/21/09
Sample: ID	GW-091021-PP-3A-I-0	Field Team: (Initials)	KA
Field Conditions	Raining		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	20.5	Bladder Pump	
Initial Depth to Water (ft.)	9.53 @ 0955	<b>Peristaltic Pump</b>	
Depth of Water Column	10.97	Other: :	
3 Casing Volumes	5.3	Start Time	1202
1 Casing Volume	1.8	End Time	1239
		Total Gallons Purged	2.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1210	0.6	6.87	2,069	8.86	0.91	14.94	71.6	clear
1213	0.9	6.98	2,106	4.10	0.66	14.91	49.6	clear
1216	1.2	7.02	2,134	2.78	0.52	14.83	34.4	clear
1219	1.5	7.04	2,136	2.43	0.49	14.79	29.6	clear
1222	1.8	7.07	2,130	1.76	0.46	14.85	23.4	clear
1225	2.1	7.09	2,129	1.68	0.44	14.84	19.5	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1227	(3) 40-mL VOA	HCl, cool to 4°C	
✓ TOC (415.1)	1227	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1227	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1239

### Comments / Exceptions:

Presence of floating product?	YES / <b>NO</b>	Presence of sinking product?	YES / <b>NO</b>

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-3B-I-0	Date	10/21/07
Sample: ID	GW-091021-PP-3B-I-0	Field Team: (Initials)	KA
Field Conditions	Clouds + Rain with sun breaks		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	50.5	Bladder Pump	
Initial Depth to Water (ft.)	9.44 @0953	<b>Peristaltic Pump</b>	
Depth of Water Column	41.06	Other: :	
3 Casing Volumes	19.7	Start Time	1241
1 Casing Volume	6.6	End Time	1400
		Total Gallons Purged	5.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1248	0.7	7.20	11.25	2.72	0.62	14.07	-269.1	clear, gray
1251	1.0	7.31	11.32	2.08	0.72	14.04	-274.9	clear, gray
1254	1.3	7.32	11.30	1.12	0.82	13.99	-282.3	clear, gray
1257	1.6	7.37	11.29	0.16	0.73	13.98	-283.2	clear, gray
1300	1.9	7.49	14.15	0.10	0.57	14.00	-296.7	clear, gray
1303	2.2	7.53	14.02	1.13	0.42	14.02	-284.2	clear, gray
1306	2.5	7.54	15.01	0.57	0.40	14.02	-278.6	clear, gray
1309	2.8	7.55	14.66	0.72	0.34	14.00	-281.1	clear, gray
1312	3.1	7.58	14.08	0.68	0.34	13.99	-296.8	clear, gray
1315	3.4	7.59	13.90	0.69	0.33	13.98	-297.5	clear, gray
1318	3.7	7.59	13.98	0.80	0.33	13.98	-296.1	clear, gray
1321	4.0	7.59	12.96	0.88	0.34	13.98	-295.7	clear, gray

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other Cont →

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1341	(3) 40-mL VOA	HCl, cool to 4°C <i>Non-preserved</i>	
✓ TOC (415.1)	1341	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1341	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1400

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

Moderate odor

See next page

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Continued from previous page

## 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-3B-I-0	Date	10/21/07
Sample: ID	GW-091021-PP-3B-I-0	Field Team: (Initials)	KA
Field Conditions	Sunny		

### Purge Information

Well Diameter (in.)	2.1	Purge Method :	Submersible pump
Well Depth (ft.)	50.5		Bladder Pump
Initial Depth to Water (ft.)	9.44 <span style="margin-left: 20px;">20953</span>		<b>Peristaltic Pump</b>
Depth of Water Column	41.06	Other: :	
3 Casing Volumes	19.7	Start Time	1241
1 Casing Volume	6.6	End Time	1400
		Total Gallons Purged	5.1

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1324	4.3	7.59	12.58	1.02	0.44	13.98	-297.4	clear, gray
1327	4.5	7.59	12.17	0.58	0.43	13.95	-298.1	clear, gray
1330	4.6	7.58	11.93	0.71	0.41	13.95	-285.4	clear, gray
1333	4.8	7.57	11.58	0.78	0.44	13.94	-290.3	clear, gray
1336	5.0	7.55	11.44	0.46	0.39	13.97	-282.9	clear, gray
1339	5.1	7.54	11.32	0.44	0.35	13.95	-284.9	clear, gray

### Sample Information

Sample Method(s): **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1341	(3) 40-mL VOA	<del>Hot</del> , cool to 4°C	
✓ TOC (415.1)	1341	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1341	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1400

### Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

Moderate odor (rotten eggs?)  
 purgewater turned bucket dark gray

3474 Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-5B-I-0	Date	10/21/09
Sample: ID	GW-091021-PP-5B-I-0	Field Team: (Initials)	KA
Field Conditions	Sunny ☺		

## Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	50.5
Initial Depth to Water (ft.)	9.50 @0949
Depth of Water Column	41
3 Casing Volumes	19.7
1 Casing Volume	6.6

Purge Method : Submersible pump  
 Bladder Pump  
Peristaltic Pump  
 Other: \_\_\_\_\_

Start Time	1412
End Time	1453
Total Gallons Purged	2.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1421	1.0	8.01	0.439	12.3	0.95	15.51	-115.7	clear
1424	1.2	8.01	0.456	6.91	0.54	15.39	-126.1	clear
1427	1.4	8.08	0.476	4.59	0.46	15.12	-149.9	clear
1430	1.6	8.12	0.488	1.96	0.43	15.02	-159.6	clear
1433	1.9	8.15	0.490	1.62	0.42	15.01	-168.8	clear
1436	2.2	8.17	0.491	1.19	0.42	14.98	-175.7	clear
1439	2.5	8.16	0.492	0.93	0.42	14.95	-169.9	clear

## Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1441	(3) 40-mL VOA	<del>cool</del> cool to 4°C	
✓ TOC (415.1)	1441	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	---	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	---	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	---	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	---	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1441	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	---	bio-flo&MI falcon tube	4°C	

End Time 1453

### Comments / Exceptions:

Presence of floating product? YES / NO      Presence of sinking product? YES / NO

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PP-1B-7-0, 1	Date	10/21/09
Sample: ID	GW-091021-PP-1B-E-0, 1	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy, Breezy		

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	50.5		Bladder Pump
Initial Depth to Water (ft.)	10.41 @ 0922		<b>Peristaltic Pump</b>
Depth of Water Column	40.1	Other: :	
3 Casing Volumes	19.2	Start Time	1511
1 Casing Volume	6.4	End Time	1615
		Total Gallons Purged	2.2

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1520	1.1	7.31	10.60	1.35	1.31	14.51	-151.3	clear
1523	1.5	7.31	10.63	1.00	0.88	14.54	-159.2	clear
1526	1.6	7.27	10.62	0.94	0.81	14.74	-162.3	clear
1529	1.8	7.24	10.66	1.03	0.85	14.69	-172.5	clear
1532	2.0	7.19	11.34	2.31	0.98	14.64	-173.7	clear
1535	2.2	6.99	13.02	3.32	1.22	14.68	-181.3	clear
1538	2.5	6.93	13.90	3.41	1.37	14.67	-191.6	clear
1541	2.8	6.95	13.98	2.97	1.02	14.67	-198.2	clear
1544	3.1	6.97	13.94	3.18	0.86	14.65	-202.3	clear
1547	3.4	6.99	13.84	2.99	0.76	14.62	-205.4	clear

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	1549	(3) 40-mL VOA	cool to 4°C	Duplicate
✓ TOC (415.1)	1549	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	Duplicate
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	1549	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	Duplicate
Census	—	bio-flo&MI falcon tube	4°C	

End Time 1615

### Comments / Exceptions:

Presence of floating product? YES / **(NO)** Presence of sinking product? YES / **(NO)**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# Chain of Custody Record & Laboratory Analysis Request

478 *Q. O. O. O.*  
**Analytical Resources, Incorporated**  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)



Page: 1 of 1

Date: 10/21/09

Number of Containers: 2

ICG Present? Yes

Cooler Temp: 4°C

Seals: 2

Turn-around Requested: Standard

Phone: \_\_\_\_\_

ARI Client Company: **Boeing**

Client Contact: **Will Ernst**

Client Project Name: **2-66 ERD IM Performance Sampling**

Client Project #: **175112 2-66**

Samplers: **K. Addis**

Sample ID	Date	Time	Matrix	Number of Containers	Analysis Requested							Notes/Comments	
					VOCs EPA 8260C	TOC EPA 415.1	MEE RSK-175	Ferrous Iron 3500-FED	Metals (dissolved)** As & Mn only	Anions EPA 300.0 (NO <sub>3</sub> & SO <sub>4</sub> )	VFA organic acids (by MI)		qDHC bacterial census (by MI)
GW-091021-PP-4B-0-0	10/21/09	0903	GW	4	⊗				X				** dissolved metals are field filtered ⊗ = Non-preserved VOCs
GW-091021-PP-4B-I-0		0935		5	⊗	X			X				
GW-091021-PL2-010A-0		1110		5	X	X			X				
GW-091021-PP-3A-I-0		1227		5	X	X			X				
GW-091021-PP-3B-I-0		1341		5	⊗	X			X				
GW-091021-PP-5B-I-0		1441		5	⊗	X			X				
Trip Blank				2	X								
GW-091021-PP-1B-I-0		1549		5	⊗	X			X				
GW-091021-PP-1B-I-1		1549		5	⊗	X			X				

Relinquished by: *Kristin L. Addis*  
 (Signature)  
 Printed Name: **Kristin L. Addis**  
 Company: **EPI**  
 Date & Time: **10/21/09 1640**

Received by: *Y. Peterson*  
 (Signature)  
 Printed Name: **Y. Peterson**  
 Company: **ARI**  
 Date & Time: **10/21/09 1640**

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021B	Date	10/22/07
Sample: ID	GW-091022-PL2-021B-0	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy		

## Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	48.6	Bladder Pump	
Initial Depth to Water (ft.)	10.23 @ 0959	<b>Peristaltic Pump</b>	
Depth of Water Column	38.37	Other: _____	
3 Casing Volumes	18.3	Start Time	0815
1 Casing Volume	6.1	End Time	0904
		Total Gallons Purged	3.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0830	1.5	6.71	9.070	2.66	1.02	13.83	-72.4	clear, colorless
0833	1.8	6.72	9.189	1.99	1.07	13.90	-69.2	clear, colorless
0840	2.4	6.73	9.241	1.46	1.11	13.93	-62.9	clear, colorless
0843	2.6	6.74	9.261	1.08	1.09	13.92	-59.2	clear, colorless
0846	2.8	6.74	9.284	1.07	1.06	13.94	-55.5	clear, colorless
0849	3.0	6.75	9.293	1.02	1.06	13.94	-55.6	clear, colorless

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	0851	(3) 40-mL VOA	cool to 4°C	
✓ TOC (415.1)	0851	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	—	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	—	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	—	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	—	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	0851	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	—	bio-flo&MI falcon tube	4°C	

End Time 0904

### Comments / Exceptions:

Presence of floating product? YES / **NO**      Presence of sinking product? YES / **NO**

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

# 2-66 Sheetpile Structure IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-021C	Date	10/22/09
Sample: ID	GW-091022-PL2-021C-0	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy		

## Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	91.7		Bladder Pump
Initial Depth to Water (ft.)	10.02 @ 0957		<b>Peristaltic Pump</b>
Depth of Water Column	81.68	Other :	
3 Casing Volumes	39.3	Start Time	0913
1 Casing Volume	13.0	End Time	1007
		Total Gallons Purged	3.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0919	6.6	7.48	22.70	11.9	1.17	14.34	-152.9	clear, colorless
0922	1.0	7.54	22.85	14.8	0.88	14.35	-172.0	clear, colorless
0932	1.8	7.61	22.89	12.3	0.95	14.45	-172.3	clear, colorless
0935	2.0	7.62	22.77	9.40	0.93	14.77	-174.0	clear, colorless
0938	2.3	7.63	22.83	16.3	0.96	14.67	-171.6	clear colorless
0941	2.6	7.65	22.80	7.43	0.98	14.65	-169.7	clear, colorless
0944	3.0	7.65	22.83	8.31	0.96	14.62	-166.0	clear, colorless

## Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
✓ Volatiles (8260B)	0946	(3) 40-mL VOA	cool to 4°C	
✓ TOC (415.1)	0946	250 mL amber	H <sub>2</sub> SO <sub>4</sub> to pH <2, cool to 4°C	
Dissolved gasses (MEE) (RSK-175)	---	(3) 40-mL VOA	cool to 4°C	
Ferrous Iron (SM3500 Fe B-97)	---	250 mL amber	cool to 4°C Do NOT filter	
Anions (EPA 300.0)	---	(1) 500 mL HDPE	cool to 4°C	
Organics Acids (VFA)	---	(1) 500 mL poly	field filter 0.45 micron filter, HNO <sub>3</sub> to pH <2, cool to 4°C	
✓ Metals (200.8&6010B)	0946	(1) 500 mL HDPE	field filter, HNO <sub>3</sub>	
Census	---	bio-flo&MI falcon tube	4°C	

End Time 1007

### Comments / Exceptions:

Presence of floating product? YES / **(NO)** Presence of sinking product? YES / **(NO)**

*Bubbly water*

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Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



**ATTACHMENT D**  
**DATA VALIDATION REPORTS**



## TECHNICAL MEMORANDUM

**Date:** 10/22/2009  
**To:** Will Ernst  
**From:** Jill Lamberts, Staff Environmental Scientist  
Kent Angelos, Principal and Project Director  
**cc:** Jeff Dengler and Doug Kunkel, EPI  
**RE:** **BOEING PLANT 2 – INTERIM MEASURE 2-66 SHEETPILE ERD PERFORMANCE SAMPLING – DATA VALIDATION QA/QC REVIEW**

**Project No.:** 013-1646-009.300.06  
**Company:** The Boeing Company  
**Email:** jill\_lamberts@golder.com

### 1.0 INTRODUCTION

A total of 20 water samples (including 3 field duplicates and 2 trip blanks) were collected July 20 and 21, 2009 to monitor the selected IM remedial technology for enhanced reductive dechlorination (ERD) for groundwater within the vicinity of the 2-66 Sheetpile in Tukwila, Washington (EPI, 2008). Samples were analyzed by Analytical Resources Incorporated (ARI) of Tukwila, Washington and Microbial Insights of Rockford, Tennessee for the following parameters:

- Volatile Organic Compounds (VOCs) by EPA Method 8260C
- Total Organic Carbon (TOC) by EPA 415.1
- Dissolved Gases (Methane, Ethane, and Ethene – MEE) by Modified RSK 175
- Dissolved Metals (Arsenic and Manganese) by EPA Methods 200.8 and 6010B
- Ferrous Iron by SM 3500 FeD
- Anions (N-Nitrate and Sulfate) by EPA 300.0
- Organic Volatile Fatty Acids (VFAs) (Pyruvic, Lactic, Acetic, Propionic, and Butyric Acids) by ion chromatography by Microbial Insights
- Bio-Dechlor Bacterial Census by qDHC (RT-PCR) – dehalococcoides by Microbial Insights

With the exception of the metabolic acids analysis, samples were analyzed in accordance with procedures described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, 3rd edition) 8260C, 6010B, metals, EPA Method 200.8, Revision 5.5; Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Standard Methods for the Examination of Water and Wastewater (20th Edition). Methods SM3500 Fe-D, RSK 175, 415.1 and 300.0.*

The bacterial and metabolic acids analyses were analyzed in accordance with the *Microbial Insights Standard Operating Procedures*.

### 2.0 SAMPLE DELIVERY GROUPS, SAMPLES AND ANALYSES

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

#### PH43, 043GG (VOCs, TOC, MEE, Ferrous Iron, Anions, and VFAs):

GW-090720-PL2-032A-0	GW-090720-PL2-035A-0	Trip Blank
GW-090720-PL2-032A-1	GW-090720-PL2-010A-0	GW-090720-PP-5B-I-0
GW-090720-PP-4B-I-0	GW-090720-PP-3A-I-0	GW-090720-PL2-008B-0
GW-090720-PP-2B-I-0	GW-090720-PP-3B-I-0	GW-090720-PL2-008B-1

bp2 2-66 erd sheetpile im q3 dv report - 102709 - final

Golder Associates Inc.  
18300 NE Union Hill Road, Suite 200  
Redmond, WA 98052 USA  
Tel: (425) 883-0777 Fax: (425) 882-5498 www.golder.com

**PH63, 054GG (VOCs, TOC, MEE, Ferrous Iron, Anions, VFAs, Dissolved Metals, and Bacterial Census):**

GW-090721-PL2-017A-0	GW-090721-PL2-021A-0	GW-090721-PP-1B-I-0
GW-090721-PL2-017A-1	GW-090721-PL2-021B-0	Trip Blank
GW-090721-PL2-031A-0	GW-090721-PL2-021C-0	

Quality assurance/quality control (QA/QC) reviews of laboratory data were performed in the laboratory in accordance with the laboratory quality assurance program plan. The data validation QA/QC review focused primarily on laboratory result summary sheets and quality control summary sheets to ensure that work plan data quality objectives were met for the project.

Data validation was conducted in accordance with the criteria outlined in the National Functional Guidelines for Organic Data Review (EPA 1999) and the National Functional Guidelines for Inorganic Data Review (EPA, 2004), modified to include method specific requirements of the laboratory analytical methods and *Interim Measure Work Plan for 2-66 Sheetpile, Boeing Plant 2 Seattle/Tukwila (EPI, 2008)*. A Level I validation was performed on this data package which included a review of quality assurance sample results and qualification of data as appropriate.

The following is a summary of quality control elements associated with each analytical fraction and the status of that element as a result of the data validation process.

### 3.0 SAMPLING, DOCUMENTATION AND REPORTING

Sample acknowledgements, chain-of-custody, request forms and data package completeness were evaluated with the following noted:

- SDG PH43 and PH63: Formic Acid results reported as “NA”. Unable to determine if it means < RL or if it was not analyzed. Microbial Insights was contacted. The response on 10/6/2009 determined that Formic Acid was not analyzed as it is not part of the lactate breakdown process and is not required. It was analyzed inadvertently in earlier sampling efforts and will not be run for future events. No further action.
- SDGs PH43: Cooler receipt form indicates that one of the VOC vials for Trip Blank had one pea bubble in one of the vials. No action was required since the samples were all analyzed within 7 days and the other two vials were ok.
- SDG PH43: ARI sample receiving noted that there was a sample identification discrepancy between the bottle and the chain of custody (COC). The bottle said GW-090720-PP-5B-0 and the COC said GW-090720-PP-5B-I-0. The lab resolved the issue by matching the sample times and determined that the correct ID was GW-090720-PP-5B-I-0.
- SDG PH43: It was noted that there were no associated QC included (i.e. MB and LCS/LCSD) with the analysis of the Trip Blank on 7/25/2009. The lab was contacted and it was determined that since this was a QC sample, no associated QC was required.
- SDG PH43: The Case Narrative noted that Bromoethane had out of control CCALs and LCS/LCSD recoveries. Bromoethane is not a client target analyte, so the lab was contacted and it was determined that there was a typo on the case narrative. It was corrected by the lab to read Bromomethane.
- SDG PH63: ARI sample receiving noted that there was a sample identification discrepancy between the bottle and the COC. The bottle said GW-090727-PL2-021A-0 and the COC said GW-090721-PL2-021C-0. The lab resolved the issue by matching the sample times and determined the correct ID.
- SDG PH63: Recorded cooler temperatures exceeded the recommended temperature (<6°C) for sample preservation. No action was taken since the samples are delivered to the laboratory on the same day as sample collection.

- Results for volatile organic compound 1, 1, 2-trichloro-1, 2, 2-trifluoroethane are reported in a truncated format (1, 1, 2-trichloro-1, 2, 2-trifluoroe) due to ARI report format. No action was taken.

## 4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

### 4.1 Analytical Methods – *acceptable*

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

### 4.2 Sample Holding Times and Preservations – *acceptable*

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples) with the following notes:

- SDG PH43: ARI sample receiving noted that there was a large bubble in one of the three HCl VOA vials for GW-090803-PL2-315A-0. No action was taken other than to note since the other two vials were ok and the samples were analyzed in < 7days.
- SDG PH63: The Chain of Custody indicated that all sample GW-090721-PL2-021C-0 for VOCs were submitted unpreserved. Also, the case narrative noted that sample GW-090721-PL2-021A-0 was submitted with a pH of 2.5. No action was required since all samples were analyzed within 7 days.

### 4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:

**TABLE 1**  
**2-66 IM ERD Reporting Limits**

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	1.0	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	1.0	5.0
2-Hexanone	1.0	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- Acetone RL was reported by the lab at 10 µg/L instead of the requested 5 µg/L for the Method Blank on 7/30/2009. The lab was contacted and it was determined that there was a recent increase in the RL. The laboratory provided a revised dataset with the correct RL for Acetone.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

#### 4.4 Instrument Calibration

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met with the following exceptions:

- SDG PH43: The case narrative listed that the CCAL from 7/29/2009 was out of control high for Chloromethane, 2-Butanone, and 4-Methyl-2-Pentanone (MIBK). The lab qualifies detects as “Q” (%D > 20%). All results for Chloromethane, 2-Butanone, and MIBK from 7/29/2009 were qualified as estimated (J/UJ) due to possible high bias. Upon review, it appeared that there were no samples associated with a CCAL from 7/29/2009. The lab was contacted and it was determined that the run started on 7/29/2009 at 20:33 and ran until 7/30/2009. Samples GW-090720-PP-2B-I-0, GW-090720-PP-3A-I-0, GW-090720-PP-3B-I-0, GW-090720-PP-5B-I-0, and GW-090720-PL2-008B-0 are associated with the 7/29/2009 analysis.
- SDG PH43: The case narrative listed that the CCAL from 7/30/2009 was out of control high for Vinyl Acetate, 2-Chlorovinylether, and Bromomethane. The lab qualifies detects as “Q” (%D > 20%). All results for Vinyl Acetate, 2-Chlorovinylether, and Bromomethane from 7/30/2009 were qualified as estimated (J/UJ) due to possible high bias.
- SDG PH43: The case narrative listed that the CCAL from 7/31/2009 was out of control high for 1,1,2-Trichloro-1,2-Trifluoroethane and out of control low for Acetone. The lab qualifies detects as “Q” (%D > 20%). All results for 1,1,2-Trichloro-1,2-Trifluoroethane and Acetone from 7/31/2009 were qualified as estimated (J/UJ) due to possible high bias.
- SDG PH63: The case narrative listed that the CCAL from 7/23/2009 was out of control low for Vinyl Acetate and o-Xylene. The lab qualifies detects as “Q” (%D > 20%). All results for Vinyl Acetate and o-Xylene from 7/23/2009 were qualified as estimated (J/UJ) due to possible high bias.

#### 4.5 Blank Contamination – *acceptable*

The method blanks and trip blanks were free of contamination with the following exceptions:

- SDG PH43 and PH63: The Trip Blank contained Methylene Chloride above the RL. No action was required since all other associated samples had no detections for Methylene Chloride.

#### 4.6 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

#### 4.7 Matrix Spike Compound Recovery

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090721-PL2-017A-0 in SDG PH63. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following exceptions:

- SDG PH43: MS/MSD analysis was not performed in this SDG. Please refer to LCS/LCSD and field duplicate data for precision and accuracy information.
- SDG PH63: The MS and MSD percent recoveries were out of control low for Styrene. The parent sample (GW-090721-PL2-017A-0) was qualified as estimated (J/UJ) due to a possible low bias from matrix effects.
- SDG PH63: The MS/MSD RPD was out of control high for Bromomethane. No action was taken since the LCS/LCSD RPD recoveries were in control and Bromomethane was not detected in the sample.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

#### 4.8 Laboratory Control Sample Recovery

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LCSD recoveries and relative percent differences (RPDs) were acceptable with the following exceptions:

- SDG PH43: The case narrative noted that the LCS and LCSD % recoveries for the 7/29/2009 analysis were out of control low for Carbon Disulfide. All associated samples for the 7/29/2009 analysis were qualified as estimated (UJ/J) for Carbon Disulfide due to a possible low bias.
- SDG PH43: The case narrative noted that the LCS/LCSD % recoveries for the 7/29/2009 analysis were out of control low for 1,1,-Dichloroethene and Bromomethane. Upon review, it was determined that the LCS/LCSD % recoveries were within the QAPP control limits (EPI, 2008), so no further action was required.
- SDG PH43: The case narrative noted that the LCS/LCSD % recoveries for the 7/30/2009 analysis were out of control high for 2-Chlorovinylether. Data validation review also noted that the LCSD % recovery was out of control high for Vinyl Acetate. No further action was required since these two compounds were already qualified due to CCAL issues.

#### 4.9 Field Duplicate Sample Analysis – acceptable

Field duplicate samples were collected and analyzed as follows:

**TABLE 2**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PH43	GW-090720-PL2-032A-0	GW-090720-PL2-032A-1
PH43	GW-090720-PL2-008B-0	GW-090720-PL2-008B-1

Field duplicate analysis criteria were met.

## 5.0 METHANE, ETHANE, AND ETHENE (MEE)

The laboratory provided Level I summary forms for compounds methane, ethane, and ethene. The items reviewed during validation are summarized below.

### 5.1 Analytical Methods – *acceptable*

Samples for MEE parameters were analyzed using EPA Method RSK-175 (Modified).

### 5.2 Sample Holding Times – *acceptable*

All samples were prepared and analyzed within the recommended holding times 14 days from collection to analysis. Please note that the QAPP stipulates that the hold time for MEE is 7 days. The lab was contacted to verify the hold time 5/11/2009. The lab responded that the QAPP was incorrect and the true hold time is 14 days. No action required other than to note.

### 5.3 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the QA Plan with the following exception:

- Table 5 of the QAPP stipulates a reporting level of 1.0 µg/L for methane, ethane, and ethene. The ARI reporting level for methane was 0.7 µg/L, 1.2 µg/L for ethane, and 1.1 µg/L for ethane. EPI's project manager was contacted and approved the slightly higher limits [personal comm. J. Dengler]. No further action was taken other than to note this.

### 5.4 Blank Contamination – *acceptable*

The method and equipment blanks were free of target compounds.

### 5.5 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

### 5.6 Matrix Spike Compound Recovery – *acceptable*

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090721-PL2-017A-0 in SDG PH63. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following exceptions:

- SDG PH43: MS/MSD analysis was not performed in this SDG. Please refer to LCS/LCSD and field duplicate data for precision and accuracy information.

### 5.7 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

### 5.8 Field Duplicate Sample Analysis – *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 3**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PH43	GW-090720-PL2-032A-0	GW-090720-PL2-032A-1

Field duplicate analysis criteria were met.

## 6.0 INORGANICS – DISSOLVED METALS

The laboratory provided a provided a Level I summary data package for review of metals analyses and the items reviewed during validation are summarized below.

### 6.1 Analytical Methods – *acceptable*

Samples for dissolved metals analysis were prepared using EPA Methods 3010A. Samples for dissolved metals analysis were completed by EPA Methods 200.8 for arsenic and EPA Method 6010B for manganese. No sampling, documentation, and reporting discrepancies were noted.

### 6.2 Sample Holding Times and Preservation – *acceptable*

All samples were prepared and analyzed within the recommended holding period from the date of collection (180 days for metals). All holding time criteria were met but the following observations were noted:

- SDG PH63: Sample GW-090721-PL2-021A-0 was submitted with a preservation greater than a pH of 2. The lab preserved the samples upon receipt. No further action was required.

### 6.3 Laboratory Reporting Limits – *acceptable*

All metals listed in the Interim Measure Work Plan (2008) QAPP were analyzed for and requested reporting levels were met with the following discussion:

- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.

### 6.4 Blank Contamination – *acceptable*

The method blanks were free of target compounds.

### 6.5 Laboratory Control Sample Recovery – *acceptable*

LCS (blank spike) recoveries were within QC limits of 80 to 120 percent.

### 6.6 Matrix Spike/Matrix Spike Duplicate Analysis – *acceptable*

Matrix Spike (MS) analysis was performed on GW-090721-PL2-017A-0 in SDG PH63. In SDGs where MS data are not available refer to LCS, matrix duplicate, and field duplicate data for precision and accuracy information. All MS recoveries were acceptable.

### 6.7 Duplicate Analysis – *acceptable*

Laboratory duplicate analysis was performed on the same selected sample as for the MS analysis listed in the previous section. Duplicate analysis criteria were met.

### 6.8 Field Duplicate Sample Analysis

No field duplicates were sampled for dissolved metals.

## 7.0 GENERAL CHEMISTRY - TOTAL ORGANIC CARBON, FERROUS IRON, N-NITRATE AND SULFATE, VOLATILE FATTY ACIDS, AND BACTERIAL CENSUS

The laboratory (ARI) provided a Level I data package for analysis TOC, ferrous iron, N-nitrate, and sulfate; the items reviewed during validation are summarized below. Microbial Insights provided a Level I data package for analysis of the organic volatile fatty acids (VFAs) and bacterial census.

### 7.1 Analytical Methods and Reporting – *acceptable*

The anions (N-Nitrate, and Sulfate) were analyzed using EPA method 300.0. Total Organic Carbon was analyzed by EPA Method 415.1. Ferrous Iron was analyzed by Standard Method 3500 FeD. Organic Volatile Fatty Acids (VFAs) (Pyruvic, Lactic, Acetic, Propionic, and Butyric) were analyzed by ion chromatography at Microbial Insights. The Bio-Dechlor Bacterial Census was analyzed by qDHC (RT-PCR) – dehalococcoides by Microbial Insights. All methods and reporting requirements were met with the following observations:

- All SDGs: Formic Acid results were reported as “NA”. Microbial Insights was contacted to determine if “NA” meant “not detected” or “not available”. An email response dated October 6, 2009 from Poonam Sheth stated the following “Formic acid was not analyzed. The formic acid is not part of the lactate breakdown products and should not have been included originally in the VFA suite. Hence we no longer run this analyte.” No further action was taken other than to note.

### 7.2 Sample Holding Times and Preservation

All samples were prepared and analyzed within the recommended holding period from the date of collection to analysis. Sample preservations met the QAPP (EPI, 2008) requirements with the following exceptions:

- SDGs PH43 (043GG): The holding time of 7 days was exceeded for the VFA analysis. All samples were qualified as estimated (J/UJ).
- Ferrous Iron: Requested holding time was ASAP “upon laboratory receipt”. Requested holding time was met (sample analysis dates are the same as sample collection dates).
- Total Organic Carbon: The required holding time of 28 days for TOC analysis was met.
- N-Nitrate: The required holding time of 48 hours was met for N-nitrate analysis.
- Sulfate: The required holding time of 48 hours is incorrect as stipulated on Table 6 of the QAPP. The EPA recommended holding time for sulfate analysis is 28 days. Holding times for sulfate analysis was met.
- Bacterial Census: The required holding time of 48 hours was met for the bacteria census analysis.

### 7.3 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the approved QAPP (EPI, 2008) with the following comments:

- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.
- SDGs PH43 and PH63: RLs for Lactic and Pyruvic Acid were elevated at 25 and 10 mg/L, respectively, instead of the 1 mg/L listed in the QAPP. No action was taken other than to note as the purpose of this analysis is qualitative rather than quantitative and results are examined how they change over time.

## 7.4 Blank Contamination – acceptable

The calibration blanks and/or method blanks were free of target compounds with the following comment:

- No blank information was provided for the bacterial census and VFA analyses.

## 7.5 Laboratory Control Spike and/or Standard Reference Material Recovery – acceptable

- A standard reference material (SRM) sample was analyzed for N-nitrate, sulfate and total organic carbon for each analytical batch. All SRM recoveries were acceptable.
- An LCS was analyzed for Ferrous Iron and the recoveries were in control.
- No LCS or SRMs were analyzed for VFAs and the bacterial census. No action was taken other than to note. LCS is not possible for bacterial census.

## 7.6 Matrix Spike/Matrix Spike Duplicate Analysis

Matrix Spike (MS) analysis was performed on GW-090720-PL2-032A-0 for TOC and Ferrous Iron, on GW-090720-PL2-032A-1 N-nitrate, and sulfate in SDG PH43 and on GW-090721-PL2-017A-0 for N-nitrate, sulfate, TOC, Ferrous Iron, and VFAs in SDG PH63. In SDGs where MS data are not available refer to LCS, matrix duplicate, and field duplicate data for precision and accuracy information. All MS recoveries were acceptable with the following comments:

- SDG PH43: MS/MSD analysis was not performed in this SDG for VFA. No other QC was provided. No action was required other than to note.
- SDG PH63: MS/MSD analysis was not performed in this SDG for bacterial census. No other QC was provided. No action was required other than to note as a MS is not possible for bacterial census.
- SDG PH63: An MS/MSD was performed on sample GW-090721-PL2-017A-0 for VFA analysis. The spike amount was not reported by the lab, so the lab was contacted and it was determined that the samples had been spiked with 100 mg/L of VFAs. Percent recoveries were calculated (see Table 4) and it was determined that all of the MS/MSD percent recoveries were in control except for the lactic acid MS at 130%. The %RPD for the MS/MSD was also out of control high. Since the unspiked result was below the RL, no action was taken because a high bias due to matrix was not suspected and the out of control MS %R was attributed to analytical variability.

**TABLE 4**

**MS/MSD Percent Recovery Calculations**

Compound	Result (mg/L)	Spike Amount (mg/L)	LCL%	UCL%	MS Result (mg/L)	%Rec	MSD Result (mg/L)	%Rec	%RPD
Pyruvic	<10	100	75	125	100	100.0	93	93.0	7.3
Lactic	<25	100	75	125	130	130.0	100	100.0	26.1
Acetic	<1	100	75	125	110	110.0	100	100.0	9.5
Propionic	<1	100	75	125	110	110.0	99	99.0	10.5
Butyric	<1	100	75	125	100	100.0	93	93.0	7.3

## 7.7 Duplicate Analysis – acceptable

Laboratory duplicate analysis was performed on the same selected samples as for the MS analysis listed in the previous section. Duplicate analysis criteria were met with the following discussion:

- No duplicates were analyzed for VFAs and qDHC. No action was taken other than to note.

## 7.8 Field Duplicate Sample Analysis

Field duplicate samples were collected and analyzed as follows:

**TABLE 5**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PH43	GW-090720-PL2-032A-0	GW-090720-PL2-032A-1
PH43	GW-090720-PL2-008B-0	GW-090720-PL2-008B-1
PH63	GW-090720-PL2-017A-0	GW-090720-PL2-017A-1

Field duplicate analysis criteria were met with the following exceptions:

- PH43: The RPD for TOC for the field duplicate samples GW-090720-PL2-032A-0 and GW-090720-PL2-032A-1 was out of control high at 27% RPD. No action was taken other than to note.
- PH63: The RPD for qDHC for the field duplicate samples GW-090720-PL2-017A-0 and GW-090720-PL2-017A-1 was out of control high at 83% RPD. No action was taken other than to note.

## 8.0 DATA QUALIFIERS

Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
- J – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.
- J+ – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased high.
- J- – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased low.
- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
- R – Data are rejected due to significant exceedance of quality control criteria. The analyte may or may not be present. Additional sampling and analysis may be required to determine the presence or absence of the constituent. For statistical reasons, rejected values are not included in the database.
- UR – The constituent is rejected at the reported quantitation limit.

Y – The reporting limit is elevated due to interference. The result is not detected.

## 9.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.

  
\_\_\_\_\_  
Jill Lamberts  
Staff Environmental Scientist, Golder

\_\_\_\_\_  
October 23, 2009  
Date

  
\_\_\_\_\_  
Kent Angelos  
Principal & Project Director, Golder

\_\_\_\_\_  
October 27, 2009  
Date

## 10.0 REFERENCES

EPA 1999, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October, 1999.

EPA 2004, USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review, EPA-540-R-02-003, October, 2004

EPI, 2008, Interim Measure Work Plan for 2-66 Sheetpile, Boeing Plant 2, Seattle/Tukwila, Washington, Prepared by Environmental Partners, Inc. (EPI), July 2008.

Golder Associates Inc. (Golder), 2009, Compendium of Sampling and Analysis Plans and Quality Assurance Plans for Boeing Plant 2, Prepared for The Boeing Company by Golder Associates Inc. (Golder) and Environmental Partners, Inc. (EPI), June of 2009.



# TECHNICAL MEMORANDUM

**Date:** January 11, 2010  
**To:** Will Ernst  
**From:** Kent Angelos, Principal Environmental Scientist  
**cc:** Doug Kunkel, Jeff Dengler, EPI  
**Project No.:** 013-1646-009.300.06  
**Company:** The Boeing Company  
**Email:** kmangelos@golder.com  
**RE: BOEING PLANT 2 – 2-66 ERD IM DATA VALIDATION REVIEW, OCT09 SAMPLE EVENT**

## 1.0 INTRODUCTION

A total of 26 water samples (including 3 field duplicates and 4 trip blanks) were collected October 19-22, 2009 as part of the Boeing Plant 2 Groundwater Interim Measures Work Plan for 2-66 ERD IM. Samples were analyzed by Analytical Resources Incorporated (ARI) of Tukwila, Washington, Microbial Insights of Rockford, Tennessee and Microseeps of Pittsburgh, PA for the following parameters:

- Volatile Organic Compounds (VOCs) by EPA Method 8260C
- Total Organic Carbon (TOC) by EPA 415.1
- Dissolved Gases (Methane, Ethane, and Ethene – MEE) by Modified RSK 175
- Dissolved Metals (Arsenic and Manganese) by EPA Method 200.8
- Ferrous Iron by SM 3500 FeD
- Anions (Bromide, N-Nitrate, and Sulfate) by EPA 300.0
- Organic Volatile Fatty Acids (VFAs) (Pyruvic, Lactic, Formic, Acetic, Propionic, and Butyric Acids) by ion chromatography by Microbial Insights
- Bio-Dechlor Bacterial Census by qDHC (RT-PCR) – dehalococoides by Microseeps

With the exception of the metabolic acids analysis, samples were analyzed in accordance with procedures described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, 3rd edition) 8260C, 6010B, metals, EPA Method 200.8, Revision 5.5; Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma-Mass Spectrometry, Standard Methods for the Examination of Water and Wastewater (20th Edition). Methods SM3500 Fe-D, RSK 175, 415.1 and 300.0.*

The bacterial and metabolic acids analyses were analyzed in accordance with the *Microbial Insights Standard Operating Procedures* and *Microseeps Standard Operating Procedures*.

## 2.0 SAMPLE DELIVERY GROUPS, SAMPLES AND ANALYSES

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

### SDG: PT20 (VOCs, TOC, MEE, Ferrous Iron, Metals, Anions, VFA, qDHC)

GW-091019-PL2-032A-0	GW-091019-PL2-017A-1	TRIP BLANK
GW-091019-PL2-021A-0	GW-091019-PL2-031A-0	
GW-091019-PL2-017A-0	GW-091019-PL2-031A-1	

### SDG: PT42 (VOCs, TOC, MEE, Ferrous Iron, Metals)

GW-091020-PL2-041AA-0	GW-091020-PP-2B-O-0	TRIP BLANK
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GW-091020-PL2-008C-0	GW-091020-PP-2B-I-0	
GW-091020-PL2-008B-0	GW-091020-PL2-035A-0	

**SDG: PT67 (VOCs, TOC, Metals)**

GW-091021-PP-4B-O-0	GW-091021-PP-4B-I-0	GW-091021-PL2-010A-0
GW-091021-PP-3A-I-0	GW-091021-PP-3B-I-0	GW-091021-PP-5B-I-0
TRIP BLANK	GW-091021-PP-1B-I-0	GW-091021-PP-1B-I-I

**SDG: PT75 (VOCs, TOC, Metals)**

GW-091022-PL2-021B-0	GW-091022-PL2-021C-0	TRIP BLANK
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Quality assurance/quality control (QA/QC) reviews of laboratory data were performed in the laboratory in accordance with the laboratory quality assurance program plan. The data validation QA/QC review focused primarily on laboratory result summary sheets and quality control summary sheets to ensure that work plan data quality objectives were met for the project.

Data validation was conducted in accordance with the criteria outlined in the National Functional Guidelines for Organic Data Review (EPA 1999) and the National Functional Guidelines for Inorganic Data Review (EPA, 2004), modified to include method specific requirements of the laboratory analytical methods. Raw data sheets were reviewed as necessary to confirm conditions reported and to support application of qualifiers to analytical results.

The validation level for the data is Level 1, as described in the QAPP (EPI, 2008). The following is a summary of quality control elements associated with each analytical fraction and the status of that element as a result of the data validation process.

### 3.0 SAMPLING, DOCUMENTATION AND REPORTING

Sample acknowledgements, chain-of-custody, request forms and data package completeness were evaluated. No issues or anomalies were identified.

### 4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

#### 4.1 Analytical Methods – *acceptable*

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

#### 4.2 Sample Holding Times and Preservations – *acceptable*

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).

#### 4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2007) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:



**TABLE 1**  
**2-66 IM ERD Reporting Limits**

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	1.0	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	1.0	5.0
2-Hexanone	1.0	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

#### 4.4 Instrument Calibration

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met.

#### 4.5 Blank Contamination

The method blanks were free of contamination. Trip blanks for SDGs PT20, PT42, and PT75 contained low levels of methylene chloride and acetone. Associated samples results less than 5x the associated trip blank contaminant concentration were qualified as undetected (U).

#### 4.6 Surrogate Recovery – acceptable

All surrogate recoveries were within control limits.

#### 4.7 Matrix Spike Compound Recovery

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-091019-PL2-017A-0 in SDG PT20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

#### 4.8 Laboratory Control Sample Recovery - acceptable

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LSCD recoveries and relative percent differences (RPDs) were acceptable.

#### 4.9 Field Duplicate Sample Analysis - *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 2**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PT20	GW-091019-PL2-031A-0	GW-091019-PL2-031A-1
PT67	GW-091021-PP-1B-I-0	GW-091021-PP-1B-I-1

Field duplicate analysis results were acceptable.

#### 5.0 METHANE, ETHANE, AND ETHENE (MEE)

The laboratory provided summary forms for compounds methane, ethane, and ethene. The items reviewed during validation are summarized below.

##### 5.1 Analytical Methods – *acceptable*

Samples for MEE parameters were analyzed using EPA Method RSK-175 (Modified).

##### 5.2 Sample Holding Times – *acceptable*

All samples were prepared and analyzed within the recommended holding times 14 days from collection to analysis. Please note that the QAPP stipulates that the hold time for MEE is 7 days, which is incorrect the correct holding time requirement for MEE analyses is 14 days.

##### 5.3 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the QA Plan with the following exception:

- Table 5 of the QAPP stipulates a reporting level of 1.0 µg/L for methane, ethane, and ethene. The ARI reporting level for methane was 0.7 µg/L, 1.2 µg/L for ethane, and 1.1 µg/L for ethane. No further action was taken other than to note this.

##### 5.4 Blank Contamination – *acceptable*

The method and equipment blanks were free of target compounds.

##### 5.5 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

##### 5.6 Matrix Spike Compound Recovery – *acceptable*

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-091019-PL2-017A-O in SDG PT20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

##### 5.7 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

## 5.8 Field Duplicate Sample Analysis – *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 3**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PT20	GW-091019-PL2-031A-0	GW-091019-PL2-031A-1

Field duplicate analysis criteria were met.

## 6.0 INORGANICS – DISSOLVED METALS

The laboratory provided a provided a summary data package for review of metals analyses and the items reviewed during validation are summarized below.

### 6.1 Analytical Methods – *acceptable*

Samples for metals analysis were prepared using EPA Methods 3010A. Metals analysis was completed by EPA Methods 6010B and 200.8. No sampling, documentation, and reporting discrepancies were noted.

### 6.2 Sample Holding Times and Preservation – *acceptable*

All samples were prepared and analyzed within the recommended holding period from the date of collection; 180 days for metals. All holding time and preservation criteria were met but the following observations were noted:

- PT75: metals samples preservation for GW-091022-PL2-021C-C did not pass the pH <2 check upon receipt and was readjusted at the laboratory.

### 6.3 Laboratory Reporting Limits - *acceptable*

Laboratory reporting limits were acceptable.

### 6.4 Blank Contamination – *acceptable*

The method blanks were free of target compounds.

### 6.5 Laboratory Control Sample Recovery - *acceptable*

LCS recoveries were within QC limits of 80 to 120 percent.

### 6.6 Matrix Spike/Matrix Spike Duplicate Analysis – *acceptable*

Matrix Spike (MS) analysis was performed on GW-091019-PL2-017A-O in SDG PT20. In SDGs where MS data are not available refer to LCS, matrix duplicate, and field duplicate data for precision and accuracy information. All MS recoveries were acceptable.

### 6.7 Duplicate Analysis – *acceptable*

Laboratory duplicate analysis was performed on the same selected samples as for the MS analysis listed in the previous section. Duplicate analysis criteria were met.

## 6.8 Field Duplicate Sample Analysis – *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 5**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PT20	GW-091019-PL2-031A-0	GW-091019-PL2-031A-1
PT67	GW-091021-PP-1B-I-0	GW-091021-PP-1B-I-1

Field duplicate analysis criteria were met.

## 7.0 GENERAL CHEMISTRY - TOTAL ORGANIC CARBON, FERROUS IRON, ANIONS, VOLATILE FATTY ACIDS, AND BACTERIAL CENSUS

The laboratory (ARI) provided a Level I data package for analysis TOC, ferrous iron, and anions; the items reviewed during validation are summarized below. Microbial Insights provided a Level I data package for analysis of the organic volatile fatty acids (VFAs) and Microseeps provided the same for the bacterial census analysis.

### 7.1 Analytical Methods and Reporting – acceptable

The anions (N-Nitrate, and Sulfate) were analyzed using EPA method 300.0. Total Organic Carbon was analyzed by EPA Method 415.1. Ferrous Iron was analyzed by Standard Method 3500 FeD. Organic Volatile Fatty Acids (VFAs) (Pyruvic, Lactic, Acetic, Propionic, and Butyric) were analyzed by ion chromatography at Microbial Insights. The Bio-Dechlor Bacterial Census was analyzed by qDHC (RT-PCR) – dehalococcoides by Microseeps. All methods and reporting requirements were met.

### 7.2 Sample Holding Times and Preservation - acceptable

All samples were prepared and analyzed within the recommended holding period from the date of collection to analysis. Sample holding times and preservations met the QAPP requirements with the following exceptions:

- Samples GW-091019-PL2-032A-O & GW-091019-PL2-021A-0 for VFA were analyzed out of hold, associated results were qualified as estimated (U/UJ).
- Samples GW-091019-PL2-017A-1, GW-091019-PL2-021A-0, AND GW-091019-PL2-017A-0 for qDHC were analyzed out of hold, associated results were qualified as estimated (U/UJ).

### 7.3 Laboratory Reporting Limits - acceptable

The laboratory achieved the reporting limits (RLs) required by the approved QAPP (EPI, 2007).

### 7.4 Blank Contamination – acceptable

The calibration blanks and/or method blanks were free of target compounds.

### 7.5 Laboratory Control Spike and/or Standard Reference Material Recovery – acceptable

A standard reference material (SRM) sample was analyzed for N-nitrate, sulfate and total organic carbon for each analytical batch. All SRM recoveries were acceptable.

An LCS was analyzed for Ferrous Iron and the recoveries were in control.

### 7.6 Matrix Spike/Matrix Spike Duplicate Analysis - acceptable

Matrix Spike (MS) analysis was performed for anions, TOC and VFA, recoveries were acceptable.

### 7.7 Duplicate Analysis - *acceptable*

Laboratory duplicate analysis was performed for TOC, Ferrous Iron and Anions. Duplicate analysis criteria were met.

### 7.8 Field Duplicate Sample Analysis - *acceptable*

Field duplicate samples were collected and analyzed as follows:

**TABLE 7**  
**Field Duplicates**

Laboratory SDG	Sample	Field Duplicate Sample
PT20	GW-091019-PL2-017A-0	GW-091019-PL2-017A-1
PT20	GW-091019-PL2-031A-0	GW-091019-PL2-031A-1

Field duplicate analysis criteria were met.

## 8.0 DATA QUALIFIERS

Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
- J – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.
- J+ – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased high.
- J- – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased low.
- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
- R – Data are rejected due to significant exceedence of quality control criteria. The analyte may or may not be present. Additional sampling and analysis may be required to determine the presence or absence of the constituent. For statistical reasons, rejected values are not included in the database.
- UR – The constituent is rejected at the reported quantitation limit.
- Y – The reporting limit is elevated due to interference. The result is not detected.

## 9.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional

judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.



Kent Angelos  
Principal Environmental Scientist

January 11, 2010  
Date

## 10.0 REFERENCES

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